

Modern Human Anatomy Program



University of Colorado
Anschutz

2026

Capstone Project Presentations

Friday, April 24

**2026 Modern Human Anatomy Program
Capstone Poster Presentations**

April 24, 2026

**Education 2 Bridge
University of Colorado Anschutz Medical Campus**

12:00 PM – 1:00 PM	Lunch
1:00 PM	Welcome and overview, Dr. Ernesto Salcedo
1:05 PM – 3:00 PM	Presentations for all posters

Poster Presenters 1:05 PM – 3:00 PM

Bench Research				
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Aleya Peji	2	6	Testing the Role of Formyl Peptide Receptors in the Development of the Human Retina	
Allison Taylor	3	7	Neuropathology Following HSV-1 Infection in an AD Mouse Model	
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Joshua Miller	11	15	Change of Heart: Active Learning with Digital 3D Congenital Cardiac Models for Medical Education	
Lucas Wilkinson	12	16	EmbryoTok: Efficacy of Short-Form Videos on Cardiac Embryology in Medical Education	

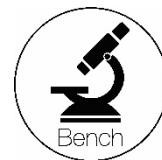
Thank you to faculty serving on capstone committees, as these projects would not be possible without your commitment to the success of our students.

MSMHA Student	Capstone Committee Chair	Capstone Mentor	Committee Member
Sydney Azar	Caley Orr, PhD	Ernesto Salcedo, PhD	Chelsea Goldberg, MS
John Barriga	Ernesto Salcedo, PhD	Jenny Zablah, MD	S B Yuvaraj Rejeti, Pharm D
Katherine Berall	Chelsea Lohman, PhD	Jenny Zablah, MD	Jennifer Romanowics, MD
Inaya Champion	Lisa Lee, PhD	Caley Orr, PhD	Kerry Barba, MS
Dongjoon Ethan Choe	Paul Morse, PhD	Jeffrey Stansbury, PhD	Noah Leppek
Charles Goetzke	John Thompson, PhD	Norman Friedman, MD	John Caldwell, PhD
Joshua Miller	John Thompson, PhD	Lisa Lee, PhD	Helen Macfarlane, MA
Carly Morris	Paul Morse, PhD	Nancy Hadley-Miller, MD	Michael David, PhD
Aleya Peji	John Caldwell, PhD	M. Natalia Vergara, PhD	Maureen Stabio, PhD
Allison Taylor	Ernesto Salcedo, PhD	Christy Niemeyer, PhD	Andrew Bubak, PhD
Lauren Verhulst	John Caldwell, PhD	John Thompson, PhD	Drew Kern, MD
Lucas Wilkinson	John Thompson, PhD	Lisa Lee, PhD	Mike Pascoe, PhD

Bench Research

Poster #1 Dongjoon Ethan Choe

Shaping the future with materials for multimaterial 3D-inkjet printed removable partial dentures



Capstone Committee: Paul Morse (chair), Jeffrey Stansbury (mentor), Noah Leppek

ABSTRACT:

Removable partial dentures (RPDs) are prostheses for missing teeth, renewing mastication function and smile presentation. However, conventional RPDs utilize metal clasps that lead to limitations including an undesirable appearance, metal allergies, and temperature sensitivity. Therefore non-metal clasp dentures (NMCDs), that utilize resin based clasps instead of metal, have been developed. This research focused on developing a thermoset NMCD material that is printable from a 3D-multimaterial inkjet printer to allow for quicker production, and lower cost for patients.

The resulting data has concluded that thermoset materials present desirable mechanical properties, identified via three-point bend testing. The acid-urethane interaction provides additional noncovalent reinforcement of the (meth)acrylate polymer network, leading to tough and durable materials. Unfortunately due to the hydrophilic nature of acid-urethane polymers, materials experienced significant degradation in mechanical properties once submerged in water. Thus a hydrophobic oligomer was integrated into the formulation, mitigating the loss of properties. Separately, mixing a high to low modulus formulation showed a linear transition in mechanical properties. This provided an identifiable map of ratios that would allow the printer to tune specific mechanical properties throughout the printed object.

For NMCDs, the studied thermoset materials have improved material properties than current thermoplastic materials. Furthermore, these materials do not cause suffering from metal allergy, temperature sensitivity, or undesirable appearance. The main goal with this material is to print NMCDs utilizing a 3D-multimaterial inkjet printer that can transition between multiple materials in a single print.



