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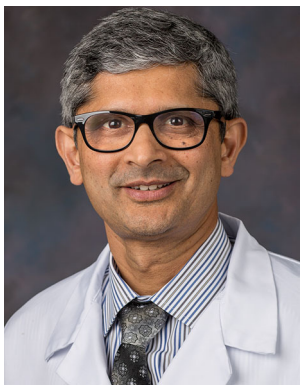
ABSTRACTS

Dysphagia Research Society 27th Anniversary Annual Meeting March 7–9, 2019 Wyndham San Diego Bayside, San Diego, California

President's Message



Dear DRS Family:

The 27th Annual Meeting of the Dysphagia Research Society, held at the Wyndham San Diego Bayside, CA, was a huge success! It was indeed a memorable one to several of us! This was made possible because of significant contributions from several individuals, committee members and groups. Team work, happiness and enthusiasm were in abundance, and made the meeting a grand success; this was evident throughout the meeting. It was like an annual DRS family reunion!

The recorded meeting attendance for the annual meeting was outstanding with a total of 502 in all (457 in attendance plus 45 exhibitors/sponsors). The representative disciplines included – Pediatric and Adult Speech and Language Pathologists, Physician-Specialists, Pediatric specialists, ENT Surgeons, Dental surgeons, Allied health professionals and Business specialists, all representing from over 30 countries attending. Success was also related to the quality of scientific program, and the scientific abstract submissions. This year's presentation quality—the scientific quality—was among the best we've ever had. Overall, there were 50 oral presentations and 106 poster presentations selected out of 227 scientific abstracts submitted. Accepted abstracts from the 2019 meeting and also from the 2018 meeting will be published in the Dysphagia Journal in this summer and fall issues. The Pre-Conference course held on March 5th, 2019, had an impressive attendance of 236 dysphagia specialists. Overall a maximum of 31 CME credits were awarded through Medical College of Wisconsin for attending the entire Conference, 0.85 ASHA CEUs were offered for Pre-Conference and 2.15 ASHA CEUs were offered for the Annual Meeting.

The Mayor of San Diego, Honorable Kevin Faulconer, kindly proclaimed March as 'Swallowing Disorders Awareness Month'!

Thank you to the outstanding program committee, DRS Board of Directors and the Executive Committee, Scientific Abstract Review Committee, our donors, sponsors and exhibitors, and the innovative management team of Badger Bay Management Company, which is truly their 1st year of full service to DRS! Congratulations!

From the discovery to mass translation, it takes several years, perhaps a generation in the life of a child. Our conference vision was to arm the researchers with new knowledge and shorten this interval, and the Program Planning Committee took this challenge in developing an ambitious program. In keeping with the meeting theme, i.e., *Swallowing, Airway and Aero-Digestive Co-Dependence*, the Program Planning Committee did an amazing job in selecting the best speakers and truly brought in inter-disciplinary contributions. Dysphagia, as a symptom is never alone, and this was addressed throughout the conference with relevance to development, physiology, mechanisms, pathophysiology, pathology, novel diagnostic methods, new therapies, transdisciplinary practices, global approaches, nutrition, and rehabilitation programs.

Dr. Jeff Palmer, received the prestigious *DRS Gold Medal*. This is the Society's highest honor and is awarded in recognition of distinguished service and contribution to the Society. *The Dodds-Donner Lecture* by *Dr. Joel Richter,* was a grand success and generated a lot of new interest among the members, as to who should take charge of the complex dysphagic patient, who clearly needs inter-disciplinary guidance. *Grand Rounds-I* presented by *Dr. Lisa Duizer* on the dynamic sensory experience of eating, and *Grand Rounds-II* presented by *Dr. Rosemary Martino* on the bed-side evaluation of dysphagia and in-depth clinico-pathological correlations. Both the Grand Rounds Topics were very well received, and had a lot to offer to the audience in taking home new ideas to implement.

I am pleased to report that there have been several *innovative programs/events* this year, and I am hopeful these will continue to remain in the years thereafter:

- *International Women's Day* (Friday, March 8th 2019) was celebrated amidst a standing ovation and by recognizing the Women in Science Education and Research *(WISER)!*
- *The Lunch and Learn Sessions*- were six workshop-style sessions to include a highly interested audience joining inter-active inter-

disciplinary sessions. This was a huge hit, and many have voiced that we should continue these sessions in future years. Details on 'how to' were presented by the leaders in the field. There was a take home message to everyone so that immediate application to our patients can be possible.
- *Sponsor-a-student program* was possible to support 2 students through donations.
- *Silent auction* events by the dynamic WCPRC committee, generated a revenue of $2,596, and total donations received were over $6,700. All these revenues support research and endowment, scholarships and student programs.
- New networking opportunities were provided through *the social Harbor Walk, Welcome Reception, and the President's Reception, which* was on the historic San Diego Maritime Museum's Star of India vessel, the world's oldest sailing ship.
- As I moderated the round table conversations at the *President's Dinner*, there was a genuine interest in advancing the society goals and revisit the strategic planning and mission. To that effect, approved by the Board of Directors, an in-person meeting is planned in Milwaukee, WI, for this summer-2019, under my chairmanship. A steering committee has been formed to include Dr. Doug Van Daele, Dr. Stephanie Daniels, Dr. Gary McCullough, Dr. Reza Shaker and myself to set the agenda. Several international leaders will meet to discuss the next steps. *Stay tuned!*
- Approval has been given by Dr. Reza Shaker, Editor-in-Chief, Dysphagia Journal, for publishing *10 Hot Topics* based on the reviews received from the 2019 Annual DRS Meeting. These topics will be selected from among the invited articles for a special supplement of Dysphagia Journal. *Stay tuned!*
- Finally, *Pediatric Dysphagia* within the DRS has matured! Formation of a *Special Interest Group* is in the process to enhance networking and focused collaborations. The goals are to advocate and advance the pediatric research related to safe swallowing, airway protection, interdisciplinary feeding management, career mentoring, and rapid translation globally. There is an urgent need to employ new research in infants and children so that they benefit from the scientific advances during their formative rapid maturational age. *Stay tuned!*

Congratulations to all of our award winners this year! Please see the complete list below: New award this year, was *The Justine J. Sheppard Award*, dedicated after Dr. Justine Joan Sheppard who has made tremendous contributions to dysphagia in those with physical disabilities. I am very grateful to the sponsors of these awards and to all of you who have donated to our Research & Education fund, which supports the awards. If you haven't donated to the R&E fund, please consider doing so; contributing to your DRS family is important to sustain and advance new programs.

2019 DRS Award Winners

- Oral Presentation:
  - 1st Place: Emily Plowman- Internal Validation of the Physiologic Risk Index for Swallowing Impairment (PRISM)
  - 2nd Place: Lauren Madhoun- Relationships Between Maternal Stress Indices and Feeding and Growth in Infants with and without Cleft Lip and/or Palate
  - 3rd Place: Heather Pyke- Parents' Experiences of Feeding, Swallowing, and Nutrition in Children Receiving Palliative Care
- Poster Presentation:
  - 1st Place: Madeline Raatz- Developing System Requirements for Pediatric Feeding Assessments via Telepractice
  - 2nd Place: Laura Pitts- Navigated transcranial magnetic stimulation to evoke lingual pressure in stroke survivors and controls.
  - 3rd Place: Ting-fen Lin- Eating-related Difficulties in Individuals with COPD
- New Investigator:
  - 1st Place: Mistyka Schar- Association Between Disordered Swallowing and Duration of Oral Endotracheal Intubation in Critically Ill Patients: A High-Resolution Pharyngeal Manometry Study
  - 2nd Place: Rachel Mulheren- The effect of Attention on Swallowing in Healthy Individuals: An Exploratory Study
- AB-SSD Distinguished Research Award: James Curtis- Effects of Verbal Cueing and Bolus Holding on Respiratory Swallow Coordination in Parkinson's Disease
- CSDRG Logemann Travel Award: Danielle Stone- Mechanisms of Perceived Swallow Change Post Whiplash: Potential for a Muscle Tension Component
- Head and Neck Cancer Alliance Award:
  - Jared Cullen- Sensate versus asensate flap reconstruction of the oral cavity with objective measurements of tongue strength and function in a rat model
  - Carly Barbon- Changes in Swallow Safety and Efficiency After Radiation in Patients with Oropharyngeal Carcinoma
- The Michael Donovan NFOSD Innovation Award: Barbara Messing- Hyposalivation and xerostomia post head and neck cancer: changes and impact on eating over time
- Springer Publishing Travel Scholarships:
  - International Award: Leisa Turkington- Carbonated liquids: An investigation of taste intensity, palatability, effervescence and sip volumes of stimuli used in videofluoroscopy
  - Clinician Award: Erica Herzberg- Physiological Compensation for Advanced Bolus Location at Swallow Onset in Healthy Seniors
  - Under-Represented Discipline Award: Emily Ramirez- DHI responses not associated with PAS score from MBS
  - Student Award: James Curtis- Effects of Verbal Cueing and Bolus Holding on Respiratory Swallow Coordination in Parkinson's Disease
- Sumiko Okada Fellowship:
  - Marie Jardine- A Systematic Review of Physiological Changes in the Oldest Old
  - Sonja Molfenter- The Association Between Tongue Pressures and Anthropometric Measures, Physical Function and Muscle Strength
  - Steven B. Leder Award: Barbara Messing- Establishing a Multidisciplinary Head and Neck Clinical Pathway: An Implementation Evaluation and Audit of Dysphagia-Related Services and Outcomes.
- Clarence T. Sasaki M.D. Award: Shaina Lynch- Swallowing Against Laryngeal Restriction (SALR) exercise technique significantly increases the duration of UES opening in both healthy elderly and dysphagic patients
- Justine J. Sheppard Dysphagia in IDD Award: Nobukaza Tanaka- Relationship between swallowing frequency and swallowing function in cerebral palsy patients with severe intellectual and physical disabilities

Finally, it has been a great privilege to serve as the President of DRS. I am truly honored to be the first pediatrician ever to lead this

distinguished research society. My gratitude is extended to every meeting attendee who devoted his or her valuable time and financial resources to attend the 2019 DRS Meeting. While understanding that we are a truly diverse society, some imperfections in not satisfying your individual expectations can be understood; and I am deeply apologetic for that and ask for your forgiveness.

I am indebted to our leadership team who have volunteered countless hours—Gary McCullough, Susan Langmore, Nadine Connor, as well as all of the members on the Board of Directors, who have dedicated so much of their personal and professional time and energy to support the mission and realize the DRS vision. Congratulations and thank you to Dr. Jacqueline Allen, our new Secretary/Treasurer, and our new councilor—Dr. Nicole Rogus-Pulia. I have no doubt Dr. Susan Langmore will take the DRS to great heights as she has an outstanding team to achieve those goals. I look forward to seeing you at the 28th meeting to be held during March 18–20, 2020 in San Juan, Puerto Rico at the Caribe Hilton. Your inspiration, dedication, and perseverance are the strengths of this DRS Family that I am proud to belong!

With Best Wishes,
Respectfully Submitted
Sudarshan R. Jadcherla, MD, FRCP(Irel), DCH, AGAF
DRS President 2018–2019

Predictors of Residue, Penetration, and Aspiration in Parkinson's Disease

James Curtis[1], Sonja M. Molfenter[2], Michelle S. Troche[1]

[1]Teachers College, Columbia University, New York, NY, United States, [2]Communicative Sciences and Disorders, New York University, New York, NY, United States

Purpose: The presence of residue, penetration, and aspiration is common in Parkinson's disease (PD), and increases the risk of developing serious medical consequences including dehydration, malnutrition, aspiration pneumonia, and death. Yet, in PD, little is known about the mechanisms that underlie these impairments. Therefore, in this study, we: (1) assessed the effects of Parkinson's disease severity on changes in swallowing kinematics, residue, penetration, and aspiration; and (2) determined which combination of spatial-temporal swallowing kinematics influenced residue, penetration, and aspiration the most.
Method(s): A secondary analysis of videofluoroscopic swallow studies (VFSS) from forty individuals with PD was performed. Swallowing safety (Penetration–Aspiration Scale 'PAS'), swallowing efficiency (Bolus Clearance Ratio 'BCR'), and ten spatial-temporal swallowing kinematics of the larynx, pharynx, and upper esophageal segment (UES) were analyzed. Simple, linear regression analyses were used to determine if disease severity significantly predicted PAS and BCR, and a multivariate regression was used to determine the influence of disease severity on combined changes in swallowing kinematics. Multiple regressions were used to determine which combination of swallowing kinematic variables influenced measures of swallowing safety and efficiency the most.
Result(s): Results revealed that PAS was primarily influenced by spatial and temporal kinematics of the larynx ($p < .0005$), while BCR was primarily influenced by spatial and temporal kinematics of the pharynx, larynx, and UES ($p < .0005$). Additionally, disease severity alone did not significantly predict changes in PAS ($p = .146$) or BCR ($p = .848$), nor did it contribute to linear changes in swallowing kinematics ($p = .363$).
Conclusions (Including Clinical Relevance): This study comprehensively examined the mechanistic factors that underlie the development of residue, penetration, and aspiration in people with PD. Physiologic causes for functional swallowing impairments were identified, and may help to guide clinicians and researchers in the selection of more effective exercise-based interventions and compensatory strategies for people with PD. These results also indicated that disease severity alone did not significantly predict swallowing changes in PD, and therefore may not be the best factor to identify risk for dysphagia in PD.
Relevant Financial Relationships: James Curtis: Nothing to Disclose | Sonja Molfenter: Has affiliations to disclose; NYU: Salary/Stipend: Employment; NIH: Contracted Research: Independent contractor (Including contracted research) | Michelle Troche: Has affiliations to disclose; MJFox Foundation: Contracted Research: Independent contractor (Including contracted research); CurePSP: Contracted Research: Independent contractor (Including contracted research); Teachers College, Columbia University: Salary/Stipend: Employment.
Relevant Non-financial Relationships: James Curtis: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership | Sonja Molfenter: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Board Membership; ASHA: Professional: Membership; ESSD: Professional: Membership | Michelle Troche: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership.

Eating-Related Difficulties in Individuals with COPD

Ting-fen Lin[1], Samantha Shune[1]

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Purpose: Chronic Obstructive Pulmonary Disease (COPD) affects patients both physiologically and psychologically. Exacerbations and follow-up medical managements aside, a common comorbidity among patients with COPD is psychological distress with resultant affected quality of life and higher economic burden. Patients with dysphagia also present with many similar comorbidities such as increased economic burden, exacerbations, anxiety, and depression. Despite this overlap in symptoms, the comorbidities are often addressed separately, and particularly at an impairment level. A more comprehensive approach to care may be beneficial. Thus, we explored patients' perceptions of the influence of COPD on eating and swallowing to better understand the wide range of factors contributing to eating-related disability.
Method(s): Semi-structured interviews were conducted with individuals with COPD. Open-ended questions related to mealtime behaviors, emotions, and barriers. Grounded Theory guided the interviews and analysis. Discourse was transcribed verbatim for both the participants and the interviewer. Data collection concluded when the same patterns of response emerged (i.e., saturation). Member checking was utilized to ensure the researcher's interpretation remained truthful to participants' perceptions.
Result(s): Even among participants without documented dysphagia, shortness of breath during food and/or liquid intake was linked to negative emotions related to intake, such as annoyance, frustration, and fear. These emotional responses often lead to adapted mindful intake behaviors such as pacing, modulating size of intake, and chewing well. Eating-related behaviors included eating less to facilitate ease of breathing. Even individuals who did not report mealtime-related emotions supported being conscientious about eating and drinking in order to breathe better and avoid pulmonary consequences like aspiration pneumonia.
Conclusions (Including Clinical Relevance): COPD impacts mealtime behaviors and emotions even in the absence of documented dysphagia. Given the interrelatedness between COPD, disease

exacerbation, and dysphagia, it is important to look beyond isolated treatments. A more comprehensive, patient-centered approach that can ameliorate disease consequences while improving quality of life can better serve patients. This project provides emerging evidence supporting more comprehensive and integrative approaches for individuals with COPD.

Relevant Financial Relationships: Ting-fen Lin: Has affiliations to disclose; University of Oregon: Grant: Other Activities | Samantha Shune: Has affiliations to disclose; University of Oregon: Salary/Stipend: Employment; ASHA: Grant: Other Activities.

Relevant Non-financial Relationships: Ting-fen Lin: Has a Non-Financial Disclosure Affiliation; ASHA: Professional: Membership | Samantha Shune: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership; GSA: Professional: Membership.

