and DNA quantification to verify sufficient removal of residual nucleic acid levels (~50 ng/mg tissue). Adipose ECM was reconstituted at 0.5g sample/mL PBS, and 0.4mL was injected into subcutaneous dorsal flank and cranial pockets of immunocompetent C57BL/6 mice through a 20-gauge catheter. Commercial-grade hyaluronic acid was injected (0.4mL, dorsal flank) as a control. Samples were explanted after one month and underwent microCT volume analysis.

RESULTS: Processing methods resulted in a significant (>95%) volume loss from initial tissue to resultant ECM. Delipidated, decellularized, adipose ECM demonstrated a mean DNA content of 44 ng of double-stranded DNA per mg of sample. For comparison, the DNA content of delipidated, non-decellularized adipose ECM was 125 ng/mg, and AlloMax™ (CR Bard/Davol Inc, Cranston, RI) decellularized human dermis was 195 ng/mg. Hematoxylin and eosin (H&E) staining of adipose ECM revealed compact milled particles, and DAPI staining confirmed the absence of cell nuclei. After one month, mean adipose graft volume was 478mm^3 (120% of initial volume) at dorsal flank, 468mm^3 (117%) at dorsal cranial, and hyaluronic acid volume was 1,381mm^3 (345%), due to its hygroscopic nature. Cranial-site adipose grafts appeared more highly vascularized than flank-site, consistent with greater regional blood flow. Minimal inflammation was observed. Histologic analysis is ongoing.

CONCLUSION: We report an innovative $scCO_2$-based decellularization process to efficiently fabricate adipose ECM scaffold. We demonstrate adequate decellularization and rapid reconstitution into a homogenous, injectable form that demonstrates excellent volume retention and unremarkable immunogenicity after one month in vivo. By optimizing adipose $scCO_2$-decellularization, we anticipate the development of an "off-the-shelf" fat graft alternative without potentially toxic residues that retains bioactive moieties critical to host cell repopulation. Further study is ongoing to explore longer term in vivo outcomes.

47. Development of a Wireless, Wearable Goniometer for Hand Physiotherapy Biofeedback

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PURPOSE: Hand physiotherapy after surgery has been shown to accelerate recovery of joint range of motion (ROM). Our group has designed a wireless, wearable goniometer to allow patients to independently and continuously measure the angle of their proximal interphalangeal (PIP) joint during home therapy exercises. Research has demonstrated that biofeedback during physiotherapy is effective, engaging, and can lead to improved outcomes. Our hope is that the ability to see real-time feedback of joint position during therapy will encourage patients to work harder, complete more exercises, and get the most benefit from their therapy programs. The purpose of this study was to assess the accuracy and feasibility for the use of this novel device during hand physiotherapy.

METHODS: Volunteers were fitted with the wearable device about their right PIPJ, which was then actively flexed and extended through its complete range of motion under live fluoroscopy (lateral projection). Paired angular measurements were derived from the wearable device and fluoroscopic images, and this was then repeated for the left PIPJ. Separately, patients donned the wearable device and were guided through four to five positions of progressive flexion. Paired angular measurements were derived from the wearable device and a handheld goniometer operated by a certified hand therapist (CHT). Next, volunteers were guided through a simulated home exercise program (HEP) (composite fist, PIP blocking, blocked extension) by a CHT while the device measured PIPJ angle in real time. The bilateral index, middle, and small fingers were tested in each subject. Bland-Altman plots were used to visualize correspondence between the device measurement and the fluoroscopic or handheld goniometer measurements. Means were compared using a paired t-test.

RESULTS: Six volunteers (12 fingers, 259 paired data points) were included in the fluoroscopy portion of the study. Mean difference between device and fluoroscopic measurement was 0.9^o (SD = 2.2^o, 95% CI = 0.7^o - 1.2^o), with errors ranging from -4.7^o to +5.6^o. Nine volunteers (27 fingers, 212 paired data-points) were included in the handheld goniometer portion of the study. Mean difference between device and handheld goniometer measurement was 0.6^o (SD = 5.2^o, 95% CI = -0.1^o - 1.3^o), with errors ranging

from -13.1° to 12.9°. The device successfully tracked PIPJ angle in real time during a simulated HEP for all fingers tested.

CONCLUSION: The wearable goniometer device is acceptably precise and accurate. It can track PIPJ angle during a simulated HEP and is a feasible method of providing biofeedback.

48. Large Language Models for Perceptual Speech Clinical Data Extraction in Cleft Palate Speech Language Pathology Notes

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PURPOSE: Speech-language pathology (SLP) assessments are vital for supporting plastic surgeons in monitoring pediatric patients with cleft palate and velopharyngeal insufficiency (VPI) by providing qualitative and quantitive data on a patient's functional speech status. Traditional manual extraction of speech notes is time-intensive and susceptible to inconsistent subjective interpretation. Recent advancements in natural language processing, specifically large language models (LLMs), offer a potential solution for automating and enhancing the extraction of diagnostic information from clinical texts. This study evaluates the efficacy of an in-house developed version of the GPT-4 model in extracting concepts from speech sample notes written by speech-language pathologists.

METHODS: We conducted a retrospective analysis of 5 anonymized speech sample notes, authored by a speech-language pathologist, for patients aged 3-11 years (average: 6.68, SD: 3.54). These notes were processed using an in-house adaptation of the GPT-4 model, termed VERSA, to extract key speech and language concepts. The model was tasked with identifying patient's diagnosis, surgical history, and scaled elements from each note such as assessments of resonance and nasal airflow. Resonance evaluations included hypernasality, rated on a 0-4 scale, and hyponasality on a 0-2 scale. Nasal airflow evaluations were conducted to assess audible nasal emission or nasal turbulence, rated on a 0-2 scale. Additionally, grimace was rated as 0 or 1, and speech acceptability was assessed on a 0-3 scale.

RESULTS: Our model successfully extracted the patient's diagnosis, any surgical history, and the date of surgery from all analyzed speech sample notes. The VERSA model efficiently identified clinically relevant speech evaluation elements for measures of hypernasality, hyponasality, nasal airflow, and grimace and were accurately extracted in four out of five applicable cases. In one instance, the model indicated "Unable to rate due to lack of verbal output", correctly recognizing the absence of necessary verbal information for evaluation.

CONCLUSION: The application of the VERSA model demonstrates substantial potential in streamlining the extraction of diagnostic and evaluative information from pediatric speech pathology notes These preliminary findings highlight the potential of LLMs to enhance the efficiency and reliability of clinical assessments in speech-language pathology. For clinicians, this model reduces the time spent manually retrieving information and mitigates subjective interpretation of speech data. Future research should focus on expanding the dataset and refining model parameters to further improve accuracy and applicability in diverse clinical scenarios. In the future, we aim our LLM to be able to summarize multiple speech evaluation in sequential order, which would further allow the cleft team to focus on the patient rather than looking up histories.

49. Development of a Novel Multi-feature Machine Learning Model for Unilateral Facial Paralysis

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PURPOSE: Accurate diagnosis of unilateral facial paralysis is crucial for effective treatment. This study proposes a novel machine learning approach using the MediaPipe model to differentiate normal faces from paralyzed faces based on facial asymmetry indices.