Poster #2 Aleya Peji

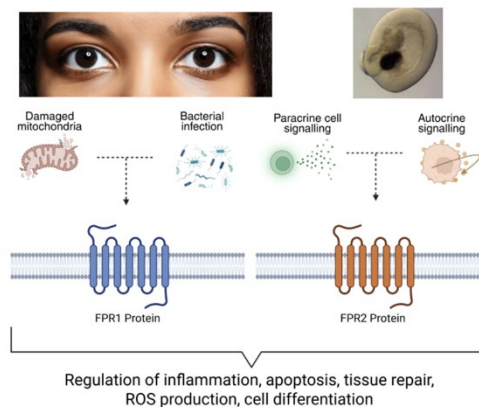
Testing the Role of Formyl Peptide Receptors in the Development of the Human Retina



Capstone Committee: John Caldwell (chair), M. Natalia Vergara (mentor), Maureen Stabio

ABSTRACT:

Formyl peptide receptors (FPRs) are G-protein-coupled receptors known for their role in regulating inflammation. Recently, FPRs have also been discovered to be involved in neurogenesis and neuronal differentiation within the central nervous system. However, whether FPRs play a similar role in retinal development remains unknown. To address this knowledge gap, we used human-induced pluripotent stem cells to generate retinal organoids (ROs), which are powerful *in vitro* models of the human retina that mimic the process of embryonic retinal development as it happens *in vivo*. The objective of this work was to determine if FPRs influence neural cell differentiation in retinal development. We hypothesized that inhibiting FPR signaling would increase the differentiation of retinal progenitors into neurons. First, we studied the dynamics of FPR1 and FPR2 protein levels by Western blot at multiple time points throughout RO development (N=5/each). To evaluate FPR function, we divided ROs into a control group or one of six treatment groups (N=7-8 ROs per condition). In the treatment groups, ROs were treated with an FPR agonist (Annexin A1) or antagonist (Boc-FLFLF or WRW4) from day 60 to day 90 of differentiation. Immunofluorescence and confocal microscopy were used to label photoreceptor precursors (CRX), retinal ganglion cells (HuC/D), amacrine cells (AP-2α), retinal progenitors (KI67), and mitotic cells (PHH3). Images were analyzed in Fiji. Our results showed fluctuating expression levels of FPR1 and FPR2 throughout retinal development, increasing from day 37 to 90 and declining by day 150. This suggests that FPRs may be more functionally relevant during specific periods in early retinal cell differentiation. ROs that were treated with FPR antagonists revealed changes in the numbers of specific retinal neuron populations, with this effect being attenuated in the groups treated with FPR agonists. In conclusion, our findings suggest that FPRs play a role in cell differentiation during human retinal development. This knowledge could be harnessed to manipulate the cellular composition of ROs for translational applications and may also have important implications for emerging therapies targeting FPRs for inflammation resolution when used in pregnant patients.



Poster #3 Allison Taylor

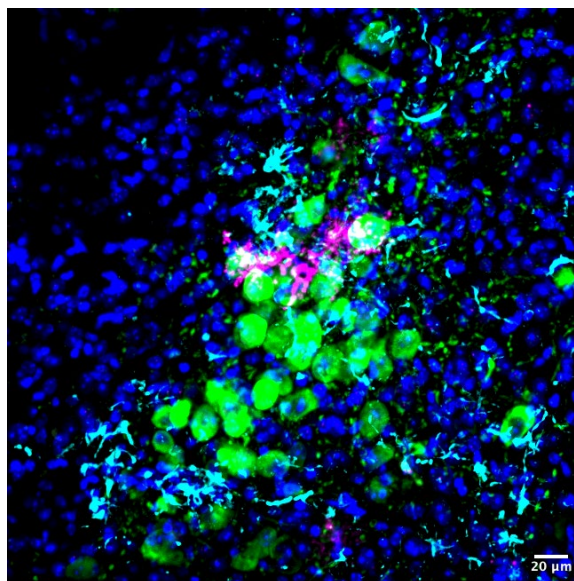


Neuropathology Following HSV-1 Infection in an AD Mouse Model

Capstone Committee: Ernesto Salcedo (chair), Christy Niemeyer (mentor), Andrew Bubak

ABSTRACT:

Alzheimer's disease (AD) is the leading cause of dementia, yet the mechanisms driving early disease onset remain unclear. Emerging evidence implicates Herpes Simplex Virus-1 (HSV-1) as an environmental risk factor, but how HSV-1 promotes AD pathology remain unknown. The locus coeruleus (LC), a major source of norepinephrine (NE) and an early site of AD vulnerability, is also highly susceptible to HSV-1 infection, suggesting it may link viral exposure to neurodegeneration. We hypothesize that HSV-1 disrupts LC function, reducing NE and downstream neuroprotective signaling, including brain-derived neurotrophic factor (BDNF), thereby accelerating AD-related pathology. To test this, WT and 3xTG mice were intranasally inoculated with HSV-1 (106 PFU, McKrae) or PBS, and the LC and its projection sites (hippocampus [DG], basolateral amygdala [BLA], lateral hypothalamus [LH]) were histologically analyzed. At 7 days post-infection, HSV-1 antigen was detected in the LC and LH of both genotypes, and additionally in the BLA of 3xTG mice. Despite viral presence in the LC, tyrosine hydroxylase (TH) expression in the LH, a proxy for noradrenergic tone, was unchanged in 3xTG mice. In contrast, TH expression was significantly reduced in the BLA of 3xTG mice relative to WT controls. Baseline BDNF levels were elevated in mock-infected 3xTG mice compared to WT but were markedly reduced following HSV-1 infection. Together, these findings indicate that HSV-1 does not overtly impair LC integrity at this timepoint but disrupts noradrenergic signaling and neurotrophic support in projection regions, suggesting that HSV-1 may promote AD pathology through circuit-level dysfunction rather than direct LC degeneration.



Clinical Research

Poster #4 John Barriga

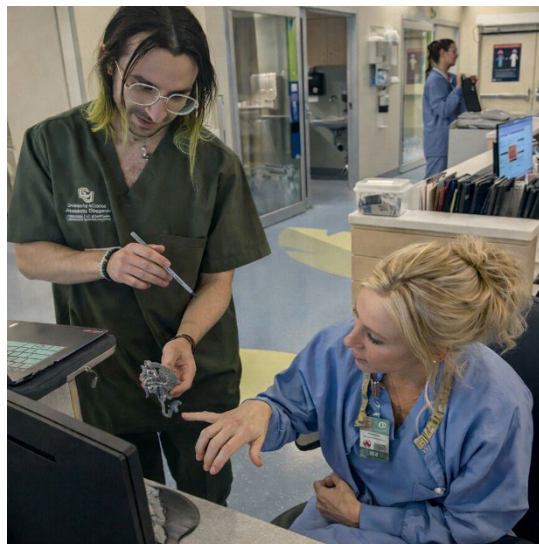
Evaluating a 3D-Printed Heart Model on Catheterization Lab Staff Knowledge and Confidence in Infracardiac TAPVR



Capstone Committee: Ernesto Salcedo (chair), Jenny Zablah (mentor), S B Yuvaraj Rejeti

ABSTRACT:

Infracardiac, or Infradiaphragmatic, total anomalous pulmonary venous return (TAPVR) is a rare congenital heart defect characterized by abnormal pulmonary venous drainage below the diaphragm, frequently resulting in pulmonary venous obstruction and neonatal compromise. Successful intervention requires accurate three-dimensional anatomical understanding, yet formal training for cardiac catheterization (Cath) lab staff on complex congenital pathology is limited. This study evaluated whether supplementing a standard educational presentation with a 3D-printed heart model improves Cath lab staff knowledge and confidence compared to presentation-only instruction. Fourteen Cath lab staff members were randomly assigned to either a presentation-only group ($n = 7$) or a presentation-plus-3D model group ($n = 7$). Participants completed a 10-question multiple-choice knowledge assessment before and after instruction and a five-item, 10-point Likert-scale confidence survey after instruction. Both groups demonstrated improved knowledge post-intervention; the presentation-only group increased from 57.1% to 81.4%, and the 3D model group increased from 62.9% to 84.3%. Mean post-session confidence scores were 7.17 and 8.06, respectively. While knowledge gains were similar, higher confidence scores in the model-assisted group suggest that 3D models may enhance perceived preparedness. Findings support the use of 3D anatomical models as complementary educational tools in interdisciplinary congenital heart education.



Poster #5 Katherine Berall

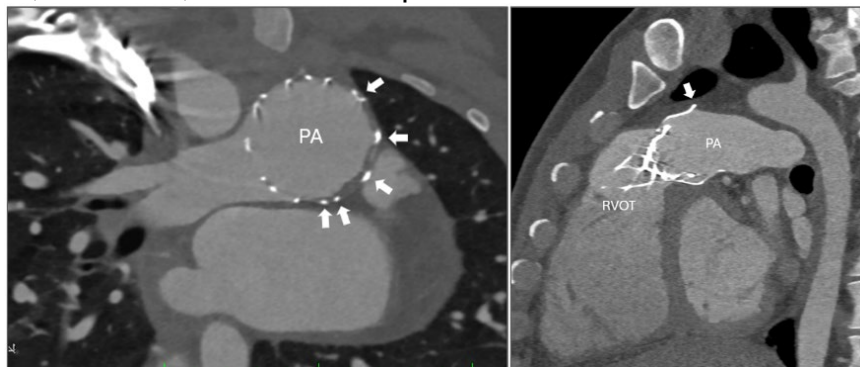
Don't Go Breaking My Heart – Investigating Vascular Injury Across Transcatheter Pulmonary Valve Platforms