Effects of Verbal Cueing and Bolus Holding on Respiratory Swallow Coordination in Parkinson's Disease

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Purpose: Typical respiratory-swallow coordination (RSC) is characterized by exhaling before and after swallowing. Deviations from this have been linked with increased risk of deficits in swallowing safety in various populations including Parkinson's Disease (PD). Additionally, while swallowing is known to be affected by verbal cueing and bolus holding, the influence of these variables on RSC remains largely understudied. Therefore, the aims of this study were to evaluate the effects of bolus holding and verbal cueing on RSC in PD.

Method(s): Sixteen people with PD underwent respiratory plethysmography and endoscopic swallowing evaluations while swallowing 5 mL liquid sips under three swallowing conditions. The non-held condition consisted of normal, self-administered cup sips. The held/non-cued condition consisted of holding boluses in the mouth while breathing normally, then swallowing "whenever is normal for you." The cued condition consisted of swallowing a held bolus only when prompted. Verbal cues to swallow were given at four different points during tidal breathing: (1) when initiating tidal exhalation (high exhalation); (2) when completing tidal exhalation (low exhalation); (3) when initiating tidal inhalation (low inhalation); and (4) when completing tidal inhalation (high inhalation). Non-parametric analyses examined differences in the frequency of inspiratory events before and after swallowing for held & non-held and cued & non-cued swallowing conditions.

Result(s): Held (non-cued) trials resulted in significantly less inspiratory events before swallowing ($p < .0005$), but not after swallowing ($p = 1.00$), when compared to non-held trials. Additionally, cueing at low exhalation and low inspiration resulted in significantly more inspiratory events before swallowing ($p < .011$, $p < .0005$) and after swallowing ($p < .0005$, $p = .025$), when compared to non-cued trials.

Conclusions (Including Clinical Relevance): The results of this study demonstrated that verbal cueing and bolus holding significantly affected RSC in people with PD. Therefore, clinicians should attend to RSC during swallowing assessments and avoid cueing at low tidal breathing. Findings also suggest that RSC is malleable and may be a feasible skill-based exercise target in PD. Lastly, held but non-cued swallows appear to be a simple compensatory strategy at immediately improving RSC, and potentially swallowing safety, in PD.

Relevant Financial Relationships: James Curtis: Nothing to Disclose | Michelle Troche: Has affiliations to disclose; Teachers College, Columbia University: Salary/Stipend: Employment; MJFox Foundation: Contracted Research: Independent contractor (Including contracted research); CurePSP: Contracted Research: Independent contractor (Including contracted research).

Relevant Non-financial Relationships: James Curtis: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership | Michelle Troche: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership.

The Limited Effect of CTAR Exercises for Dysphagia in Persons with Oculopharyngeal Muscular Dystrophy

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Purpose: The purpose was to assess the effectiveness of the Chin Tuck Against Resistance (CTAR) exercise in improving the functional swallowing of persons with OPMD.

Method(s): Three participants with OPMD completed this A-B-A-B design study. Primary measures included duration and extent of UES opening, stasis in the valleculae and pyriform sinuses, hyolaryngeal excursion, strength of the chin tuck and tongue to palate pressure strength. Secondary measures included a qualitative measure of eating satisfaction, swallow capacity measured by the Timed Water Swallow, and IDDSI diet rating.

Result(s): The CTAR regimen increased chin tuck strength, but did not significantly improve the swallowing of these three individuals with OPMD. The p values for all pretest and posttest measures were above the .05 cutoff for significance and the visual analysis of continuous data indicates no significant change, except in the strength of the chin tuck itself. As a result, the PI cannot reject the null hypothesis. While the CTAR may be of value in other populations, this type of strength training may affect the disordered muscles that occur in OPMD differently. More studies with larger sample sizes and more discrete imaging sample rates are required to confirm the lack of effectiveness of the CTAR with greater certainty.

Conclusions (Including Clinical Relevance): This study set out to determine if the CTAR exercise improves the swallowing of individuals with OPMD. Several continuous and pretest and posttest measures were tracked and analyzed. The CTAR exercise improved the strength of the chin tuck in all three individuals to a statistically significant level. As anticipated, the increase in the strength of the chin tuck did not carry over to improve linguapalatal strength.Unfortunately, the expected outcome of improved swallow was also not met. Functional swallowing capacity, kinematic aspects of the swallow, and the amount of stasis did not show a significant change. Clinically this study may indicate that exercise, especially the CTAR and in the later stages of the disease, does not offer hope of improving the functional swallow.

Relevant Financial Relationships: Kristen Torres: Nothing to Disclose | Phyllis Palmer: Nothing to Disclose | Carlos Staley: Nothing to Disclose.

Relevant Non-financial Relationships: Kristen Torres: Nothing to Disclose | Phyllis Palmer: Nothing to Disclose | Carlos Staley: Nothing to Disclose.

Understanding Dysphagia Following Anterior Cervical Discectomy and Fusion

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Purpose: Dysphagia can be a detrimental complication following anterior cervical discectomy and fusion (ACDF). Understanding the incidence, pathophysiology, and risk factors related to post-ACDF dysphagia may help develop treatment strategies and prophylactic measures to lessen debilitating complications. The goal of this study is to provide a better understanding of postoperative dysphagia as related to ACDF through a systematic literature review.
Method(s): Information was disseminated from peer-reviewed research studies published over a 20-year period. Data obtained included patient profile, incidence rate, risk factors, symptoms and signs, progress in recovery, swallowing therapy, and any established or recommended prophylactic measures.
Result(s): Based on the 69 research articles under review, the results indicate that more than one-third of patients exhibit oropharyngeal dysphagia immediately or shortly after surgery, and two-thirds of these patients exhibit moderate to severe symptoms including aspiration that requires PEG tube feeding. Patients who showed difficulties with oral feeding tend to have longer hospital stays. The most common factors that raised the risk of dysphagia after ACDF include the location and extent of surgery, longer operative time, and post-surgical complications such as soft-tissue swelling with displacement of the pharynx or esophagus, surgical hardware displacement or bone graft displacement, esophageal perforation, and retropharyngeal abscess. Most patients show satisfactory progress toward normal oral intake about 2 months postoperatively, albeit in some cases a prolonged recovery time is indicated.
Conclusions (Including Clinical Relevance): Understanding the recovery pattern of post-ACDF dysphagia is a prerequisite to developing effective rehabilitative strategies and prophylactic measures. Interdisciplinary team care that includes timely assessment and early intervention is the key element for expeditious recovery.
Relevant Financial Relationships: Fang-Ling Lu: Nothing to Disclose | Tabitha Kao: Nothing to Disclose | Valerie Meaux: Nothing to Disclose | Shane Thomas: Nothing to Disclose | Kenzie Rattan: Nothing to Disclose | Derrick Sun: Nothing to Disclose.
Relevant Non-financial Relationships: Fang-Ling Lu: Nothing to Disclose | Tabitha Kao: Nothing to Disclose | Valerie Meaux: Nothing to Disclose | Shane Thomas: Nothing to Disclose | Kenzie Rattan: Nothing to Disclose | Derrick Sun: Nothing to Disclose.

Carbonated Liquids: An Investigation of Taste Intensity, Palatability, Effervescence and Sip Volumes of Stimuli Used in Videofluoroscopy

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Purpose: Carbonation effect on dysphagia has been studied under videofluoroscopy, however, variability in fluids tested exists. There has also been limited consideration of the stability of the carbonation, and palatability issues for patients, particularly when carbonation is mixed with barium. The study aim was to compare taste intensity, palatability, effervescence and sip volumes of carbonated and non-carbonated liquids, at time of mixing and 5 min later.
Method(s): Forty-two healthy females (20 super-taster; 22 non-taster, 20 -61 years) took sips of 4 fluids (water; carbonated water; barium sulphate with sodium bicarbonate granules; barium sulphate with carbonated water), across 2 time conditions (preparation; 5 min post preparation). Eight conditions were presented in 100 mL amounts, in randomised order. After each fluid, participants rated taste intensity, palatability, and effervescence. Sip size was derived from residual volume. Participant perceptions of fluids were collected post trial.
Result(s): Sip size, palatability, effervescence and taste intensity differed between conditions ($p < 0.01$). Barium sulphate with sodium bicarbonate granules, as used in published studies, was rated lowest for palatability, was most impacted by time post preparation, and had the largest impact on sip size. Participant comments grouped in 4 themes:
(1) Adverse reactions; (2) Sensory properties; (3) Physiological reactions, and (4) Swallow changes.
Conclusions (Including Clinical Relevance): Patient perceptions, palatability, impact on naturalistic sipping and preparation time need to be considered for carbonated fluids tested under videofluoroscopy.
Relevant Financial Relationships: Leisa Turkington: Has affiliations to disclose; The Royal Brisbane and Women's Foundation: Scholarship: Other Activities | Elizabeth Ward: Nothing to Disclose | Anna Farrell: Nothing to Disclose.
Relevant Non-financial Relationships: Leisa Turkington: Nothing to Disclose | Elizabeth Ward: Has a Non-Financial Disclosure Affiliation; Dysphagia research society: Professional: Membership | Anna Farrell: Nothing to Disclose.

Developing System Requirements for Pediatric Feeding Assessments via Telepractice

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Purpose: While studies have detailed the system architecture for performing clinical swallow assessments with adults via telepractice, there are key differences in the requirements of adult swallow versus pediatric feeding assessments. The aim of the study was to develop the system architecture required for conducting pediatric feeding assessments via telepractice.
Method(s): A multi-phase iterative process was used to develop system architecture/safety requirements for the telepractice model. Desired session components were first mapped by an expert panel (2 telepractice, 2 feeding specialists). Next, multiple simulations using mannequins were run to test technology/camera positions. Live trials with 10 typically developing children (5 infant, 5 child) were then completed using purpose-built forms. All parents provided consumer feedback.
Result(s): Different technology (phone/computer/tablet) provided optimal vision/audio depending on the nature of assessment (breast/

bottle vs. solids). Multiple camera positions were needed to deliver required vision/audio. For breastfeeding, a second person was needed to position the camera for optimal viewing of attachment/feeding. Sending asynchronous store-and-forward images of usual feeding positions, oral cavity/palate and lingual frenulum prior to the session was useful.

Conclusions (Including Clinical Relevance): The 4-phase iterative study design aided development of a telepractice model that clinicians and parents found viable for collection required information for conducting feeding assessments via telepractice. Validity testing of the system is underway.

Relevant Financial Relationships: Madeline Raatz: Has affiliations to disclose; Queensland Health: Salary/Stipend: Employment; Children's Hospital Foundation: Grant: Other Activities | Elizabeth Ward: Has affiliations to disclose; The University of Queensland: Salary/Stipend: Employment; Queensland Health: Salary/Stipend: Employment | Jeanne Marshall: Has affiliations to disclose; Queensland Health: Salary/Stipend: Employment | Clare Burns: Has affiliations to disclose; Queensland Health: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Madeline Raatz: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership; Speech Pathology Australia: Professional: Membership | Elizabeth Ward: Has a Non-Financial Disclosure Affiliation; Speech Pathology Australia: Professional: Membership; Dysphagia Research Society: Professional: Membership | Jeanne Marshall: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership; Speech Pathology Australia: Professional: Membership | Clare Burns: Has a Non-Financial Disclosure Affiliation; Speech Pathology Australia: Professional: Membership; Dysphagia Research Society: Professional: Membership.

Dysphagia Optimised Radiotherapy to Reduce Swallowing Dysfunction Severity: A Systematised Scoping Review

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Purpose: To review current evidence surrounding dose optimisation of anatomical structures involved in swallowing and resultant dysphagia outcomes, in patients undergoing (chemo) radiotherapy for head and neck cancer (HNC).

Method(s): A systematised search strategy was used to retrieve evidence published between 2007 and 2017. Participant demographics, treatment regimens, swallowing structures chosen for optimisation, dosimetric constraints employed and measures of dysphagia were considered in the analysis.

Result(s): Nine prospective cohort studies, were included. Oropharynx cohorts only were explored in 2 studies, while 7 included mixed sites within the head and neck. Key structures routinely spared included pharyngeal constrictor muscles (PCMs), glottic larynx (GL), supraglottic larynx (SGL) and esophageal inlet muscle (EIM). Shorter enteral feeding times and reductions in CTCAE grade 3 dysphagia toxicity were observed when dose to the GL, SGL and PCMs was constrained to < 50 Gy and < 60 Gy, respectively. Probability of physician rated RTOG grade 2–4 dysphagia was reduced by up to 17.2% when dysphagia optimised radiotherapy was chosen over standard treatment.

Conclusions (Including Clinical Relevance): Actively constraining dose received to the swallowing structures may yield improvements in radiation induced dysphagia severity, without compromise to planning target volumes (PTV) and loco regional control. Longitudinal, randomised control trials are required in order to further quantify the benefit of dysphagia optimised radiotherapy in reducing severity of swallowing dysfunction.

Relevant Financial Relationships: Alana Hutchison: Nothing to Disclose | Bena Cartmill: Nothing to Disclose | Laurelie Wall: Nothing to Disclose | Elizabeth Ward: Nothing to Disclose.

Relevant Non-financial Relationships: Alana Hutchison: Nothing to Disclose | Bena Cartmill: Nothing to Disclose | Laurelie Wall: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership | Elizabeth Ward: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership.

Knowledge and Practices of Speech Pathologists and Radiation Therapists Regarding Radiation Dose and Implications for Dysphagia Management

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Purpose: Research suggests a synergistic relationship between radiation dose and dysphagia severity. This study aimed to examine knowledge and practices of speech-language pathologists (SLPs) and radiation therapists (RTs) regarding radiation dose and dose optimisation in head/neck cancer (HNC) care, and potential impacts to dysphagia. The secondary aim was to investigate the level of interaction occurring between these professional groups within cancer centres.

Method(s): Two electronic surveys were developed from current literature and expert consensus. Participants were recruited across Australia and New Zealand through specialist member networks and snowball sampling. Analysis involved descriptive statistics and plain content analysis.

Result(s): Respondents included 32 SLPs and 41 RTs. Most were experienced (> 6 years) and worked in large metropolitan centres. All SPs and 50% of RTs were aware of dose-dysphagia relationships, though few SPs used dosimetric information to inform dysphagia management, and only 33% of RTs indicated that their centres actively constrain dose to swallowing structures during treatment. Both groups felt they could assist their colleagues in devising patient management plans, though current collaboration/interaction was minimal.

Conclusions (Including Clinical Relevance): Few SLPs and RTs reported regular use of dosimetric information to inform patient management. Limited interaction between SLPs and RTs is a likely barrier to increased use of dosimetry-guided dysphagia management post HNC. Opportunities for enhanced collaboration should be considered within centres.

Relevant Financial Relationships: Alana Hutchison: Nothing to Disclose | Bena Cartmill: Nothing to Disclose | Laurelie Wall: Nothing to Disclose | Elizabeth Ward: Nothing to Disclose | Cathy Hargraves: Nothing to Disclose | Elizabeth Brown: Nothing to Disclose.

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Development of Swallowing Simulation by Means of Computational Fluid Dynamics

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Purpose: This study describes fluid motion during swallowing movement by means of computational fluid dynamics (CFD) simulation.
In this study, we show that bolus is carried difficultly without swallowing-pressure, and the computed bolus movement in successful swallowing almost corresponds with the real bolus movement.
Method(s): This study is a retrospective observation for patients with head and neck cancer.
We use the examination data for preoperative assessment of patients without dysphagia in Tohoku University hospital.

We develop 3 dimensional computer graphics model of swallowing movement from patients' CT and video fluorography(VF) and compute fluid dynamics of bolus, with several viscosity and neck-angle. The computer model consists of four organs: the larynx, pharynx, tongue and palate. The organs are forcibly displaced. We use lattice Boltzmann method (LBM), simulate the bolus flow with some graphic cards. In order to quantitatively evaluate the results of this simulation, we compare the lowest position of bolus at each time.
Result(s): We observed from VF that bolus flowed into the piriform sinus after accumulation in the epiglottic vallecula. We observed the similar bolus movement in simulation.
The bolus was stagnant in the vertical direction for about 0.1–0.2 s from reaching the vallecula to flowing into the pyriform sinus.

In this simulation, in each situation, aspiration was not observed. The inflow speed into the throat became faster as lying supine.
Conclusions (Including Clinical Relevance): We developed 3 dimensional computer graphics model of swallowing movement.
The simulated bolus movement almost corresponded with the real bolus movement, but the bolus in simulation spread out over a wider area than reality and did not form a mass.