Capstone Committee: Chelsea Lohman (chair), Jenny Zablah (mentor), Jennifer Romanowicz

ABSTRACT:

Transcatheter Pulmonary Valve Replacement (TPVR) is a minimally invasive catheter-based procedure utilized since 2000 in the treatment of pulmonary regurgitation and right ventricular outflow tract dysfunction. Since 2021, there has been an increase in available valve and stent technologies, including balloon-expandable valves, self-expanding valves, and self-expanding stents/prestents, but the long-term impacts of exogenous implants utilized during TPVR have not been well established. This study sought to characterize device-tissue interactions and degradation of device integrity across multiple valve platforms. Utilizing two- and three-dimensional image datasets of post-procedural MRI or CT, images were visually inspected for anchoring and for device integrity anomalies by two independent reviewers – an imaging cardiologist and an interventional cardiologist. Positioning findings were categorized as being anchored via engagement, embedment, or perforation. These classifications were defined as engagement – appropriate positioning within the anatomy; embedment – extravascular protrusion with no blood pooling/bleeding, pseudoaneurysm, or hemopericardium; or perforation – evidence of device beyond the pulmonary artery (PA) anatomy with contrast extravasation, pseudoaneurysm, and/or dissection. Artifact interference in both MR and CT imaging led to assessment difficulty due to imaging limitations. Of the findings that were able to be assessed, no perforation was identified in any valve platform. Engagement was the predominant anchoring mechanism across all valve types, occurring in 41.1% of cases. The second most common finding was embedment, found in 16.7% of cases and the most common valve types affected were the Alterra PreStent with Sapien 3 valve (32.1%), and the Harmony TPV (22.2%). A secondary analysis investigating device integrity evaluated valve platforms for infolding, constraint, and fracture. There was no evidence of anomalous device integrity in 77.8% of cases and no cases of stent fracture were identified across any valve platform. This retrospective review provides novel comparative data across five valve platforms in patients who underwent TPVR. Experience with varied valve platform technologies will continue to grow, and it will be paramount to define risk factors, incidence, and clinical implications of device-tissue interactions.



Poster #6 Charles Goetzke



PALM Scale Surgical Outcomes for Obstructive Sleep Apnea in Children with Down Syndrome

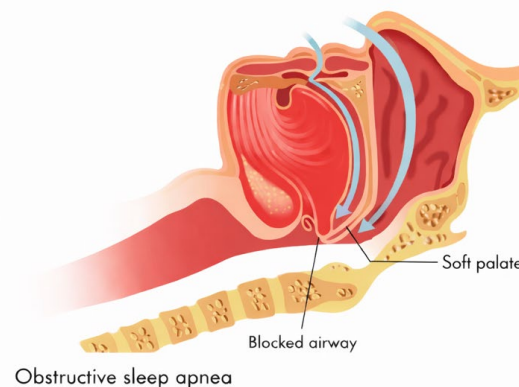
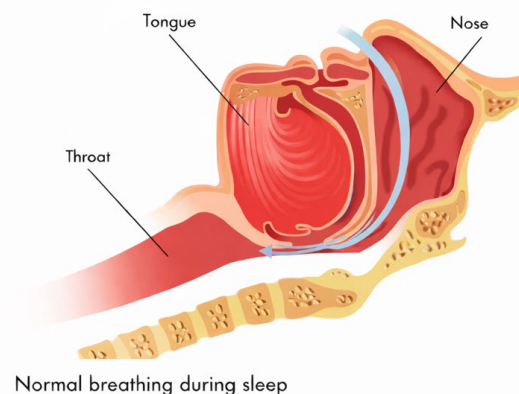
Capstone Committee: John Thompson (chair), Norman Friedman (mentor), John Caldwell

ABSTRACT:

Obstructive sleep apnea (OSA) is a heterogeneous disorder arising from complex interactions between upper airway anatomy and physiological control of breathing. The PALM scale is defined by variability in pharyngeal collapsibility, arousal threshold, ventilatory control stability (loop gain), and upper airway muscle responsiveness. These endotypes highlight differences in disease severity and treatment response. Children with Down syndrome represent a high-risk population for persistent OSA due to combined craniofacial and neuromuscular factors. Although surgical intervention remains a primary treatment strategy, postoperative outcomes are variable and cannot be reliably predicted using traditional severity metrics such as the obstructive apnea–hypopnea index (OAHI) alone.

Surgical intervention produced a statistically significant reduction in obstructive sleep apnea. Mean OAHI decreased from approximately 23 events/hour preoperatively to 9 events/hour postoperatively ($n = 30$, $p = 0.004$). Mean oxygen desaturation index (ODI) also improved significantly, declining from approximately 36 to 20 events/hour following surgery ($p = .002$). In addition, preoperative arousal index demonstrated a strong positive correlation with pre OAHI ($R^2 = 0.486$, $p < 0.001$), suggesting that greater obstructive severity was associated with increased sleep fragmentation.

These findings demonstrate tonsillectomies can significantly improve OAHI and ODI in children with Down syndrome, while also highlighting limitations of relying solely on AHI to characterize disease and predict responses. Incorporating physiology-informed approaches such as the PALM framework may improve patient stratification, guide individualized treatment selection, and support more precise management strategies for pediatric OSA.



Poster #7 Carly Morris

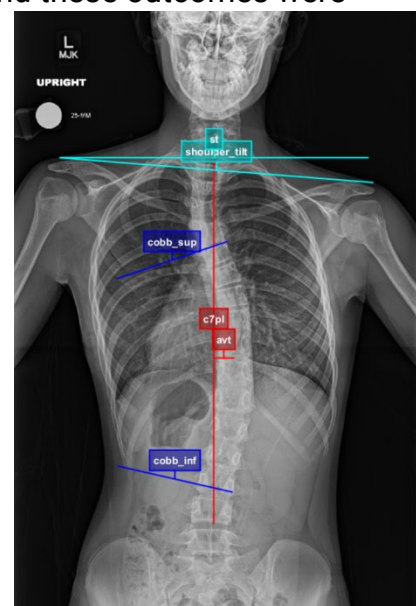
Adolescent Idiopathic Scoliosis Curvature Clustering & Prediction with Machine Learning Models



Capstone Committee: Paul Morse (chair), Nancy Hadley-Miller (mentor), Michael David

ABSTRACT:

Adolescent idiopathic scoliosis (AIS) is a spinal deformity with unknown causes that exists in up to 5.2% of the worldwide population, disproportionately affecting females. In the clinical setting, AIS curvatures are monitored through sequential radiographs assessing the Cobb angle, or magnitude, of the AIS curvature. Patients are often treated with back braces that aim to stop the progression of the curvature, but if bracing fails to stop this progression, patients must undergo a surgical intervention. Bracing fails in about 25% of patients, and there are currently no means of predicting this progression or lack thereof. With other orthopedic conditions, machine learning (ML) models have been successful in diagnosing, classifying, and making predictions. This study was designed to test the hypothesis that ML models will be able to detect groupings and predict bracing success or failure using demographic, clinical, and radiographic information. We tested this hypothesis in a retrospective study with an IRB approved protocol. After a chart review of 1327 braced scoliosis patients, 65 AIS patients who were bracing successes and failures were selected for the study. For each patient, demographics, clinical information, and radiographic features and measurements on anteroposterior radiographs were collected to be used in two ML models: (1) clustering and (2) classification. The ML cluster model assessed a range of clusters for a variety of algorithms. The data separation in these clusters were analyzed by looking at silhouette scores with 1 representing perfect separation. All potential clusters had silhouette scores less than 0.2, indicating poor clustering. The ML classification model predicted whether a given patient would be a bracing success or failure, and these outcomes were compared to the patient's actual status as a bracing success or failure. A variety of classification algorithms were used, and their prediction accuracy was measured with the area under the receiver operator curve (AUC) with values of 1 indicating perfect prediction. Linear discriminant analysis (LDA) was determined to be the best algorithm with the highest AUC score of 0.59 ± 0.20 . Although the LDA algorithm created the best model, the relatively low AUC score paired with a high standard deviation demonstrate that it is not an accurate predictor. The ML models were not successful in detecting groupings of or predicting bracing successes and failures with the given information. Future studies with more patients, different measurements, and lateral radiographs could yield more successful results in clustering and prediction.