The lower position of bolus may depend on gravity and the bolus spreading properties may depend on swallowing pressure.

In the future, we will study the diffusion characteristics of the bolus by changing the viscosity and timing.
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Transcutaneous Electrical Stimulation on the Submental Area: The Relations of Biopsychological Factors with Maximum Amplitude Tolerance and Perceived Discomfort Level

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Purpose: Transcutaneous Electrical Stimulation (TES) amplitude is a frequently used adjunctive modality to strengthen weak swallowing muscles. TES amplitude is limited by maximum amplitude tolerance (MAT). Previous studies have reported high inter-individual variability regarding MAT and discomfort level. This variability might be one of the potential reasons of conflicting outcomes in TES-based dysphagia rehabilitation literature. MAT and discomfort are influenced by a variety of biopsychological factors. The influence of these factors related to swallow applications is poorly understood. This study explored the relation of biopsychological factors with MAT and discomfort level related to TES in the submental area.
Method(s): Thirty healthy older adults (60–70 years of age) participated in this study. TES was delivered using two-channel surface electrodes on the submental muscles. MAT and discomfort level were identified. Furthermore, gender, submental adipose tissue thickness, perceptual pain sensitivity, and pain coping strategies were evaluated for each subject. Relation of different biopsychological variables with MAT and discomfort level was examined using Pearson and Spearman correlation, and Mann–Whitney U test.
Result(s): No biological factor was related to MAT and discomfort level. Among psychological factors, catastrophizing was the only pain coping strategy that significantly related to MAT($r = -.385$, $P < .002$).
Conclusions (Including Clinical Relevance): Given the negative impact of pain catastrophizing on MAT, this coping strategy should be considered as an amplitude-limiting factor in TES-based dysphagia rehabilitation.
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Can Geriatric Screening Identify Patients at Risk for Dysphagia and Related Complications in Head and Neck Cancer Patients?

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Purpose: The Geriatric 8 (G8) survey has been used as a screening tool in geriatric oncology to determine vulnerability. In our study, we examined the association between G8 vulnerability and dysphagia-associated variables in older adults undergoing head and neck cancer surgery.
Method(s): The G8 was administrated by speech pathologists before treatment. Vulnerability was defined as ≤ 14 points on the G8. Independent variables evaluated included indicators of baseline dysphagia (FOIS score, feeding tube, presence of dysphagia), post-op complications, and post-op swallowing outcomes (feeding tube use, weight loss).

Result(s): 32 adults $\geq$ 65 years undergoing head and neck surgery at two academic medical centers were included in analysis. Patients screening as vulnerable were more likely to have restricted diets at baseline as measured by FOIS (mean 4.89 versus 6.46; $p = 0.0087$) and were more likely to have baseline dysphagia (74% vs. 29%; $p = 0.029$).
Further, those screening vulnerable had longer LOS (9.42 days vs. 6.54 days; $p = 0.0239$) and a greater degree of weight loss 2 weeks post-op (4% vs. 2%; $p < 0.0001$). While the percentage of patients dependent on tube feedings one month post-op failed to reach statistical significance, it is notable that more than twice as many vulnerable patients were tube dependent at 30 days.
Conclusions (Including Clinical Relevance): G8 vulnerability was associated with pre-operative dysphagia and diet as well as post-operative risk in older head and neck cancer patients. When assessing this population, including the G8 tool as part of the pre-operative dysphagia assessment can help clinicians identify at risk patients.
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The Safety and Efficacy of Expiratory Muscle Strength Training (EMST) for Rehabilitation After Supracricoid Partial Laryngectomy: A Pilot Investigation

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Purpose: Expiratory Muscle Strength Training (EMST) is a safe, effective intervention that can be performed at home and may be beneficial for individuals with voice and swallowing disorders. To date there have been few studies of EMST in the head and neck cancer population and there are no previous reports of its use after supracricoid partial laryngectomy (SCPL). This prospective clinical pilot study was undertaken to determine the safety and efficacy of a 4-week treatment program.
Method(s): Six participants were recruited who had undergone SCPL, were medically stable, and had no contraindications for EMST. At baseline objective respiratory measurements were collected, dietary status was recorded, and participants completed a series of validated self-report instruments relating to voice, swallowing, breathing, and cough. Following the completion of treatment, baseline measures were repeated and participant feedback was solicited.
Result(s): The majority of individuals found EMST easy to use (83%) and beneficial (83%). The side-effects of treatment were relatively minor and included dizziness, muscle inflammation, and vocal fatigue. There were improvements in two measures from pre- to post-treatment, namely an average 21% increase in Peak Cough Flow (371.67 L/min to 451.33 L/min) and a 38% decrease on the Dyspnea Index (6.17 to 3.83). Other measures showed inconsistent changes.
Conclusions (Including Clinical Relevance): EMST appeared to improve cough strength and reduce dyspnea symptoms and may be a useful rehabilitation tool after SCPL. Further study of the relative efficacy of EMST compared to other rehabilitation protocols after SCPL is needed.
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The Accuracy of Screening Measures in Identifying Reduced Airway Protection in Patients with Parkinson's Disease

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Purpose: There is currently no widely-established screening protocol for dysphagia in Parkinson's Disease (PD). The goal of the current study was to examine the accuracy of three dysphagia screening measures.
Method(s): Patients with idiopathic PD and no confounding medical conditions were examined consecutively. All individuals completed a series of screening measures, including the Swallowing Disturbance Questionnaire (SDQ), Peak Cough Flow (PCF), and the Water Swallow Test (WST), prior to undergoing swallowing evaluation on videofluoroscopy.
Result(s): There was no significant correlation between three screening measures and Penetration–Aspiration Scale (PAS) scores. Scores on the 3 screening measures were typically the same or better in those with reduced airway protection or aspiration compared to those with normal airway protection. Using cut-off scores, an abnormal PCF had 57% sensitivity for predicting reduced airway protection. Otherwise none of the screening tests were better than chance. When re-examined using cutoffs based on age-based normative data, the sensitivity of the WST increased to 83% for reduced airway protection and 66% for aspiration.
Conclusions (Including Clinical Relevance): Screening measures were not accurately able to predict swallowing safety on videofluoroscopy. More abnormal findings on videofluoroscopy were associated with better rather than worse screening test values. The use of age-based normative values to identify individuals with abnormally low or abnormally high scores increased the accuracy of prediction. These findings require further exploration and validation with a larger and more diverse sample.
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Novel Method to Treat Stricture Following Head and Neck Cancer

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Purpose: Pharyngoesophageal Junction (PEJ) stricture occurs following head and neck cancer. Endoscopic dilatation is effective however labor intensive and expensive. 50% of responders relapse in 9.6 months resulting in a high burden on healthcare facilities. The Fox Tissue Modification Device (FTMD) dilates strictures in unsedated patients in a controlled, gradual manner with minimal tissue injury. Our aim was to assess whether FTMD dilatation is: (1) safe and feasible (2) reduces dysphagia severity (3) increases PEJ diameter.
Method(s): Patients (n = 5) underwent 4 unsedated dilatations with CRE wire-guided balloon (15–18 mm, Boston Scientific). The balloon was slowly inflated to reach a target pressure and increased each session (20, 30, 50, 60 PSI). Balloon position and stricture diameter was confirmed fluoroscopically. Pain scores and swallow function were assessed at baseline and after each dilatation session using Sydney Swallow Questionnaire (SSQ).
Result(s): All patients completed dilatation with no adverse events. The average maximum pain reached during dilatation was 6.5 95% CI [5.3 7.7] however in all cases it resolved immediately on extubation. There was an average increase in narrowest diameter of the PEJ by 0.58 mm 95% CI [0.08 1.08] (p = .023) each session. SSQ scores improved by −244 95% CI 6.5 95% CI [− 642 161] (NS, p = .15) but this was not significant.
Conclusions (Including Clinical Relevance): In this small study, awake dilatation appears safe and feasible. The narrowest PEJ diameter increased modestly and this method may provide clinicians with a safe and economic choice to standard endoscopic management of recalcitrant stricture.
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Expiratory Muscle Strength Training: Feasibility in patients with advanced Parkinson's Disease and Dysphagia

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Purpose: The benefit of Expiratory Muscle Strength Therapy (EMST-150) for dysphagia has been shown in patients with mild-moderate Parkinson's disease (PD) (Troche et al, 2010). This study aimed to determine feasibility of the EMST protocol and evaluate swallowing outcomes in patients with more advanced PD.
Method(s): Using a single arm pre/post design, patients identified to have moderate-severe PD (> 3 Hoehn & Yahr scale) were approached to receive 4-weeks of EMST therapy. Participants had weekly therapy with a speech–language pathologist (SLP); they were also asked to independently complete 4 sessions per week. Feasibility over time was judged using therapy attendance and homework logs. Swallow physiology and patient reported outcomes were evaluated pre/post using: videofluoroscopy of swallowing (VFS); breathing measures including Forced expiratory volume (FEV1), Forced vital capacity (FVC), Peak expiratory flow (PEF), Peak cough flow (PCF), Maximum inspiratory pressure (MIP) and Maximum expiratory pressure (MEP); swallowing related quality of life (SWAL-QOL); and swallowing symptom burden (SDQ). Two experienced SLPs independently rated VFSs using the Penetration–Aspiration Scale (PAS); discrepancies were resolved by consensus.
Result(s): A total of 22 patients were approached and the first 10 that consented were enrolled. Across all 10 participants: 8 were male; 8 had post-graduate education; median age = 75 years; median H&Y = 3; median UPDRS = 36; and median MOCA = 23. Across all participants, 88% of SLP sessions were attended (n = 44 of 50 sessions); and 87.5% of home practice sessions were completed (n = 140 of 160 sessions). 3 participants dropped out of the study; reasons for discontinuing included cognitive impairment, psychiatric comorbidity and unrelated illness. Over the 4-week intervention, FEV1 improved from a median of 2.6L/s to 3.0L/s, p = .043; however, no statistically significant changes were noted for other respiratory measures. Likewise, overall no statistically significant changes were noted on PAS, QOL, or symptom burden. The only exception was the oral SDQ score which changed from a median of 3.5 to 4.5, p = .026.
Conclusions (Including Clinical Relevance): Our results suggest that the existing EMST protocol is feasible in even a more advanced PD population; however, the attrition rate of 30% suggests that the rigors of this protocol may not be practical for select individuals, such as those with cognitive impairment.
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Interobserver Reliability of Diet Recommendations and Compensatory Strategies Following Instrumental Swallowing Assessments

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Purpose: The purpose of the study was to determine the interobserver reliability of diet recommendations and compensatory strategies via simultaneous evaluation of the MBSS and FEES. Individuals with amyotrophic lateral sclerosis and Parkinson's disease were participants in the study.
Method(s): Ten individuals with ALS or PD participated in a simultaneous MBSS and FEES to determine interobserver reliability of the following categories: recommended food, liquids, postures, and maneuvers. The overall interobserver agreement, agreement of occurrence, and agreement of non-occurrence was calculated for each aforementioned categories. The national dysphagia diet was used as a standard for food and liquid recommendations.
Result(s): The results of the study indicated that the there was a good overall agreement between the MBSS and FEES in determining diet recommendations and compensatory strategies. There was a 96% overall agreement for food recommendations. There was a 100% overall agreement for liquid recommendations. There was a 98.18% agreement for maneuver recommendations. There was a 96.67% agreement for posture recommendations.
Conclusions (Including Clinical Relevance): Findings indicated that the MBSS and FEES were both effective assessments in determining diet recommendations and compensatory strategies for study participants. Combining the MBSS and FEES may yield a more comprehensive evaluation for individuals swallowing capabilities, impairments, diet recommendations, compensatory strategy recommendations, and pathophysiological deficits that determines therapeutic exercises.
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Revelations of Pharyngeal and UES Dysfunction in Symptomatic Patients with "Normal" Esophageal Manometry Using Large Scale Manometric Database Techniques

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Purpose: A significant number of symptomatic patients referred for clinical esophageal manometry exhibit normal manometric findings based on currently established metrics derived from high resolution manometry. This can pose a diagnostic dilemma and a difficult management challenge. We hypothesized that characterization and comparison of the entire deglutitive esophageal isocontour between these manometrically "normal" symptomatic patients (MNSP) and healthy controls may provide enhanced differentiating ability compared to the currently used metrics. Purpose: Establish the feasibility of a database to: (1) Evaluate deglutitive pharyngo-esophageal pressures for mean as well as standard deviation (SD) isocontours in controls and MNSP. (2) Statistically compare groups over the entire deglutitive pressure topography.
Method(s): Using the data in our recently developed manometry bank (Milwaukee ManoBank), we studied 1610 swallows in 52 healthy subjects (50 $\pm$ 14 years,20F) and 109 symptomatic patients. (52 $\pm$ 16, 56F). MNSP were defined using the Chicago Classification criteria. All subjects performed 5 mL water swallows (x10). Each swallow was normalized by defining "time zero" as the instant of initial deglutitive upper esophageal sphincter (UES) relaxation and by defining the inter-sphincteric esophageal length. In addition to characterizing average and SD, we also tested the disease-related differences in pressure topographies using analysis of variance spanning the entire isocontour across all subjects
Result(s): Inspection of the average isocontours showed mean esophageal peristalsis is similar for control and patient groups. These similarities are further shown by the SD isocontours. The significant group-wise effects ($p < 0.0001$) may also be shown on the isocontour maps. While no differences were detected in the body of the esophagus, significant differences were found in the pharyngo-esophageal junction.
Conclusions (Including Clinical Relevance): Group analyses of esophageal deglutitive pressures using topographic techniques provide further insight into the motility of symptomatic patients with "normal" esophageal manometry not offered by derived metrics. Abnormalities outside the distal smooth muscle esophagus such as pharyngo-esophageal junction and proximal esophagus should be considered as sources of symptoms in symptomatic patients with normal esophageal manometry.
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Light Video as a Means of Swallow Identification in Pre-term and Term Infants

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Purpose: Video fluoroscopy is the best way to evaluate swallowing, however, it is contraindicated in pre-term infants because of associated health risks. Identifying swallows from light videos has been proposed as a safer alternative, but poor swallowing coordination of pre-term infants relative to term infants may compromise this. We tested the validity of swallow identification from light camera data compared to video fluoroscopy in pre-term and term infant pigs.
Method(s): Three term and four pre-term pigs were fed from a bottle containing barium and a milk solution. At seven days after birth pigs were recorded feeding from the bottle using simultaneous high speed (100 fps) x-ray and light video cameras. In the light video, the frame of most rapid elevation of the hyoid was scored as the swallow. In the x-ray, the swallows were scored as the beginning of posterior bolus

movement. The number of frames separating x-ray and light camera swallow identifications was calculated for each swallow.
Result(s): Hyoid movement was found to be closely correlated to bolus movement in term pigs, but not closely correlated in pre-term pigs. The mean frame offsets for term and pre-term pigs were different (Wilcox test, $p < 0.001$). The variance for the pre-term pigs was larger (Levene's test $p < 0.001$).
Conclusions (Including Clinical Relevance): The light videos were found to be a good measure of swallows in term pigs, but were not a good measure of swallows in pre-term pigs. These results suggest that x-rays may be the only way to identify swallowing in pre-term infants, despite risks of radiation exposure, and that swallowing mechanics differ in preterm infants.
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Participation in a Proactive Swallowing Program while Undergoing Chemoradiation for Head and Neck Cancer: Patient Perspectives

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Purpose: Many centers now provide proactive swallowing treatment for individuals undergoing chemoradiation for head and neck cancer. However, little is known about the patient viewpoint regarding participation in these programs. The purpose of this study is to explore patient perspectives regarding participation in a proactive exercise-based swallowing program during treatment for head and neck cancer.
Method(s): Five participants of an intensive exercise-based swallowing treatment program at the University of Washington Medical Center, between the ages of 58 and 80, were recruited for this qualitative research study. In-depth semi-structured interviews were conducted three to six months following completion of the program.
Result(s): Analysis of transcribed interviews revealed two major themes; my relationship with food and figuring it out. Each major theme contained three subthemes. My relationship with food included subthemes of my eating identity, new uncertainty and I feel fortunate. The second major theme, figuring it out included subthemes; preparation for the journey, following the map and eating is a trial. The majority of participants expressed chemoradiation-related challenges of eating through the lens of a unique eating identity. Partcipants also described development of customized strategies to adapt to challenges. The desire for a more individualized treatment approach, greater access to qualified professionals after chemoradiation treatment ended and access to psychosocial support was also expressed.
Conclusions (Including Clinical Relevance): Findings have the potential to expand medical provider awareness of patient perspectives in order to tailor programs to better suit individual needs and enhance adaptation for the road ahead.
Relevant Financial Relationships: Jan Pryor: Nothing to Disclose | Kathryn Yorkston: Nothing to Disclose | Carolyn Baylor: Nothing to Disclose.
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You Want Me to Order What? Creating Education Awareness of the Role of an Infant FEES Program in a Level III NICU and Cardiac Intensive Care Unit

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Purpose: Fiberoptic Endoscopic Evaluation of Swallowing (FEES) has been an instrumental tool used in adult intensive care units for many years. Adult intensivists have had education, training, and exposure to FEES to assess oropharyngeal physiology and direct appropriate treatment plans. Pediatric intensivists and neonatologists have had limited exposure to FEES and typically use videofluroscopic swallow studies (VFSS) as the gold standard for assessing dysphagia in infants. The purpose of this presentation is to review the role of FEES in a level three neonatal intensive care unit and pediatric cardiac intensive care unit.
Method(s): An online survey was created that assessed healthcare workers perception and knowledge of infant FEES in critical care units. The survey was posted via social media outlets and emailed to healthcare professionals who work in the NICU and PCVICU.
Result(s): The results of the survey revealed that healthcare workers who work with medically fragile and critically ill infant had little to no knowledge on scope of FEES, safety of FEES, or benefits of FEES. Further, 69% of respondents did not know that FEES could be used instead of a VFSS or 73% did not know that speech language pathologists have ability to perform and interpret infant FEES.
Conclusions (Including Clinical Relevance): This survey revealed that further education/training for healthcare workers about infant FEES is warranted before, during and after an infant FEES program is being developed.
Relevant Financial Relationships: RAQUEL GARCIA: Nothing to Disclose.
Relevant Non-financial Relationships: RAQUEL GARCIA: Nothing to Disclose.

A Case Report of Improved Swallowing Following Tongue Strength Training in Dentatorubral-Pallidoluysian Atrophy (DRPLA)

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Purpose: Dentatorubral-pallidoluysian atrophy (DRPLA) is an autosomal dominant spinocerebellar degenerative disease with a frequency of 2 to 7 per million people in Japan. We report the case of a 55-year old male patient who presented with complaints of dysphagia and dysarthria. Baseline examination confirmed reduced maximum isometric tongue strength (16 kPa), aspiration on thin

liquids (Penetration–Aspiration Scale score of 7) and pharyngeal residue with solid foods.
Method(s): We prescribed a course of tongue strengthening exercises, with 10 repetitions performed twice daily. A silicon tongue pressure resistance tool (Pekopanda, developed in Japan) was used to aid home practice. Treatment outcomes were measured after 6 months.
Result(s): Post-treatment, maximum isometric tongue pressure measures had improved by 88% to 30 kPa.
Videofluoroscopy showed improved swallowing safety with Penetration–Aspiration scale scores of 2 on thin liquids. A dramatic reduction in residue with a cake stimulus was also observed (i.e. 2.9% of the C2–C4[2] area compared to a pre-treatment measure of 9%). Measures of peak hyoid excursion (i.e. % of the C2–C4 scalar distance away from C4) were also increased post-treatment (11% increase on a slightly thick liquid to 169.8%; 5% increase on a cake to 158.9%). The patient reported no choking episodes and no episodes of pneumonia during treatment.
Conclusions (Including Clinical Relevance): This case study shows improvement in tongue strength and swallowing function in a patient with neurodegenerative disease after a course of daily tongue strength exercise.
Relevant Financial Relationships: Mari Nakao: Nothing to Disclose | Catriona Steele: Has affiliations to disclose; Natinal Institute of Deafness and Other Communication: Grant: Independent contractor (Including contracted research); Dysphagia Research Society: Other Financial or Material Support: Teaching and speaking; Medbridge:Royalty: Teaching and speaking; Tronto Rehabilitation Institute-University Health Network: Salary/Stipend: Employment; Northern Speech Services:Royalty: Teaching and speaking | Yutaka Maeno: Nothing to Disclose | Shinichi Izumi: Nothing to Disclose.
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The Effect of Lidocaine on Perceived Comfort and Swallowing Pressures during High Resolution Pharyngeal Manometry

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Purpose: To determine the level of comfort during high-resolution manometry (HRM) and if potential discomfort is reduced with the use of lidocaine. A secondary aim of the study was to explore whether differences in pharyngeal pressure measurements exist between HRM conducted with the use of atomized lidocaine verses HRM conducted without.
Method(s): Twenty-nine participants underwent two HRM procedures under two conditions spaced 5–7 days apart: 2% viscous lidocaine to nares or .4 mL 4% atomized lidocaine to nares in addition to 2% lidocaine to nares. During each procedure, participants received six boluses of water. Following catheter removal, participants were asked to rate comfort using a visual analog scale (VAS) and upon completion of both conditions, participants indicated which procedure they preferred. A paired t-test was used to compare pharyngeal pressure measurements at the velopharynx, tongue base region and during upper esophageal sphincter opening. We also categorized the pharyngeal pressures as normal or outside of normal limits and compared conditions using a McNemar's test.
Result(s): Twenty-eight participants indicated they preferred both viscous lidocaine and atomized lidocaine. VAS ratings yielded a significant difference ($p = .0001$). No significant difference in pharyngeal pressures was detected between the two groups.
Conclusions (Including Clinical Relevance): The findings indicate higher comfort scores in the condition with atomized lidocaine. Patients preferred the condition using both viscous lidocaine to nares in addition to atomized lidocaine.
Differences in pharyngeal swallowing pressures were not significant.
Relevant Financial Relationships: Jodi Hernandez: Has affiliations to disclose; UW Hospital & Clinics: Salary/Stipend:Ownership | Glen Leverson: Nothing to Disclose | Susan Thibeault: Has affiliations to disclose; NIH: Grant: Other Activities
Relevant Non-financial Relationships: Jodi Hernandez: Nothing to Disclose | Glen Leverson: Nothing to Disclose | Susan Thibeault: Nothing to Disclose.

Ability to Track Hyoid Bone Movement During Swallowing Using Vibratory Signals from Neck Sensors

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Purpose: Hyoid bone movement is an important videofluoroscopic marker of swallow physiology reflecting biomechanical events that produce laryngeal closure and upper esophageal sphincter opening. However, VFSS are not always feasible or available, and they expose patients to radiation. This study investigated the ability of vibratory signals (VS) from an accelerometer on the anterior neck during swallowing to approximate human measurements of hyoid bone movement. We hypothesized that machine learning techniques using VS would track hyoid bone movement with a high degree of accuracy.
Method(s): We analyzed 400 swallows from 114 patients who underwent VFSS due to suspected dysphagia at the University of Pittsburgh Medical Center Presbyterian Hospital. We compared machine learning analysis of the VS from an accelerometer to frame-by-frame hyoid displacement measurements. To produce VS predictions of hyoid motion, we reduced the signal features analysis to a bounding box approximating hyoid bone position on each video frame and compared these predictions to human measurements using a metric of Relative Overlapped Percentage (ROP).
Result(s): The overall mean value of ROP among all data was high (50.92%) indicating that more than 50% of the hyoid body on each frame was correctly predicted by machine learning techniques.
Conclusions (Including Clinical Relevance): This study found that advanced machine learning techniques using VS can effectively track hyoid bone movement non-invasively. This provides preliminary evidence for continued development of accelerometry as a non-invasive swallowing screening instrument and as a potential tool to track hyoid bone movement.
Relevant Financial Relationships: Cara Donohue: Has affiliations to disclose; NIH: Contracted Research: Independent contractor (Including contracted research); University of Pittsburgh: Salary/Stipend: Employment | Shitong Mao: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH: Contracted Research: Independent contractor (Including contracted research) | Ervin Sejdic: Has affiliations to disclose; University of

Pittsburgh: Salary/Stipend: Employment; NIH/NSF: Contracted Research: Independent contractor (Including contracted research) | Jim Coyle: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH: Contracted Research: Independent contractor (Including contracted research).
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How Closely Do Machine Ratings of Duration of UES Opening During Videofluoroscopy Approximate Clinician Ratings Using the MBSImP?

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Purpose: UES opening facilitates the flow of swallowed material into the esophagus. Reduced duration of UES opening (DUESO) can result in pharyngeal residue or penetration/aspiration. The MBSImP is a tool used to rate aspects of swallow function but requires an element of subjectivity. For example, DUESO is quantified as "complete" (0), "partial" (1), "minimal" (2), or "no" (3) duration and distention of flow without objective parameters. DUESO can be quantified using swallow kinematic analysis of VFSS images but is impractical clinically and exposes patients to radiation. High resolution cervical auscultation (HRCA) is a swallow screening tool that uses noninvasive electronic sensors to record signals reflecting underlying pharyngeal swallow activity. This study compared the ability of machine learning using HRCA signals to MBSImP ratings of DUESO. We hypothesized that machine learning techniques using HRCA signals would match human ratings of DUESO with a high degree of accuracy.
Method(s): 28 patients referred for VFSS were examined in the lateral plane. An MBSImP certified SLP analyzed DUESO of 100 swallows using MBSImP ratings. We used an ANOVA model to determine the statistically significant HRCA signal features of DUESO. After determining the statistically significant features, we used machine learning techniques to predict clinician ratings of DUESO using the MBSImP.
Result(s): The bandwidth of swallowing sounds and anterior-posterior acceleration were the only aspects of HRCA found to be significant for MBSImP DUESO scores. Using these aspects of HRCA signals, the machine learning algorithm predicted MBSImP scores of DUESO with 85.7% accuracy.
Conclusions (Including Clinical Relevance): We found that HRCA signals combined with machine learning closely approximates human measurements of DUESO using the MBSImP. This demonstrates that HRCA has clinical potential as a non-invasive swallow screening instrument to identify physiological aspects of swallowing such as DUESO without imaging. Future work should examine the ability of HRCA signals and machine learning to predict UES diameter in addition to duration.
Relevant Financial Relationships: Cara Donohue: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH: Contracted Research: Independent contractor (Including contracted research) | Yassin Khalifa: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NSF: Contracted Research: Independent contractor (Including contracted research) | Ervin Sejdic: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH/NSF: Contracted Research: Independent contractor (Including contracted research) | Jim Coyle: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH/NSF: Contracted Research: Independent contractor (Including contracted research).
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Changes in Swallowing Functions in Patients Undergoing Esophagectomy

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Purpose: Oropharyngeal dysphagia is one of major complications following esophagectomy. However, pre-to-post-operative changes in patients' swallowing safety and efficiency have not been detailed. This study aims to investigate the changes in swallowing functions in patients undergoing esophagectomy.
Method(s): We included eleven patients (male = 10; age range 49–78 years) who completed both laryngoscopy and videofluoroscopy before and after surgery. Presence or absence of vocal fold immobility was judged in laryngoscopic evaluation. Swallowing function was assessed using trials of 5 mL of thin, mildly thick, moderately thick, and extremely thick liquids. Degree of airway protection was scored using Rosenbek's Penetration–Aspiration Scale (PAS). Timing of penetration/aspiration was also noted as before, during, or after the swallow. PAS $\geq$ 3 was considered to be abnormal. Severity of residue in the valleculae and pyriform sinus was graded respectively using a four-point scale. Statistical analyses were performed to compare the median PAS scores and the residue grades for four different viscosities before and after surgery.
Result(s): Median days between surgery and postoperative laryngoscopy and videofluoroscopy were 15 and 16 days respectively. Postoperative vocal fold immobility was observed in nine patients (81.8%). No PAS 3 $\geq$ events (0%) were observed before surgery; nine PAS $\geq$ 3 events out of all 44 trials (20.5%) were observed after surgery. Of those, eight PAS 3 $\geq$ events (88.8%) occurred during swallowing, indicating incomplete laryngeal vestibule closure after esophagectomy. The changes in the median PAS scores of four viscosities before and after surgery did not reach a statistical significance. The postoperative valleculae residue increased significantly for all four consistencies, suggestive of reduced hyolaryngeal excursion and incomplete epiglottic inversion after surgery. The pyriform sinus residue did not increase significantly.
Conclusions (Including Clinical Relevance): This study showed changes in swallowing functions after esophagectomy: penetration/aspiration during the swallow and residue in the valleculae. Future studies are warranted to examine the swallowing biomechanics

related to those swallowing dysfunctions, which may be targets of post-esophagectomy swallowing rehabilitation.
Relevant Financial Relationships: Asako Kaneoka: Nothing to Disclose | Haruhi Inokuchi: Nothing to Disclose | Rumi Ueha: Nothing to Disclose | Taku Sato: Nothing to Disclose | Takao Goto: Nothing to Disclose | Sky Yang: Nothing to Disclose | Takaharu Nito: Nothing to Disclose | Yasuyuki Seto: Nothing to Disclose | Nobuhiko Haga: Nothing to Disclose.
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Effects of Expiratory Muscle Training on Swallowing: A Systematic Review

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Purpose: Respiratory training has been utilized in dysphagia rehabilitation, however little is known about the effects of this approach on specific swallowing measures and its adequacy for different patient populations. We conducted a systematic review to appraise evidence about the effects of expiratory muscle strength training (EMST) on swallowing.
Method(s): A literature search was conducted according to Cochrane guidelines in 9 databases. Of 2786 non-duplicate articles, 17 were judged to be relevant for review. These underwent detailed review, data extraction, rating for level of evidence, and study quality evaluation. Meta-analysis was performed on 15 studies with available data.
Result(s): The articles included in the review described respiratory muscle training interventions in a variety of patient populations using different devices, but the majority used EMST. The usual protocol was 5 days per week for 4 weeks, in 5 sets of 5 breaths through the device (25 breaths/day). Exercise was supervised weekly with loads between 25% and 75% depending on population. The Penetration–Aspiration Scale (PAS) and Maximum Expiratory Pressure (MEP) were the most commonly reported outcome measures. Swallow measures were extremely heterogeneous, and comparisons across studies were not possible. In 8 studies MEP increased significantly post-training across the populations studied ($Z = 3.39$ [$P = 0.0007$]). In 10 studies PAS data were typically analyzed as a continuous parameter, despite the scale being categorical and unsuitable for parametric analysis. Conclusions regarding changes in PAS could therefore not be drawn.
Conclusions (Including Clinical Relevance): Overall, the evidence regarding the effects of EMST as an intervention for dysphagia is lacking. Future investigations should focus on non-parametric analysis of changes in PAS scale and on inspection of other biomechanical changes.
Relevant Financial Relationships: Renata Mancopes: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment; University of Santa Maria: Salary/Stipend: Employment | Sana Smaoui: Has affiliations to disclose; Toronto Rehabilitation Institute - University Health Network: Salary/Stipend: Employment; University of Toronto - Peterborough K.M. HUNTER Charitable Foundation Graduate Awards: Scholarship: Other Activities; University of Toronto - Mary Gertrude l'Anson Scholarship OSOTF - SGS University-Wide Awards: Scholarship: Other Activities; University of Toronto Fellowship: Scholarship: Other Activities | Catriona Steele: Has affiliations to disclose; Toronto Rehabilitation Institute - University Health Network: Salary/Stipend: Employment; National Institute of Deafness and Other Communication Disorders: Grant: Independent contractor (Including contracted research); Medbridge:Royalty: Teaching and speaking; Northern Speech Services:Royalty: Teaching and speaking; Dysphagia Research Society: Other Financial or Material Support: Teaching and speaking.
Relevant Non-financial Relationships: Renata Mancopes: Nothing to Disclose | Sana Smaoui: Nothing to Disclose | Catriona Steele: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Board membership; Dysphagia Journal: Professional: Board membership; international Dysphagia Diet Standardisation Initiative: Professional: Board membership.