Poster #8 Lauren Verhulst

Exploring the Effects of Exercise on Cognitive and Motor Deficits in Parkinson's Disease: An MRI-Based Atlas-Guided Volumetric Study



Capstone Committee: John Caldwell (chair), John Thompson (mentor), Drew Kern

ABSTRACT:

Parkinson's Disease (PD) is a progressive neurodegenerative disease that exhibits a wide array of motor and cognitive symptoms. Standard treatment involves oral dopaminergic medications, rehabilitation therapies, and surgical treatments. Aerobic exercise is increasingly recognized as a disease-modifying strategy. This study assessed whether localized abnormalities in brain volumes correlate with changes in cognitive performance and motor symptoms following an aerobic exercise intervention. Eight participants with PD engaged in an exercise regimen and underwent pre- and post-exercise testing including cognitive and motor assessments. Cognitive measures included Verbal Fluency and Color-Word Interference; motor function was assessed with MDS-UPDRS Part III in OFF-medication/ON stimulation state. Pre-operative MRI images were assessed by volBrain's motortree pipeline. Analysis was conducted into regional analysis of cortical and subcortical regions and normalized to a non-PD dataset. The motortree outputs, cognitive, and motor scores were then statistically analyzed to examine associations between structural abnormalities and PD symptom presentation. Analysis of the eight participants (7 men, 1 woman) showed volumetric abnormalities, greatest in the cortex, with additional abnormalities in the subcortical regions of the basal forebrain and thalamus. Higher global volumetric abnormality scores were negatively correlated with letter fluency ($p=-0.175$, $p=.033$). Motor improvement positively correlated to better verbal fluency (category ($p=0.476$, $p<.001$) and letter ($p=0.205$, $p=.012$)). The higher abnormality values were associated with lower phonemic fluency performance post-exercise, suggesting that baseline structural integrity may influence the degree of domain-specific cognitive change after exercise.



Educational Research

Poster #9 Sydney Azar

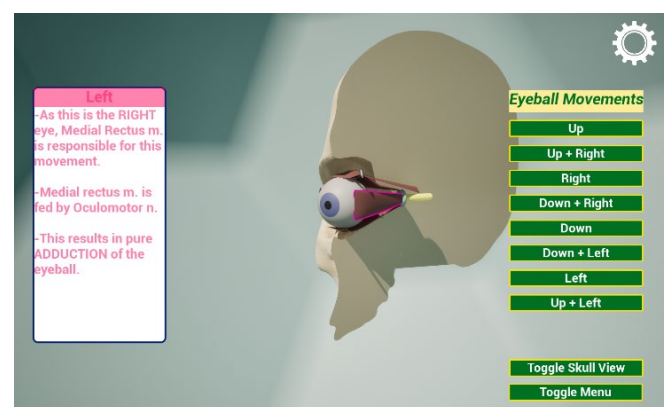
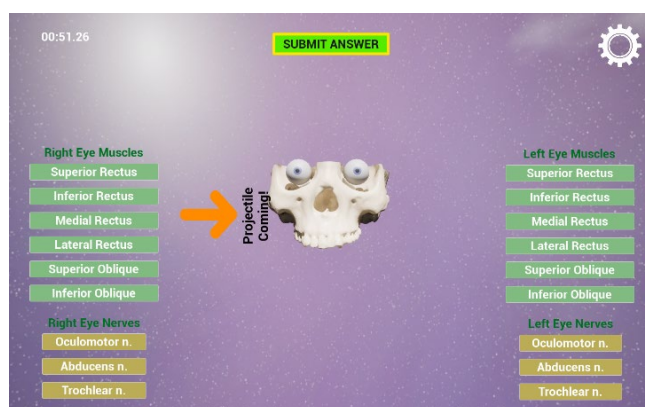
Keeping Our Eyes on the Prize: Using a Video Game to Learn the Extraocular Muscles



Capstone Committee: Caley Orr (chair), Ernesto Salcedo (mentor), Chelsea Goldberg

ABSTRACT:

The extraocular muscles are a frequent source of difficulty for anatomy students due to their complex three-dimensional orientations, non-intuitive actions, and reliance on two-dimensional instructional images. Mastery of these muscles and their cranial nerve innervation is essential for accurate neurological examination. Prior studies suggest that educational video games can enhance spatial reasoning, engagement, and learning outcomes, yet their effectiveness in teaching extraocular muscle anatomy remains underexplored. A custom educational video game was developed using Autodesk Maya and Unreal Engine 5. Master of Science in Modern Human Anatomy students completed a pre-quiz assessing baseline knowledge and were randomly assigned to either an experimental group (full game experience) or a control group (3D instructional module only) for 30 minutes. Both groups then completed a post-quiz with equivalent first-, second-, and third-order questions. Data was analyzed using MATLAB following participant testing to compare pre- and post-quiz performance between groups. There was no statistically significant difference between student pre- and post-quiz scores in the control ($P=1.0000$) or experimental ($P=0.8673$) groups, and no statistically significant difference in average score change between groups ($P=0.9068$).



Poster #10

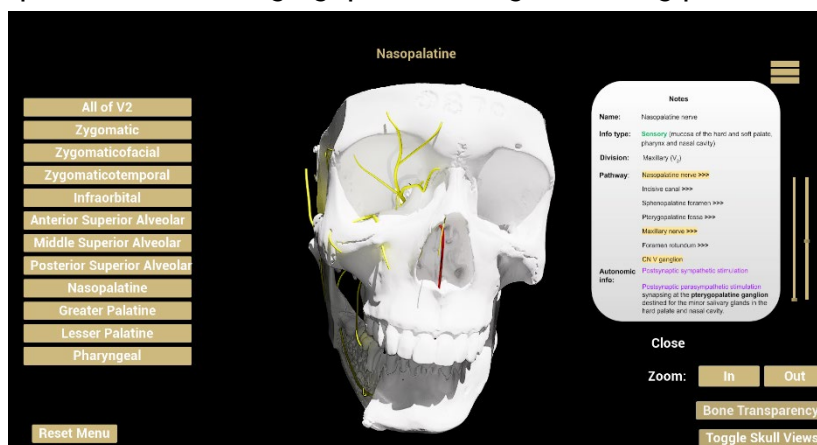
Inaya Champion

Chew on that! Developing an Educational Digital 3D Model of Trigeminal Nerve Anatomy

Capstone Committee: Lisa Lee (chair), Caley Orr (mentor), Kerry Barba

ABSTRACT:

Cranial nerve anatomy is a challenging subject to learn due to its large volume of information and its complexity. Instructors are often left to rely on two-dimensional schematics, textbooks, and videos, each with various limitations. Body donor dissection is also challenging to visualize the branching patterns and distal fibers of cranial nerves. Three-dimensional (3D) digital and physical models can supplement these tools, but few detailed models are available as open educational resources. Most digital representations currently available illustrate the 12 main cranial nerves and may show their terminal branches, but do not provide comprehensive information about their functions. To begin to close this gap in cranial nerve educational resources, an open-access, interactive, three-dimensional model of the trigeminal nerve system (Cranial Nerve V) was created. To model the associated osteology, an Artec Space Spider surface scanner was used to create a digital 3D model from a physical human skull model, in order to obtain a high level of anatomical detail while maintaining file sizes that allow for feasible deployment. The branches of the trigeminal nerve were modeled in Autodesk Maya® by following Grant's and Netter's Atlases of Anatomy. To make the model deployable and easily accessible to educators and learners, a downloadable application with an interactive user interface was built in Unreal® Engine. The application containing the model has two main sections: viewer mode and quiz mode. Viewer mode is for learning the branches and functions of the trigeminal nerve and overall exploration of the model. Further, users can employ dual coding, with information about each nerve's function presented alongside the model in specific, consistent colors to encourage association between the visual content and the written information. Users can also view nerves grouped by the information they carry or the locations where they terminate. Quiz mode lets users assess their newly acquired knowledge of the trigeminal nerve's anatomy and functions through multiple-choice and fill-in-the-blank questions. Users can also choose question categories based on their personal knowledge gaps, including branching patterns, osteological markers, and other related spatial relationships. Because of the model's unique blend of structural and detailed contextual information on the trigeminal nerve, along with its quiz features, this new application offers an important open educational resource that may enhance cranial nerve anatomy education.



Poster #11

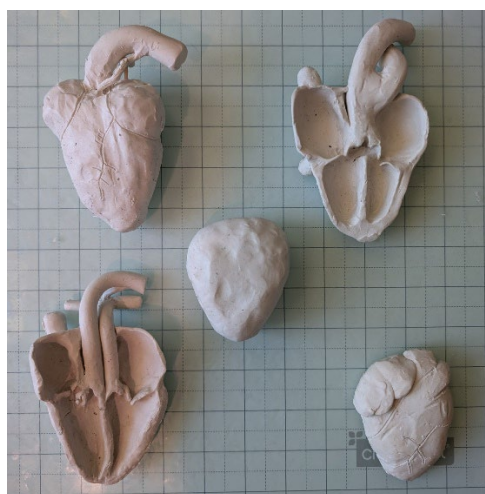
Joshua Miller

Change of Heart: Active Learning with Digital 3D Congenital Cardiac Models for Medical Education