Relationships Between Maternal Stress Indices and Feeding and Growth in Infants With and Without Cleft Lip and/or Palate

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Purpose: Feeding and growth difficulties are common in infants with cleft lip and/or palate (CL/P). Feeding interventions are often needed to ensure adequate nutrition and growth. Maternal stress and postpartum depression may also increase a child's risk of failure to thrive. This cross-sectional study examined interrelationships between maternal traits (stress, depression) and outcomes (feeding, growth) of infants with and without CL/P.
Method(s): Mothers of infants with clefts (CL/P group, $n = 30$) and without clefts (Control group, $n = 30$) were recruited. The CL/P group included 16.6% with cleft lip, 46.6% with cleft palate (CPO), and 36.6% with cleft lip and palate. Mean infant age in the CL/P group was 48 days (47% female) compared to 43 days (43% female) for controls ($p = .39$).
Mothers completed the Feeding/Swallowing Impact Survey (FS-IS), Parenting Stress Index-Short Form (PSI-4-SF), and Edinburgh Postnatal Depression Scale (EPDS). Demographic characteristics, the child's feeding history, and growth measurements were assessed.
Result(s): One-way ANOVA revealed significant group differences on total FS-IS scores, indicating that having an infant with a cleft ($F = 4.587$, $p = .04$) and low financial security ($F = 7.984$, $p = .01$) predicted greater caregiver impact due to infant feeding issues. Mothers of infants with CL/P reported significantly higher PSI-4-SF Total Stress scores versus controls ($F = 5.111$, $p = .03$). Weight and length percentiles differed significantly for controls vs. infants with CPO ($p < .05$), with poorer growth noted in the latter. In the sample, significant relationships ($p < .05$) were found between FS-IS scores and weight ($r = -.31$), length ($r = -.32$), and reported feed duration ($r = .32$). EPDS score had a moderate positive correlation with both and FS-IS Total Score ($r = .47$) and PSI-4-SF Stress Total ($r = .30$), while total FS-IS and PSI-4-SF scores ($r = .65$) exhibited a strong positive correlation.
Conclusions (Including Clinical Relevance): Despite receiving early team care and feeding interventions, mothers of infants with CL/P reported higher stress and greater negative impact of feeding issues on their well-being. Infants with CPO displayed significantly poorer

feeding and growth outcomes compared to controls. Stress and psychosocial risks associated with clefting may adversely affect both mothers and infants. Future studies should examine targeted psychosocial interventions to improve feeding and growth outcomes in infants with CL/P.
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The Maturation of Coordination of Respiration and Swallowing in Preterm Infants

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Purpose: The ability to coordinate feeding and breathing is critical to survival, yet preterm infant mammals typically struggle to coordinate these behaviors, in part due to an immature nervous system. Increased neuroplasticity in these infants suggests that they may overcome problems coordinating breathing and swallowing as they mature. We hypothesize that preterm infants will follow an accelerated maturation of aerodigestive coordination relative to term infants.
Method(s): To test this hypothesis, we synchronously recorded the respiration, using plethysmography, and deglutition, using 100 fps videoflouroscopy, in preterm and term infant pigs (N = 8?) longitudinally from birth to weaning.
Result(s): We found that term pigs exhibited substantial coordination between breathing and feeding from seven days old through weaning, and that they increased the delay of inspiration following a swallow as they aged, implying increased airway protection. However, although preterm infants did develop stereotyped respiratory and swallowing patterns, they failed to develop coordination between the two behaviors throughout suckling.
Conclusions (Including Clinical Relevance): These results suggest that the immaturity of the preterm nervous system has a larger impact than plasticity. Further, without intervention, preterm infants may not develop the ability to coordinate breathing and swallowing patterns during feeding.
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Swallowing Time in Children with Cerebral Palsy

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Purpose: To evaluate oral preparation duration (OP), oral transit time (OTT), pharyngeal transit time (PTT), upper esophageal sphincter transit time (UESTT), and oral-pharyngeal transit time (OPTT) in children with cerebral palsy (CP).
Method(s): We evaluated, by videofluoroscopy, swallowing of 13 CP children aged 7 to 108 months (median: 72 months), seven females and six males. Four children were Gross Motor Function Classification System level IV and nine were level V. According to the Dysphagia Outcome and Severity Scale, 8 patients were level I (severe), 1 patient was level III, 2 level IV and 2 level V (mild). The results were compared with those of 15 healthy children (HC), nine females and six males, aged 6 to 38 months (median: 15 months). They swallowed liquid (milk, free volume) and paste boluses (5 mL).
Result(s): CP children had a longer bolus transit time than HC, for both liquid and paste boluses. In HC the transit was longer with paste than with liquid bolus, however in CP children there was no difference between liquid and paste boluses. Oral transit time was 0.43(0.26)s in CP and 0.16(0.06)s in HC for liquid, and 0.41(0.32)s in CP and 0.31(0.30)s in HC for paste bolus; PTT was 0.51(0.30)s in children with CP, and 0.24(0.08)s in HC for liquid, and 0.44(0.13)s in CP and 0.39(0.30)s in HC for paste bolus.
Conclusions (Including Clinical Relevance): Oral and pharyngeal bolus transit time was longer in CP children than HC. No changes in swallowing time were observed in CP children with the increase of viscosity of the bolus swallowed.
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Does Aging Effect Esophageal Bolus Transit Time in the Upright Position Observed Under Videofluoroscopy?

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Purpose: The purpose of this study was to examine age-related effects on esophageal transit time (ETT) in two swallowing trials (5-mL nectar-thickened liquid and 5-mL pudding) observed during videofluoroscopy among healthy adult participants.
Method(s): ETT was defined to begin once the bolus passed the inferior segment of the true vocal folds and ended once the bolus head passed the lower esophageal segment. Differences across age categories were determined using Kruskal-Wallis Test. A mixed effect model was performed to investigate the effect of age on ETT, as well as the relationship between Esophageal Clearance score (Modified Barium Swallow Impairment Profile Component 17) and ETT. Differences between sexes were also explored.
Result(s): Among 175 participants, ETTs for nectar and pudding were 6.7 ($\pm$ 2.8) and 8.2 ($\pm$ 4.2) s, respectively. No significant differences were observed in ETT across age groups for either nectar ($p = 0.231$) or pudding ($p = 0.335$), respectively. For nectar consistency, the mean ETT for patients with scores 2 or greater, was significantly higher than that of participants with a score of 0 ($p < 0.0001$). For pudding consistency, participants with a score of 1 and 2 demonstrated significantly higher mean ETT compared to participants with a score of 0 (with $p = 0.0008$ and $p < 0.0001$, respectively).
Conclusions (Including Clinical Relevance): Study findings failed to support age differences in ETT. However, these normative values following a standardized protocol provide guidance in clinical interpretation of esophageal function observed during videofluoroscopy.
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Swallowing Interdisciplinary Psychophysics (SIP): How Psychophysics Reveals a Safety Bias in Bolus Volume Difference Detection

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Purpose: Studies show that increases in bolus volume lead to increases in both airway protection and UES opening durations. It is assumed that sensory information in the oral cavity is responsible for this swallow safety modulation. However, it is unknown whether volume increases in the oral cavity are accurately detected by healthy adults. Psychophysics aims to describe relationships between physical stimuli and perceived experience. Our study uses psychophysics to test just noticeable differences (JND) of water volume changes among 36 healthy adults
Method(s): We developed an adaptive protocol to identify the smallest discriminable differences (JND) in bolus volume. Subjects were randomized into 3 groups where the first bolus (standard quantity) was either 5 mL, 15 mL, or 25 mL. Based on that standard quantity, volume changes were gradually reduced across several trials using a protocol that required at least 2 correct answers per volume change until it identified the smallest JND. We investigated whether subjects were more likely to report volume changes accurately when volumes increased versus when they decreased, because we hypothesized a safety-motivated bias. Also, because judgements in volume could be made while bringing cup to mouth, when the bolus is in the mouth, and during the swallow, subjects rated during 3 different phases: hand, mouth, or swallow.
Result(s): Our primary finding is that subjects were more accurate to detect a JND when the volume increased, rather than when it decreased ($p < .01$). Interestingly, JND ratings were more sensitive when volume changes were judged based on the bolus being in the mouth versus hand (cup). Also, subjects who started with the smallest standard quantity (5 mL) detected smaller JNDs (1 mL volume changes) versus 2 mL with the 15 mL standard quantity and 2.5 mL with the 25 mL standard quantity.
Conclusions (Including Clinical Relevance): We suspect the greater accuracy in detecting volume increases is due to a safety bias; that is, people are responsive to the need to protect the airway from larger boluses that could overwhelm the pharynx and larynx if the swallow is not modified. Patients with oral sensory impairments may require greater volume changes to detect differences and modify the subsequent pharyngeal swallow. JNDs should next be compared with objective swallow measures to direct clinical assessment of dysphagia.
Relevant Financial Relationships: Alycia Rivet: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose | Andrew Lotto: Nothing to Disclose.
Relevant Non-financial Relationships: Alycia Rivet: Nothing to Disclose | Ianessa Humbert: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership | Andrew Lotto: Nothing to Disclose.

Esophageal Motility Changes Associated with Perception of Esophageal Bolus Transit In Healthy Volunteers

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Purpose: Perception of bolus transit through the esophagus may be influenced by mechanical obstruction, altered motility and hypersensitivity. Our objective was to evaluate esophageal motility in case of perception of esophageal bolus transit.
Method(s): Perception of esophageal transit was evaluated in 22 (12 women) healthy volunteers, aged 22–50 years. Impairment of esophageal motility was induced by sildenafil, an inhibitor of phosphodiesterase type 5, that causes decreased contractions in distal esophageal smooth muscle, with no effect on striated muscle. High resolution impedance/manometry and transit perception after each swallow were evaluated after 10 swallows of liquid bolus and 10 swallows of solid bolus, in the sitting position, before and after oral ingestion of 50 mg of sildenafil.
Result(s): Sildenafil caused an increase in the frequency of failed contraction in distal esophagus after swallows of liquid (24.8% to 68.8%) and solid (43.4% to 82.2%) boluses, and in absence of distal liquid bolus transit (51.2% to 71.2%). Transit perception of both liquid (11.7% to 25.5% of swallows) and solid (48.1% to 60.3% of swallows) bolus increased with sildenafil. Esophageal transit perception of liquid bolus was associated with changes in distal

contractile integral, whereas solid bolus perception was associated with longer distal latency, and a decreased proximal contraction extension.
Conclusions (Including Clinical Relevance): Bolus transit perception through the esophagus is associated with esophageal motility changes, mainly a decrease in esophageal contractions.
These results contibuted to the understanding of transit perceptionin during swallows.
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The Effect of Attention on Swallowing in Healthy Individuals: An Exploratory Study

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Purpose: Cued swallows have faster swallow response times compared to spontaneously initiated swallows. It is unknown whether, in addition to cueing, further heightening awareness about swallowing impacts swallowing kinematics. The aim of this study was to determine whether attention to swallowing can modify swallowing physiology. We hypothesized that attentional cues would result in shorter swallow response times.
Method(s): 20 healthy adults participated in 2 conditions (2 days apart), during which they swallowed 60 thin boluses under VFSS (30 5 mL and 30 15 mL). In the Low Attention Condition, participants drank as they normally would while listening to white noise that masked noise from the C-arm and while viewing abstract artistic images on a monitor before them. In the High Attention Condition, participants first viewed a prerecorded VFSS while a research assistant provided a standardized, basic description of swallowing physiology. Then, written and verbal cues were provided about each bolus size, and as they drank, they watched a live VFSS video feed of their swallowing. The order of sessions was counterbalanced: 10 participants completed the Low Attention Condition first and 10 completed the High Attention Condition first. The 2 conditions were compared by mixed model analysis on the following outcome measures: (1) number of swallows per bolus, (2) swallow initiation relative to (a) barium that enters pharynx BEFORE base of tongue retraction and (b) barium that enters pharynx DURING base of tongue retraction, (3) duration of laryngeal vestibule closure, (4) duration to laryngeal vestibule closure, (5) duration to maximum hyoid elevation, (6) duration to UES opening, (7) pharyngeal transit time, and (8) duration of UES opening.
Result(s): High Attention swallows had the shortest swallow onset latencies for both swallow initiation measures (before and during retraction) ($p < 0.039$) and the shortest durations to maximum hyoid elevation ($p = 0.031$). No other measures were different.
Conclusions (Including Clinical Relevance): Directing attention to the swallow by verbal and visual cues can change the duration of certain events. There may be unique mechanisms for sensory and attentional modification of swallowing, and investigation in patients with dysphagia is warranted.
Relevant Financial Relationships: Rachel Mulheren: Nothing to Disclose | Wendy Liang: Nothing to Disclose | Carol Smith: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.
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Parents' Experiences of Feeding, Swallowing, and Nutrition in Children Receiving Palliative Care

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Purpose: Parents caring for children receiving palliative care due to life-threatening illnesses face tremendous stressors, including providing nutrition to their child. Very little is known about this experience or how parents manage nutritional needs amidst the uncertainty of the illness. The purpose of this study was to explore parents' experiences, including strategies employed to cope with stressors and manage the feeding, swallowing, and nutrition of their children.
Method(s): A qualitative descriptive design was used. Data was collected from 20 parents and 20 children. The parents (17 women) were aged 25–55 (mean 36). Children ranged from 11 days to 5 years (mean 15 months) with diagnoses including neurological conditions (6), congenital heart malformations (6), mitochondrial disorders (2), prematurity (8), and cancer (1). Data from parents: interviews, field observations, and levels of distress. Data from children was abstracted from their medical records. Analysis is ongoing. Interviews were transcribed and are being coded using open and process coding. Other data is being used to describe the sample and provide context.
Result(s):

(1) Guilt and grief are prominent for parents with feelings of failure as a parent. Distress levels were high related to the overall experience and the feeding, swallowing, and nutrition issues.
(2) Parents cope by normalizing their experiences, taking it day by day, and maintaining optimism.
(3) The projected trajectory of the child's illness affected the parents' experiences.
(4) Feeding and nutrition management included taking part in providing nutrition in the manner best for the child and finding alternative ways to nurture and bond with the child. Parents relied on support of family, other parents, and online groups. Good interprofessional communication was felt to be key to good care for the child.

Conclusions (Including Clinical Relevance): Having a child with a life-threatening illness, affecting the parent's ability to feed the child, is fraught with grief, high levels of distress, and difficulty achieving the parenting role. Over time parents adapt and modify their role. Parents expressed a need for additional support and training to manage their child's nutrition.
Health care professionals must take into account the emotional burden that parents experience. Services should be family-centered with support and training for parents.
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Establishing Reliability and Norms of Spinal Curvature Between Cervical Vertebrae Two and Four Using the Cobb Angle

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Purpose: The Cobb angle is a method historically used for quantifying the degree of spinal curvature for patients with scoliosis through evaluation of the full spinal cord and has been established as reliable in this context. However, by conducting measurements in ImageJ on lateral-view videofluoroscopy swallowing studies (VFSS), the Cobb angle can also reveal the degree of curvature of cervical vertebrae, which may have implications on swallowing function. Given that this measure may have utility in dysphagia research, the reliability of this measure and norms were the focus of the current study.
Method(s): VFSS from 19 healthy young adults (mean age: 32; range 22–45), 39 healthy older adults (mean age: 77; range 65–95) and 25 patients with dementia (mean age: 81; range 59–100) were retrospectively analyzed and the Cobb angle was measured between cervical vertebrae 2 and 4 on frames of laryngeal vestibule closure (LVC) and post-swallow rest. Two-way mixed intra-class correlation coefficients were calculated to establish reliability. Independent samples t-tests were used to compare the degree of curvature at each time point between healthy young and healthy old, and healthy old and dementia.
Result(s): Results revealed excellent levels of agreement within and across raters for frame of swallow rest, and fair to good levels of agreement for frame of LVC. Healthy younger adults had a mean angle of 5.8 $\pm$ 9.0 degrees at LVC and 7.7 $\pm$ 4.5 at swallow rest, whereas healthy older adults had a mean angle of 12.5 $\pm$ 9.0 degrees at LVC and 12.4 $\pm$ 9.7 degrees at rest. Patients with dementia had mean angles of 14.5 $\pm$ 7.9 degrees and 15.4 $\pm$ 8.2 degrees, respectively. Significant differences in the Cobb angle were found between the healthy young and old data at both time points, but no significant differences existed between the healthy old and dementia data.
Conclusions (Including Clinical Relevance): Consistent with the existing spinal cord literature, cervical vertebrae 2 to 4 appear to increase in curvature with age. With established reliability and norms for younger and older adults, the Cobb angle can now be used to determine the degree of spinal curvature in a variety of populations, specifically those where we might expect damage to or deterioration of the cervical spine. Future research should focus on determining the implications of lordotic and kyphotic cervical spines on swallowing function in different populations and in various swallowing postures.
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Characteristics of Sarcopenic Dysphagia: Measurement of Suprahyoid Muscle Activity Using Surface Electromyography

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Purpose: Sarcopenic dysphagia is a critical problem among older post-acute patients. Swallowing-related suprahyoid muscle activation patterns in patients with sarcopenic dysphagia are largely unknown. The purpose of this study was to characterize suprahyoid muscle activity in patients with and without sarcopenic dysphagia.
Method(s): Data were collected from 60 inpatients (30 male, 30 female) aged $\geq$ 65 years without specific diseases known to result in dysphagia. Sarcopenic dysphagia was diagnosed using the Asian criteria for sarcopenia and fiberoptic endoscopic evaluation of swallowing. Suprahyoid muscle activity was measured using surface electromyography (sEMG). Measurement parameters were swallowing event durations (swallow onset to peak amplitude time, peak amplitude to swallow end time, and total muscle activity) and peak amplitude during a 1-mL water swallow. sEMG parameters were compared between patients with sarcopenic dysphagia (n = 30) and those without sarcopenic dysphagia (n = 30). The diagnostic accuracy was assessed using the area under the receiver operating characteristic curve (AUC).
Result(s): Swallow onset to peak amplitude duration did not differ significantly between groups ($p = 0.159$). Patients with sarcopenic dysphagia showed significantly longer peak amplitude to swallow end time duration and total activity duration ($p < 0.001$) as well as significantly higher peak amplitude ($p < 0.001$). The AUCs were 0.94 for peak amplitude to swallow end time duration, 0.95 for total activity duration, and 0.75 for peak amplitude.
Conclusions (Including Clinical Relevance): Longer suprahyoid muscle activity duration and higher peak amplitude during swallowing may reflect sarcopenic effects on swallowing function in older adults. These results contribute to an enhanced understanding of the pathophysiology of sarcopenic dysphagia.
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Accuracy of the Brazilian Version of the DYMUS Questionnaire for the Assessment of Dysphagia in Multiple Sclerosis

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Purpose: Dysphagia is common in multiple sclerosis (MS) patients. Several studies show an increase of it's prevalence with the progression of the disease and in those with impairment on cerebellar, pyramidal and brainstem function systems. The early identification of dysphagia symptoms is necessary for the best referral of patients to specialized evaluations, identification of the risk of dysphagia and implementation of specific rehabilitation programs for the oral and pharyngeal swallowing impairment. In this study, we submit the Brazilian Portuguese version of DYMUS questionnaire (DYMUS-BR) to the last step of the validation process, and determine its sensitivity, specificity, positive and negative predictive values and accuracy in identifying dysphagia in MS patients.
Method(s): Data were collected from 30 MS patients (24 female), aged 18–70 (median 44) with or without complaints of swallowing problems. At the time of examination, all patients were asked whether they had swallowing problems, then irrespective of their responses, the DYMUS-BR and a videofluoroscopic swallow study (VFS) were performed.
Neurologic examinations were performed and quantified using the Kurtzke Functional Systems and Expanded Disability Status Scale (EDSS). To access the diagnostic accuracy of DYMUS-BR relative to VFS, a receiver operating characteristic (ROC) curve was created to calculate the area under the curve (AUC). The accuracy of the DYMUS-BR for detecting dysphagia were determined by the measures of sensitivity, specificity, predictive positive and negative predictive values.
Result(s): Most patients presented EDSS score ≥ 6. The MS patients had a median score of 1 on the DYMUS-BR. According to the initial self-assessment 37% of MS patients reported themselves as dysphagic. According to DYMUS-BR, 53% were classified as dysphagic and based on dysphagia severity, 23% and 30% had mild and alarming dysphagia, respectively. The AUC of the ROC curve for detecting dysphagia was 64%. The accuracy of the DYMUS-BR was 67%. The DYMUS-BR had a sensitivity, specificity, positive and negative predictive values of 50%, 78%, 60%, and 70% respectively. None of the participants aspirated on VFSS evaluation.
Conclusions (Including Clinical Relevance): The present study validates the Brazilian-Portuguese language version of the DYMUS questionnaire, a preliminary screening tool that can be used to identify the risk of dysphagia in patients with multiple sclerosis.
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Effects of Tongue Pressure Training Interventions on Swallowing Physiology: A Systematic Review

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Purpose: Decreased tongue pressure strength and endurance have been identified in patients with dysphagia. Tongue pressure training is commonly used for dysphagia rehabilitation; however, little is known about its impact on swallow physiology. This systematic review aimed to summarize the existing literature regarding changes in swallowing physiology following tongue pressure training, as characterized on videofluoroscopy (VFSS).
Method(s): Six databases were searched using standardized search terms for (1) the tongue, (2) swallowing, and (3) exercise. Only English peer-reviewed articles were eligible. 855 non-duplicate articles underwent abstract and title screening by two reviewers. Ten papers were judged to be relevant for inclusion in this review and underwent data extraction and quality assessment.
Result(s): The 10 articles included in the review described tongue pressure training interventions in a variety of patient populations and sample sizes, used different training protocols, and reporting different outcome measures, making it difficult to generalize results. The Iowa Oral Performance Instrument (IOPI) was the primary device used. Training with the IOPI yielded improved tongue strength across most of the studies identified. The Penetration–Aspiration Scale was the most commonly used VFSS outcome measure. However, VFSS protocols and stimuli varied, with mixed results for improved safety post-treatment. Measures of swallow efficiency were also collected, however, methods of measurement differed and most studies reported no statistically significant reductions in residue following training.
Conclusions (Including Clinical Relevance): Overall, the evidence regarding the impact of tongue pressure training as an intervention for oropharyngeal dysphagia is weak regarding improved swallowing safety and efficiency. Lack of a clear finding is likely due to differences in training protocols and outcome measurements across studies. Future investigations should focus on conducting instrumental evaluations and robust analyses following tongue pressure training to determine efficacy for treatment of dysphagia.
Relevant Financial Relationships: Sana Smaoui: Has affiliations to disclose; Toronto Rehabilitation Institute-– University Health Network: Salary/Stipend: Employment; University of Toronto -–

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The Safety and Efficacy of Endoscopic Zenker's Diverticulotomy: A Cohort Study

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Purpose: To determine whether the application of laser-assisted techniques for the treatment of Zenker's Diverticulum (ZD) would reduce the failure rate of endoscopic procedures without compromising safety or durability.
Method(s): We performed a single-institution review of 106 consecutive patients in whom endoscopic laser-assisted diverticulotomy (ELD) or endoscopic stapler-assisted diverticulotomy (ESD) was attempted. The Eating Assessment Tool (EAT-10) was collected pre- and post-operatively. Long-term follow-up was conducted on average 2.4 years post-operatively.
Result(s): The decision to use either ELD or ESD was made intra-operatively. An endoscopic procedure was successfully completed in 103 of 106 patients (97.2%). Eighty-three patients underwent ELD, 20 underwent ESD, and only 3 required use of an open approach. No serious complications occurred. Post-operatively there was a significant reduction in dysphagia symptoms. At follow-up, most individuals had dysphagia scores within the normal range (69%) and were eating a regular diet (73%). Fourteen patients (14%) required revision. Compared to historical data from our institution for ESD alone, the addition of ELD resulted in a reduction in the failure rate without an increase in serious complications. Recurrence rates and long-term outcomes were equivalent.
Conclusions (Including Clinical Relevance): Through careful patient selection, appropriate work-up, and judicious use of techniques, it was possible to perform endoscopic surgery in a majority of patients without serious complications. Both approaches resulted in short- and long-term symptom management with high levels of satisfaction.
Relevant Financial Relationships: Andrew Palmer: Has affiliations to disclose; OHSU: Salary/Stipend: Employment | Michelle Barton: Nothing to Disclose | Kara Detwiller: Has affiliations to disclose; OHSU: Salary/Stipend: Employment | Joshua Schindler: Has affiliations to disclose; OHSU: Salary/Stipend: Employment.
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The First 30 Years of Research in Dysphagia: A Scoping Review

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Purpose: To characterize primary data studies in the journal Dysphagia during its first 30 years of publication and to identify potential gaps in existing deglutology science.
Method(s): Full articles of primary research published in Dysphagia from its inception (Mar 1986) to Dec 2015 were systematically reviewed using a customized online database by trained clinicians. Data related to study characteristics was extracted according to a priori operationalized parameters, including: aim; design; and, subject population.
Result(s): There were 1,664 articles identified, with contact authors representing 35 countries. Of these, 1059 (64%) contained primary data, 351 (33%) citing funding. Observational studies (n = 733, 86%) had a median of 22 subjects (interquartile range [IQR] = 8, 70); experimental studies (n = 123, 14%) had a median of 23 subjects (IQR = 16, 45) and included 7 (6%) registered clinical trials. Primary data collection was completed primarily at single institutions (n = 664; 63%), multiple institutions 10% (n = 108), and using databases (n = 14; 1%); 26% (n = 273) were unclear. Of 1,09 studies with human participants, 58 (6%) were pediatrics only, 894 (88%) were adults only, and the remaining 20 (2%) were both. Of all studies, 35 (3%) included animals only and 3 (0.3%) combined humans and animals. Study focus varied as disease specific (n = 692, 69%) vs. normal function (n = 305, 31%). Common disease categories were neurological, 47% (n = 444), gastroenterological/hepatological, 22% (n = 210), and head and neck cancer, 14% (n = 137). The remaining 6 categories (i.e., pulmonary, cardiac, medicine, general oncology, rheumatology, orthopedics) comprised 17% (n = 160).
Clinical, basic, and engineering science comprised 72%, 19%, and 6% of all studies, respectively. Of these, 745 (70%) were prospective and 314 (30%) retrospective studies. The reported aims were: clinical assessment (n = 415, 39%), anatomy and physiology (n = 242, 23%) and health outcomes (n = 209, 20%). Engineering/computational modeling was least published (n = 29, 3%).
Conclusions (Including Clinical Relevance): The vast majority of studies are from single institutions, have sample sizes < 50, are observational, focused on adults, and largely concentrated on neurological diseases. Dysphagia is, however, prevalent across the age span and in many more diseases. Our findings suggest that as the field of deglutology continues to mature, it needs to expand in scope and align with these noted gaps.

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The Association Between Tongue Pressures and Anthropometric Measures, Physical Function and Muscle Strength

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Purpose: Age-related dysphagia is often attributed to sarcopenia, which is typically captured through reduced maximal isometric tongue pressures. In reality, swallowing is a sub-maximal task and sarcopenia is multifactorial. We explored the relationships between tongue pressures (maximal, swallowing) and anthropometric, physical function, and muscle strength measures.
Method(s): 54 community-dwelling older adults participated in a wellness visit (42 female, mean age = 80.0, SD = 6.7) to assess a) anthropometric measures (mid-arm muscle area, MAMA; mid-arm muscle circumference, MAMC; fat free mass index, FFMI); b) physical function (Short Physical Performance Battery, SPPB; sarcopenia questionnaire,
SARC-F) and c) muscle strength (Jamar hand dynamometer, dominant hand). Maximal anterior, maximal posterior and saliva swallow pressures were collected (Iowa Oral Performance Instrument) in triplicate and averaged. Height was measured using a portable stadiometer; weight with a Seca digital scale. MAMC and MAMA were calculated using triplicate measures of mid-arm circumference (Gulick II constant tension measuring tape) and triceps skinfold (Lange skinfold caliper). Body composition was measured via bioelectrical impedance analysis using the Quad Scan

4000 multifrequency analyzer (BodyStat). Lean tissue (kg) was determined and FFMI was calculated [fat mass, kg/(height, m)^2]. Partial correlations assessed the relationships between tongue pressures and these health measures while controlling for age.
Result(s): Maximal anterior pressure was significantly associated with all anthropometric and muscle strength measures: MAMC (R = .33, p = .02), MAMA (R = .34, p = .01), FFMI (R = .34, p = .02), grip strength (R = .29, p = .03) but not with physical function. Maximal posterior pressure was significantly associated with muscle strength: (R = .31, p = .03) and physical function: SPPB (R = .28, p = .04), SARC-F (R = − .31, p = .03). Swallow pressures were only associated with physical function: SPPB (R = .27, p = .048).
Conclusions (Including Clinical Relevance): Maximal anterior tongue pressures are associated with anthropometric measures and muscle strength, while maximal posterior pressures and saliva swallows are significantly associated with physical function. This finding suggests that desirable anthropometric measures may be associated with greater functional reserve in swallowing. Future investigations should explore measures of physical function and swallowing physiology.
Relevant Financial Relationships: Sonja Molfenter: Has affiliations to disclose; NYU: Salary/Stipend: Employment; NIH NIDCD: Grant: Other Activities | Kathleen Woolf: Has affiliations to disclose; New York University: Salary/Stipend: Employment; NIH: Contracted Research: Other Activities; US Dept of Agriculture: Contracted Research: Other Activities; Math for America: Consulting fee: Consulting.
Relevant Non-financial Relationships: Sonja Molfenter: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Board Membership; ASHA: Professional: Membership; ESSD: Professional: Membership | Kathleen Woolf: Has a Non-Financial Disclosure Affiliation; Academy of Nutrition and Dietetics: Professional: Membership; American College of Sports Medicine: Professional: Membership.

Hyposalivation and Xerostomia Post Head and Neck Cancer: Changes and Impact on Eating Over Time

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Purpose: Hyposalivation post head and neck cancer (HNC) care is a common deficit that negatively impacts eating. This prospective study examined changes in saliva weight and patient-reported xerostomia. Secondary aims explored associations between saliva weight and Quality of Life (QoL), perceived dysphagia severity, diet level and eating interference.
Method(s): Data were collected on 22 HNC patients (77% with oropharynx tumors) at baseline, weeks 2, 4 of treatment (TX) and 1, 3, 6 months' post chemo/radiotherapy (IMRT/parotid sparing). Saliva weight was measured using the Saxon Test. The Head and Neck Patient Symptom Checklist (HNSC) assessed patient-reported xerostomia and eating interference. Perceived dysphagia severity and normalcy of diet were rated using the EAT-10 and Performance Status Scale (PSS). QoL was assessed with the FACT-HN. Changes over time were analyzed as repeated measures and associations computed with Spearman correlations.
Result(s): Statistically significant ($p < 0.05$) changes from baseline occurred on all measures without return to baseline at 6 months.

Saliva loss began early at TX week 2 without return to baseline at 6 months. QoL was lower at all timepoints compared to baseline. Largest mean changes were seen at TX week 4 [saliva weight (-3.4 mL), QoL (-30), FACT/xerostomia (-2.3), HNSC/eating interference (1.8), EAT-10 (13.6), PSS (-46)]. The strongest correlations with saliva weight were evident with EAT-10 at 2 weeks TX (-0.66), 3 months post TX (-0.57), and 6 months (-0.66).

Conclusions (Including Clinical Relevance): Saliva loss post-HNC care was an early and ongoing influencing factor on dysphagia severity and normalcy of diet, and negatively impacted oral intake. Hyposalivation symptom management is essential and may lessen saliva loss contributing to improved QoL and eating during and post-treatment. Further investigations and advances in HNC management are needed to reduce the negative impact of hyposalivation on patient's functional outcomes.

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Characterizing the Physiology of Swallowing Following Spinal Cord Injury

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Purpose: Dysphagia is an expected complication following spinal cord injury (SCI), with one cause being vagal nerve damage during surgical intervention. The purpose of this study was to characterize swallowing physiology in individuals with SCI during subacute rehabilitation. We explored differences in timing and kinematic measures of swallowing.

Method(s): A standard videofluoroscopy was performed in 10 individuals undergoing rehabilitation for a spinal cord injury (C1-T6 injury level, AIS A-D) with functional swallowing (i.e., no diet texture restrictions). Control data for 10 age and sex matched healthy adults were abstracted from a prior dataset. Participants swallowed liquid stimuli ranging from thin to extremely thick consistency, as per the International Dysphagia Diet Standardisation Initiative. Detailed frame by frame analysis was performed by two blinded raters; discrepancies were resolved by consensus. Timing measures and pixel-based measures of maximum UES diameter and pharyngeal constriction area were compared between the SCI and non-SCI groups.

Result(s): All swallows were rated as safe (i.e. Penetration–Aspiration Scale scores < 3). Repeated measures analysis of variance revealed significantly longer laryngeal vestibule closure reaction times in the SCI group ($p < 0.05$). In addition, the SCI group demonstrated significantly shorter laryngeal vestibule closure durations ($p < 0.05$). There were no significant differences in measures of swallow reaction time, pharyngeal phase duration, or UES opening duration, and no differences in pixel-based measures of UES opening diameter or pharyngeal constriction.

Conclusions (Including Clinical Relevance): These data suggest the SCI group presented with differences in airway protection during swallowing, even when they had recovered to the point where diet texture restrictions are no longer required. Longer laryngeal vestibule closure reaction times and shorter laryngeal vestibule closure durations were observed, even in the context of safe swallows. These differences represent an increased risk for airway invasion.