Capstone Committee: John Thompson (chair), Lisa Lee (mentor), Helen Macfarlane

ABSTRACT:

Cardiac embryology and congenital heart defects are challenging topics for novice learners due to the complex four-dimensional nature and clinical context imposing a high cognitive load. While three dimensional (3-D) printed objects have been shown to be effective for teaching congenital heart diseases, access to 3-D printers and accurate datasets remain limited by cost and availability. This study aimed to develop and evaluate Change of Heart (CoH), a digital active learning resource featuring interactive digital 3-D models of four common congenital cardiac conditions, compared to a control resource presenting the same conditions as clinical cases with clinical 2-D images consistent with standard approach in medical curricula. In an IRB-exempt, randomized controlled study, first-year medical students (MS1) completed a pre-quiz at the start of an in-person active learning session, then were randomly assigned to either CoH or the control group. After 20 minutes of active learning using the assigned resource, students completed a post-quiz composed of new items of comparable difficulty as the pre-quiz. Only anonymized, matched pre-/post-quiz data were analyzed using two-way ANOVA with post-hoc tests. Both groups demonstrated a significant increase in the post quiz scores (control, $n=48$; experimental, $n=35$; $F(2)=30.71$, $p<.001$, $\eta^2=0.16$). Post hoc comparisons confirmed significant learning gains within each group (control: $p<.001$; experimental: $p<.014$). However, differences in learning between groups were not significant ($F(2)=1.97$, $p>.163$). The outcomes of this study indicate that CoH was as effective as the standard active learning resource using clinical cases with 2-D images while eliminating barriers to costly 3D print models or high-fidelity image dataset. The outcome of this study shows that CoH can be used as a free alternative resource, especially in developing countries where printing physical 3-D models is not possible. The impact of CoH on spatial understanding and long-term retention of congenital cardiac defects warrants further investigation.



Poster #12

Lucas Wilkinson

EmbryoTok: Efficacy of Short-Form Videos on Cardiac Embryology in Medical Education

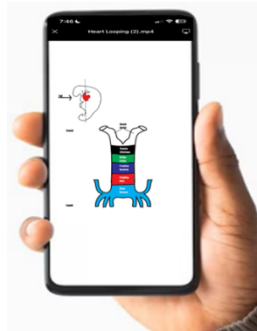
Capstone Committee: John Thompson (chair), Lisa Lee (mentor), Mike Pascoe

ABSTRACT:

Microlearning is a popular educational delivery method to meet evolving learner needs and decreasing curricular contact hours. While microblogging tools such as X have shown potential for engagement and learning, the effectiveness of short-form video formats such as TikTok or Instagram reels as structured microlearning tools in medical curricula remains understudied. This project aimed to develop eight short videos, under 2 minutes each, for required cardiac embryology prework (EmbryoToks) and compare their impact on first-year medical students' (MS1) learning outcomes and engagement against a single, 15-minute tutorial video (control) required for respiratory embryology prework.

In an IRB-exempt, within-subjects study, MS1 completed the control and EmbryoTok prework before the in-class active learning session on the respective topic held one week apart in the first-year curriculum. Learning outcomes were measured using pre- and post-quizzes with different items assessing the same concept for each topic. Engagement was analyzed by the number and total duration of video views, which were correlated with post-quiz data. All data were anonymized prior to analysis. Due to differences in the video quantity (one control vs. eight experimental), correlations were run independently for each condition. Of 170 students, 118 and 114 completed either a pre- or post-quiz for the control and experimental prework, respectively. Matched pre-/post-data were available for 47 students from the control, 24 in the experimental, and 14 in both. A repeated measures ANOVA on the 14 matched samples revealed significantly larger learning gains in the control than the experimental condition ($p = .004$, Cohen's $d = 0.926$). Within conditions analyses on all matched data revealed significant quiz improvement in the control ($n = 47$, $p < .001$, $d = .891$), but significant decrease in the experimental ($n = 24$, $p = .007$, $d = .609$). Engagement analyses revealed a positive correlation in the control condition between the number of views (Spearman's $\rho = .395$, $p < 0.001$) and total view duration (Spearman's $\rho = 0.381$, $p < 0.001$) with post-quiz scores. No significant correlations were observed in the experimental condition ($\rho = .107$, $p = .299$ for number of views; $\rho = 0.128$, $p = 0.214$ for duration).

In this study, a single, long-form tutorial yielded more engagement and significant learning gains compared to multiple short-form reels, suggesting that despite their popularity, short-form videos may not be the most effective learning resource delivery method in medical education.



Embryotok