Although SCI patients may be clinically assessed and cleared to resume a regular diet, patients should receive education regarding their increased risk of aspiration with oral intake of liquids.

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Comparing Hydration Levels of Long Term Care Residents on Thickened Liquids and Regular Liquids

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Purpose: The purpose of this research was to use laboratory and non-laboartory data to assess hydration/dehydration levels in the frail long-term care residents on regular and nectar thick liquids.
Method(s): The participants consisted of 22 long-term care residents divided into two groups (Regular Liquids and Thickened liquids). Laboratory measures (basic metabolic panel (BMP), urinalysis, complete blood count (CBC), glucose, urine and/or blood osmolality) and non-laboratory measures (urine output, nursing assessment of dryness of skin and mucous membranes, skin turgor, respiratory rate, heart rate, blood pressure, weight and fluid intake) were analyzed and compared.
Result(s): Based on a general linear model (GLM)/analysis of variance (ANOVA) performed for each variable, the results indicated that there were no significant differences in hydration levels between these two groups of residents. Analyzes of the laboratory and non-laboratory data found that nursing assessment of dehydration signs was not significantly different for all residents in both groups, when the beginning and the end of the trial were compared. Nursing notes in the medical record indicated no signs and symptoms of dehydration.
Conclusions (Including Clinical Relevance): This study did not find any significant difference in hydration level between two groups of residents, one taking nectar thick liquids and the other one taking regular liquids. This finding is in contrast with the belief of many clinicians, medical staff or family members that residents on thickened liquids become dehydrated. As suspected, long-term care residents may become dehydrated regardless of the consistency of fluids consumed, and that dehydration is multifactorial. All professionals involved in the care of long-term care residents must account for all possible causes of dehydration and not just the amount of fluid they intake. While the results indicate no difference in hydration levels between the two groups of residents, for the future, researching a larger sample size over a 6 week period, may provide additional information on this topic.
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Feasibility of a Neural Network in Predicting Aspiration Severity Post Supratentorial Stroke

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Purpose: The objective was to examine the feasibility of an artificial neural network in predicting aspiration severity post supratentorial stroke. Such networks can aid in the complex nature of aspiration risk assessment by providing rapid decision support based on simultaneous non-linear processing of multiple patient data inputs.
Method(s): As part of a larger study, 29 patients with supratentorial stroke were recruited over 6 months from the stroke unit of a rehabilitation hospital. Patients were excluded if they had infratentorial stroke, reduced alertness, active respiratory disease, tracheostomy, or were medically fragile. Participants completed a VFSS and Penetration–Aspiration Scales (PAS) scores were rated blindly for all consistencies.

For the development of a pilot 3-layer feedforward neural network with one hidden layer of 10 nodes, the Neural Network Fitting Tool of the Mathworks MATLAB® (version 2013b) Neural Network Toolbox was used. The input layer consisted of 13 predictor variables derived from patients' charts: age, sex, time of VFSS post onset, side and site of lesion (frontal, parietal, occipital, temporal, basal ganglia, corona radiata, thalamus, internal capsule), and NIH Stroke Scale score. The output layer consisted of a cumulative PAS score, i.e., the sum of all PAS scores across boluses.

The Levenberg-Marquardt backpropagation optimization method was used. Of the 29 patient data, 17 (60%) were randomLy used for the training and learning phases of the network (step 1), 6 (20%) for system validation (step 2), and 6 (20%) for testing (step 3). Network performance was evaluated using two measures: (i) mean squared error (MSE), i.e., the average squared difference between actual and predicted outputs, and (ii) regression coefficient R values, related to how well the actual and predicted outputs correlate.
Result(s): For step 1 the values were MSE = 0.0003 and R = 0.955, for step 2 MSE = 0.0039 and R = 0.815, and for step 3 MSE = 0.0005 and R = 0.830.The low MSE values and the high R values during all steps, indicate the good predictability of the pilot network.
Conclusions (Including Clinical Relevance): We showed the feasibility and good predictability of a pilot neural network in predicting aspiration severity in supratentorial stroke. Adding more data to the model has the potential to further improve its performance, resulting in a powerful diagnostic and learning aid.
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Comparison and Calibration Guide for Six Respiratory Muscle Strength Devices for Patients and Clinicians

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Purpose: Respiratory muscle strength training is used for effective treatment of airway protection and swallowing. Respiratory devices propose to strengthen muscles (inspiratory and/or expiratory) by imposing opposition to respiratory air. There are two basic device types: (A) Adjustable-Force Threshold-Includes an adjustable-force spring-loaded valve requiring a specific pressure to open the valve to initiate air flow; (B) Adjustable-Aperture-Includes an adjustable-sized opening to limit air flow. For each device type, lack of precise calibration settings limits a clinician's ability to develop specific goals and measurable treatment targets for various clinical populations. Our goal was to map how adjustments to each device related to measurable pressure loads provided by each device.
Method(s): We measured the load pressure required to initiate air flow at each setting of 6 different commercially available devices including EMST 150, Respironics IMT, Power Lung (each are adjustable-force threshold devices); Breather, Eolos, ExpandALung (each are variable-aperture devices). We tested 5 of each device (30 devices total), testing each device twice. We tabulated/plotted each device setting by measured valve opening pressure (cm H2O) and air flow onset (cc/sec). For example, there were 240 total measurements for the EMST 150.
Result(s): Adjustable-Force Threshold Devices: We found a consistent positive linear relationship between each settings and the exercise pressure load required to initiate air flow. Until the threshold pressure was reached, air flow remained zero.
For Adjustable-Aperture Devices: Air flow could be initiated even at very low pressures. However, there was a modest positive linear relationship between each setting and the resistance (pressure/air flow) of the device to oppose air flow. However, resistance remained modest, suggesting that exercise load would also remain relatively modest.
Conclusions (Including Clinical Relevance): This work resulted in a set of calibration reference guides that provide the load pressure (or resistance) for 6 different respiratory muscle strength training devices. The results also highlight the differences between the two primary types of devices. These findings and the resulting calibration guides will enable clinicians to develop more specific goals and measurable treatment targets, and to thoughtfully select devices that are appropriate for their clinical goals.
Relevant Financial Relationships: Michael Hammer: Nothing to Disclose | Kayla Foster: Nothing to Disclose.
Relevant Non-financial Relationships: Michael Hammer: Nothing to Disclose | Kayla Foster: Nothing to Disclose.

High-Resolution Pharyngeal Manometry in Pediatric Populations: A Systematic Review

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Purpose: High-resolution pharyngeal manometry (HRPM) objectively measures pressures in the pharynx during swallowing, contrasting with more-subjective analysis of videofluoroscopy and endoscopy. Recently, the role of HRPM in pediatric swallowing has been investigated. Implementation of pediatric HRPM in clinical practice remains challenging due to a lack agreement on which measures to take, how to take them, and normative values. The purpose of this study was to systematically review peer-reviewed literature on HRPM in pediatrics to describe common measures, protocols, and to synthesize normative data.
Method(s): A multi-engine electronic search was conducted on 6/5/17 and updated on 6/11/18 in accordance with standards published by the Preferred Reporting for Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA). Full-text articles were included if they reported high-resolution manometric data from the pharynx and upper esophageal sphincter (UES) in subjects aged 0–17 years. The query was conductedwith terms related to "high resolution", "manometry" and "pediatrics."
Result(s): The search yielded 367 articles; following screening of abstracts and titles, 216 full text articles were inspected and 30 reviewed in full. Thirteen met inclusion criteria. Case Controls and Case Series were the most common study types. Across studies, more than 25 HRPM measures were reported. The most frequent were pharyngeal peak pressure (PP) and UES resting pressure. Studies varied in age, diagnostic population, protocol, and level of detail provided in measure definitions. Subsequently, results of measures taken varied widely. In nondysphagic populations across ages, measures of central tendency for PP ranged from a mean of 22 to a median of 165 mmHg, and for UES resting pressure from a mean of 13 to a median of 55.2 mmHg. HRPM often differentiated groups with and without dysphagia.
Conclusions (Including Clinical Relevance): HRPM in pediatric populations is valuable in objectively describing swallowing function, and has the potential to contribute significantly to decision-making in dysphagia management. Measures, methods and normative data are inconsistent between studies. There is a need for definition of standard measures that should be obtained during HRPM, and for normative data for interpretation of these measures specific to age and diagnostic population.
Relevant Financial Relationships: Jesse Hoffmeister: Has affiliations to disclose; UW Health: Salary/Stipend: Employment; NIH, NIDCD T32 DC009401: Grant: Other Activities | Maia Braden: Has affiliations to disclose; University of Wisconsin Medical Foundation: Salary/Stipend: Employment | Courtney Broadfoot: Has affiliations to disclose; NIH, NIDCD T32 DC009401: Grant: Other Activities | Christopher Hooper-Lane: Has affiliations to disclose; University of Wisconsin-Madison: Salary/Stipend: Employment | Corinne Jones: Nothing to Disclose | Susan Thibeault: Has affiliations to disclose; NIH, NIDCD: Grant: Other Activities.
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Relationship Between Swallowing Frequency and Swallowing Function in Cerebral Palsy Patients with Severe Intellectual and Physical Disabilities

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Purpose: In cerebral palsy (CP) patients with severe intellectual and physical disabilities, aspiration pneumonia caused by a decreased

swallowing function is an important issue related to prognosis. Thus, it is important to detect the presence or absence of aspiration by evaluating the swallowing function, and to take appropriate measures to prevent aspiration pneumonia. However, in previous studies on CP cases we showed that there is a discrepancy between the presence of aspiration at examination and the onset of pneumonia; therefore, it may be useful to not only detect the presence or absence of aspiration by using FEES or VFSS, but also to predict any decrease in the swallowing function based on physiological phenomena. Since swallowing is an aspiration protection mechanism to enable the processing of bolus food, saliva and secretions from the pharynx to the esophagus, the frequency of swallowing may be an indicator of swallowing function. However, the relationship between swallowing frequency and swallowing function in CP patients is not clear; therefore, we measured the swallowing frequency of CP patients in daily compared the results based on differences in food intake methods.

Method(s): Fifty CP patients were included (mean age 44.4). We compared the swallowing frequency of 30 patients who ingested food orally (group O) and 20 patients who were fed via tube feeding due to repeated aspiration pneumonia (group T). In addition, group O was divided into two groups: An oral intake group (group O1) and a partly oral intake group (group O2), and swallowing frequency was compared among group O1, group O2, and group C. Measurements of swallowing frequency were performed using a laryngeal microphone. This measurement was set to one hour during daily life.

Result(s): The mean swallowing frequency in group T (8.9 ± 10.3) was significantly lower than that in group O (29.2 ± 26.6) ($p < 0.001$). There was no significant difference in the mean swallowing frequency between group O1 (30.1 ± 26.5) and group O2 (27.4 ± 28.1), whereas the group C frequency was significantly lower than group O1 and group O2 (vs group O1; $p < 0.01$, vs group O2; $p < 0.05$).

Conclusions (Including Clinical Relevance): These results suggest that in CP patients with severe intellectual and physical disabilities, reduced swallowing frequency is associated with a decreased swallowing function. As a result, swallow frequency may be a useful indicator of aspiration risk.

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Determining ICU practice patterns for oral intake reinitiation following tracheostomy: Survey development and validation

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Purpose: Following critical illness, dysphagia occurs in the majority of patients with tracheostomy (Macht et al, 2011). Reinitiating oral intake following tracheostomy is a complex process involving teams of professionals that vary across intensive care units (ICU) while using an array of assessment strategies to determine patient readiness. To explore this, our aim was to develop and validate an ICU practice pattern survey regarding oral intake commencement following tracheostomy in adults.

Method(s): We developed our survey through a multi-step iterative process with each step being followed by a consensus panel revision. Initially, item generation was guided by a content specific scoping review and an expert consensus panel. Our provincial evaluation department then evaluated and revised survey semantics and response metrics. To assess face and content validity, we disseminated our revised survey and structured feedback form to expert clinical raters from multiple professions at a university teaching hospital via RedCap. We stratified their feedback according to the themes which emerged from the data and made the final revisions. Results are summarized descriptively.

Result(s): Five acute care dysphagia experts (speech-language pathologists) comprised the consensus panel and developed the 14-item survey. Feedback was requested from 42 professionals across 5 disciplines. Twenty-four (57%) individuals responded to the survey questions and of those, 20 (4 dietitians, 4 nurses, 4 nurse practitioners, 3 occupational therapists, 5 physicians) provided feedback. The primary work setting for 90% of the respondents was the ICU. Questions were rated highly (strongly agree or agree) across multiple domains including: appropriateness (92%), understandability (90%) and response generation ease (86%). Following feedback, the primary theme was to improve clarity on 4 items. We made fifteen unique changes including: 8 (50%) sub-item additions, 4 (25%) parsing of survey items, and 4 (25%) semantic changes, resulting in an 18-item survey.

Conclusions (Including Clinical Relevance): A comprehensive methodology enabled us to design and create a valid survey and successfully pilot an efficient dissemination process for interprofessional respondents and multi-site distribution.

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Affection of Chewing Muscles in Patients with OPMD

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Purpose: Oculopharyngeal muscular dystrophy (OPMD) is a rare late onset progressive neuromuscular disease, with ptosis and dysphagia as the most common features. While the dysphagia is characterized by pharyngeal complaints, some patients also report difficulty with chewing of food. As part of a larger study we aimed to investigate muscle abnormalities of four chewing muscles (tongue, masseter,

temporalis, and pterygoid muscle) and to relate these to clinical chewing measurements.
Method(s): Forty-eight genetically confirmed OPMD patients (25 women, mean age 61, SD 8.6) participated. Thirteen participants (27%) reported chewing problems on a questionnaire of which 2 were unable to chew solid food at all. Quantitative muscle ultrasound (QMUS) measuring absolute echo intensities (AEI) was used to quantify fatty infiltration of the tongue, masseter and temporal muscles, where z-scores > 2 were considered abnormal. MRI was used to quantify fat fractions (FF) of the tongue, pterygoid and masseter muscles, where FF $> 10\%$ was considered abnormal. Clinical tests included maximum isometric tongue pressure (MITP), maximum bite force (MBF) and maximum chewing time (MCT, as part of the Test Of Mastication And Swallowing Solids). Correlations were calculated between the AEI, FF and clinical measurements in patients with and without chewing problems.
Result(s): Overall the chewing muscles were often affected in OPMD patients: the FF was increased in 96% of patients for the tongue, 40% for the masseter 27% for the pterygoid muscle. Abnormal AEI was found in the tongue in 42%, in the temporal muscle in 23% and in the masseter muscle in 15% of patients. MITP correlated strongly with FF and AEI of the tongue ($r = .76$, $p = .00$; $r = .63$, $p = .00$). MBF only correlated significantly with the FF of the pterygoid muscle ($r = .48$, $p = .00$). No correlations were found between the MCT and the FF and AEI of any muscle. Patients with chewing problems scored less on all measurements, but only MBF was significantly lower: 8 kg compared to 16 kg ($p = .00$).
Conclusions (Including Clinical Relevance): This study demonstrates fatty infiltration not only in the tongue, but also in the jaw muscles of people with OPMD. Although people with chewing complaints only differ from those without regarding bite force, this suggests justification of attention for biting and chewing problems in OPMD.
Relevant Financial Relationships: Hermina Kroon: Nothing to Disclose | Corinne Horlings: Nothing to Disclose | Bert de Swart: Nothing to Disclose | Baziel van Engelen: Nothing to Disclose | Johanna Kalf: Nothing to Disclose.
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Pharyngeal Residue in Oculopharyngeal Muscular Dystrophy (OPMD) is Not Consistency-Dependent

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Purpose: Oculopharyngeal muscular dystrophy (OPMD) is a rare late onset progressive neuromuscular disorder, characterized by pharyngeal dysphagia. Patients' typical complaint is solid food getting stuck in their throat. Our aim was to better understand this complaint by comparing videofluoroscopic images of various consistencies with clinical measurements and MRI of the tongue.
Method(s): Forty-eight genetically confirmed OPMD patients (25 women, mean age 61, SD 8.6) participated. Videofluoroscopy ($n = 45$) was performed at 30 frames per second with thin liquid (10 mL, 20 mL), thick liquid (10 mL, 20 mL), solid food (cracker). We used the Penetration–Aspiration Scale (PAS, ≥ 3 unsafe) to identify swallowing safety and the Normalized Residue Ratio Scale (NRRS, abnormal values: NRRS_v $\geq .09$, NRRS_p $\geq .20$) to analyze post swallow residue (ImageJ). Scores were compared to the MRI fat fraction of the tongue (FF), maximum isometric tongue pressure (MITP) and maximum swallowing speed (MSS).
Result(s): Unsafe swallowing (PAS ≥ 3) was seen in 19% of participants swallowing thin liquid. Abnormal residue in the valleculae was seen in 53% of patients swallowing 10 mL thin liquid, in 71% with 20 mL thin liquid, in 69% with 10 mL thick liquid, in 82% with 20 mL thick liquid and in 64% with solid food. Abnormal residue in the pyriform sinus was seen in 58% after swallowing 10 mL thin liquid, in 69% with 20 mL thin liquid, in 51% with 10 mL thick liquid, in 48% with 20 mL thick liquid and in 24% with solids. Only one pre-symptomatic patient had no residue at all. Vallecular residue significantly correlated with FF of the tongue (thin 20 mL, solid), MITP (solid) and MSS (thin 20 mL), with correlation coefficients ranging from $r = -.34$ to $r = .48$. Pyriform sinus residue significantly correlated with FF of the tongue (thin, thick, solid), MITP (thin, thick), and MSS (thin, thick), ranging from $r = -.34$ to $r = .62$.
Conclusions (Including Clinical Relevance): In OPMD, pharyngeal residue (up to 69% of patients) is a much larger problem than aspiration (19%), now confirmed in a large cohort. Moreover, pharyngeal residue is not only highly prevalent with solid food, but also with thin and thick liquids. FF of the tongue and MITP correlate with residue of all consistencies, where MSS correlates with liquid residues, suggesting that reduced tongue strength and reduced swallowing speed may imply residue of food including liquids, with consequences for treatment.
Relevant Financial Relationships: Hermina Kroon: Nothing to Disclose | Corinne Horlings: Nothing to Disclose | Bert de Swart: Nothing to Disclose | Baziel van Engelen: Nothing to Disclose | Johanna Kalf: Nothing to Disclose.
Relevant Non-financial Relationships: Hermina Kroon: Nothing to Disclose | Corinne Horlings: Nothing to Disclose | Bert de Swart: Nothing to Disclose | Baziel van Engelen: Nothing to Disclose | Johanna Kalf: Has a Non Financial Disclosure Affiliation; DRS: Professional: Membership; ESSD: Professional: Membership.

Effects of Tongue Exercise Dose on Tongue Force and Bolus Flow Rate in a Rat Model

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Purpose: The optimal dose of tongue exercise to achieve maximum benefit is not known. Clinical research protocols include a range of dose recommendations, however, many of these procedures are based on studies of limb muscle, which differ in structure and function from muscles of the head and neck. If smaller doses are equally efficacious to larger doses, there could be positive implications for treatment burden reduction, increased adherence, and reduced health care costs.
Method(s): In this study, 50 rats (27 old, 24 young adult) were randomized into one of 4 conditions: 1 day, 3 days, 5 days/week exercise, or sham exercise. During 8 weeks of tongue exercise, rats were trained to press their tongues against a disk at a set resistance for $\sim$ 100 presses/training day. Tongue force and swallowing characteristics (via VFSS) were compared pre and post training.
Result(s): For tongue exercise, change in tongue force was significantly affected by exercise dose ($F = 35.6$, $p < 0.001$). Compared to sham condition, tongue forces were increased at all three exercise

doses, regardless of age. However, 5 days/week of exercise resulted in greater change in tongue force after 8 weeks of exercise than 1 and 3 days ($p = 0.001$), which were not statistically different from one another ($p = 0.25$). For bolus flow rate, there was an interaction effect between age and exercise ($F = 5.4$, $p = 0.003$). Post hoc comparison with a Tukey correction indicated that old exercise animals had the greatest increase in bolus flow rate after 5 days/week of exercise as compared to all other conditions.

Conclusions (Including Clinical Relevance): Findings show 5 days/week of exercise result in significantly increased tongue force and bolus flow rate as compared with smaller doses. These data suggest that more days/week of tongue exercise result in greater change from baseline. However, biological effects these different training doses are not yet known. Extrinsic tongue muscle tissues were collected at the end of this study and are being analyzed to further delineate the effects of these varied doses at the biological level.

To translate these findings to evidence based practice, it is important to design human clinical trials examining tongue exercise dose as a function of number of days of exercise, repetitions of tongue press, and force intensity. Based on the findings of this study, more exercise days result in greater change from baseline in force and possibly bolus flow rate.

Relevant Financial Relationships: Brittany Krekeler: Has affiliations to disclose; University of Wisconsin- Madison: Salary/Stipend: Employment | Jacqueline Weycker: Nothing to Disclose | Nadine Connor: Has affiliations to disclose; University of Wisconsin-Madison: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Brittany Krekeler: Nothing to Disclose | Jacqueline Weycker: Nothing to Disclose | Nadine Connor: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership.

Physiological Compensation for Advanced Bolus Location at Swallow Onset in Healthy Seniors

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Purpose: Delayed initiation of the pharyngeal swallow has been repeatedly reported in aging populations. While a lower bolus location at swallow onset (BLSO) raises concern for the possibility of bolus being adjacent to an open airway, and is often cited clinically as a cause of aspiration, advanced BLSO alone is not correlated with increased safety risk (Stephen et al, 2005; Martin-Harris et al, 2007). Our primary goal was to examine whether healthy seniors systematically alter their laryngeal vestibule closure reaction time (LVCrt) to maintain a safe swallow in the context of advanced BLSO. The secondary goal was to determine if longer LVCrt distinguished Penetration–Aspiration scale (PAS) scores of 1 versus 2.

Method(s): Videofluoroscopies from 41 healthy seniors (19 male, mean age = 76.9, SD = 7.2) were analyzed. LVCrt was calculated for 3x5 mL and 3x20 mL thin liquid barium boluses per participant. LVCrt represents the number of frames between onset of brisk anterior-superior hyoid movement and onset of laryngeal vestibule closure (LVC). Frames were converted to milliseconds (ms). PAS (Rosenbek et al, 1996) and BLSO (Martin-Harris et al, 2008) were scored for all swallows. Reliability (ICC > 0.7) was established on all measures. A linear mixed effects regression was run to examine the effect of PAS and BLSO on LVCrt while controlling for bolus volume and trial.

Result(s): BLSO scores distribution was: 0 = 34.9%, 1 = 25.9%, 2 = 14.3%, 3 = 24.9%. PAS scores distribution was 1 = 64.6% and 2 = 35.4%. There was a main effect of BLSO ($F = 6.6$, $p < 0.001$) and PAS ($F = 21.8$, $p < 0.001$) on LVCrt. Post-hoc pairwise comparisons revealed that LVCrt was significantly faster in BLSO scores of 2 (192 ms) and 3 (148 ms) compared to scores 0 (274 ms) and in scores of 3 (148 ms) compared to 1 (269 ms). Significantly prolonged LVCrt was observed in PAS scores of 2 (271 ms) in comparison to 1 (169 ms). No significant main effects of bolus volume or trial, or interactions, were observed.

Conclusions (Including Clinical Relevance): Our findings suggest that healthy seniors compensate for advanced BLSO by increasing their LVCrt. Further, faster LVCrt was shown to distinguish PAS scores of 1 versus 2. This work provides preliminary support for the use of interventions targeting LVCrt in individuals with compromised swallow safety, secondary in part to delayed swallow onset. Additional work should explore the relationship between LVCrt, BLSO and PAS scores in dysphagic populations.

Relevant Financial Relationships: Erica Herzberg: Has affiliations to disclose; NYU Steinhardt: Contracted Research: Independent contractor (Including contracted research); NYU Langone: Salary/Stipend: Employment | Danielle Brates: Has affiliations to disclose; NYU: Contracted Research: Independent contractor (Including contracted research) | Sonja Molfenter: Has affiliations to disclose; NYU: Salary/Stipend: Employment; NIH NIDCD: Grant: Other Activities.

Relevant Non-financial Relationships: Erica Herzberg: Nothing to Disclose | Danielle Brates: Nothing to Disclose | Sonja Molfenter: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Board membership.

Longitudinal Effects of Preterm Birth on patterns of Respiration in Infant Pigs

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Purpose: Preterm (PT) birth affects breathing and swallowing patterns in human infants. However, the individual relationships between PT birth and (1) quiet respiration, (2) anesthetized respiration, and (3) respiration while feeding are unclear. Using our validated model of infant pigs, we tested how PT birth impacted respiration using 4 PT and 4 term (T) infants delivered by c-section. We hypothesized that PTs would have both longer inspiration phases and respiratory cycles than Ts.

Method(s): Using respiratory inductance plethysmography, we measured inspiration phase and respiratory cycle lengths (1) at rest, (2) under anesthesia, and (3) while using VFSS and feeding simultaneously at comparable chronological ages for PT and T pigs.

Result(s): We found no effect of age (up to 13 days) on quiet respiration. PT infant pigs had longer inspiration phase lengths at rest and under anesthesia. Respiratory cycle lengths were longer for PT pigs in quiet respiration, but not under anesthesia. There was no significant difference in respiration rate between PT and T pigs while feeding. PT pigs had more variable respiration than T pigs, although variation in cycle length was similar between groups under quiet respiration. PT pigs had less variable respiration rates than T pigs while feeding.

Conclusions (Including Clinical Relevance): Since pig lungs are matured by 90% gestation, we propose that the effects of PT birth on respiration can be attributed to a less mature CNS. Our results will serve as a baseline for further research determining the impact of other aerodigestive problems endemic to prematurity.

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Relevant Non-financial Relationships: Katherine Wu: Nothing to Disclose | Laura Bond: Nothing to Disclose | Bethany Stricklen: Nothing to Disclose | Francois Gould: Nothing to Disclose | Christopher Mayerl: Nothing to Disclose | rz german: Nothing to Disclose.

Mechanisms of Perceived Swallow Change Post Whiplash: Potential for a Muscle Tension Component?

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Purpose: Although non-specific self-reports of dysphagia have been reported in a wide-range (10–60%) of individuals with chronic Whiplash Associated Disorder (WAD) following motor vehicle collision (MVC), little is known about mechanisms contributing to these perceived changes in swallowing. Alterations in pharyngeal dimensions on Magnetic Resonance Imaging (MRI), along with heightened levels of stress, pain and changes in stress-dependent micro-RNA expression (miR-320a) have been associated with WAD. This study reports patterns observed in a case series of 3 patients with swallowing changes associated with chronic WAD compared to 3 nominating full-recovery, to highlight potential contributing factors to swallow change, as a foundation for larger-scaled studies.
Method(s): Six cases were selected for detailed analysis from a separate parent study that demonstrated extreme presentations of chronic and recovered whiplash, with and without self-reported change in swallowing, < 1 week and 3 months post MVC. 3D MRI representing all regions of pharyngeal anatomy (P) and upper oesophageal sphincter (UE) was performed at both time points and P-UE volumes measured. Blood samples were taken within 1-week of injury, where total RNA was isolated to investigate the expression of miR-320a. Patient-reported traumatic distress was investigated using the Traumatic Injury Distress Scale (TIDS). Data were qualitatively triangulated using a radar plot with 6 domains.
Result(s): In the 3 patients with chronic WAD and reported changes in swallowing following injury, all had smaller P UE volumes within $<$ 1-week post injury, indicating a moderate effect size (Cohen's $d = 0.89$). Lower levels of miR-320a $<$ 1-week post injury (Cohen's $d = 2.02$) also demonstrated a large effect size. At 3-months post-MVC, P-UE volume difference between groups indicated a large effect size (Cohen's $d = 1.19$). TIDS scores were elevated in all 3 chronic individuals at both time points, in comparison to the recovered group. No inferential statistics were performed due to group size.
Conclusions (Including Clinical Relevance): Larger scaled investigations are warranted to determine factors contributing to self-reported change in swallowing for individuals with chronic WAD and to what extent altered pharyngeal dimensions, increased microRNA expression and high traumatic distress may help predict those with findings consistent with muscle tension-based swallow changes.
Relevant Financial Relationships: Danielle Stone: Nothing to Disclose | Hans Bogaardt: Nothing to Disclose | Sarah Linnstaedt: Nothing to Disclose | Bonnie Martin-Harris: Has affiliations to disclose; Northern Speech Services through agreement with Northwestern University: Intellectual property rights:Ownership; inventors: Shuai Xu, Kun Lee, Angela Roberts, Bonnie Martin-Harris, John Rogers: Hold Patent on equipment:Ownership; Northwestern University: Salary/Stipend: Employment; Veteran's Administration: Salary/Stipend: Employment | Andrew Smith: Nothing to Disclose | David Walton: Nothing to Disclose | Elizabeth Ward: Has affiliations to disclose; The Uni of Qld: Salary/Stipend: Employment; Queensland Health: Salary/Stipend: Employment; Plural Publishing: Royalty: Other Activities | James Elliott: Has affiliations to disclose; National Institutes of Health: Grant: Employment; JOSPT: In kind: Board membership; Kaiser Permanente-Northern California: Honoraria: Teaching and speaking; OSF-Peoria, IL: Honoraria: Teaching and speaking; Medbridge: Royalty: Teaching and speaking.
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Are HRCA Signal Features Associated with Clinician Ratings of Pharyngeal Residue Using the MSBImp?

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Purpose: Pharyngeal residue is pre-swallow secretions and/or post-swallow food residue in the valleculae, pyriform sinuses, or both. Pharyngeal residue can lead to aspiration and decisions to alter oral

intake that can decrease quality of life. The MBSImP is a widely used clinical tool to rate physiological aspects of swallowing including pharyngeal residue, but requires x-ray images which expose patients to radiation. High resolution cervical auscultation (HRCA) may provide an alternative, non-invasive option for predicting residue. HRCA uses acoustic and vibratory signals during swallowing to provide information about physiological events. This study examined whether HRCA signal features are associated with the presence or absence of pharyngeal residue using the MSBImP. Our hypothesis is that HRCA signal features will be associated with pharyngeal residue.
Method(s): 98 patients underwent videofluoroscopy. Trained raters scored the pharyngeal residue component of the MBSImP on 201 swallows. MBSImp ratings were categorized into "non-disordered" (scores 0–1) and "disordered" (scores 2–4). A generalized estimating equation (GEE) model was used to determine whether HRCA signal features were associated with the presence or absence of pharyngeal residue based on categorized MSBImp ratings.
Significance level was set at $p < .05$.
Result(s): The GEE model indicated that two signal features were independently and significantly associated with residue from pudding ($p < .05$). Three signal features were independently and significantly associated with residue from thin liquid ($p < .05$). Six independent variables (i.e. signal features and sex) were independently and significantly associated with residue regardless of thin or pudding consistency ($p < .05$).
Conclusions (Including Clinical Relevance): This study found that there is a significant association between HRCA signal features and pharyngeal residue for thin and pudding viscosities. This is considered an important and necessary first step toward developing an alternative, non-invasive clinical tool for predicting pharyngeal residue without imaging.
Relevant Financial Relationships: Aliaa Sabry: Nothing to Disclose | Amanda Mahoney: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Independent contractor (Including contracted research) | Subashan Perera: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Independent contractor (Including contracted research) | Ervin Sejdic: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Independent contractor (Including contracted research) | Jim Coyle: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Independent contractor (Including contracted research).
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Severity of Vocal Fold Atrophy is a Predictor of Swallowing Safety in Parkinson's Disease

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Purpose: Swallowing dysfunction, which is nearly ubiquitous in patients with Parkinson's disease (PD), can lead to diminished quality of life at best and mortality from aspiration complications at worst. The goal of this study was to identify anatomic or functional abnormalities seen on flexible laryngoscopy that influence swallowing safety in PD.
Method(s): Thirty people with PD were recruited and completed flexible laryngoscopy and flexible endoscopic evaluations of swallowing (FEES). Bowing index (BI) was measured using ImageJ software to quantify the presence and severity of vocal fold atrophy. Binary ratings indicating presence or absence of laryngeal tremor and supraglottic hyperfunction were also recorded. Correlational analyses were used to assess the association between age and disease duration with BI and PAS. ROC and Fisher's exact test analyses were performed to determine if laryngoscopy findings significantly predicted deficits in swallowing safety, as derived from Penetration–Aspiration Scale (PAS) scores on FEES examinations.
Result(s): Twenty-four of 30 patients demonstrated some degree of vocal fold atrophy ($BI > 0$). Five patients showed evidence of laryngeal tremor and 13 patients had either moderate or severe supraglottic hyperfunction. Seven patients had either normal or near-normal swallowing safety (PAS 1–3), while the remaining 23 patients had impaired swallowing safety (PAS 4–8). Participant age and disease duration did not significantly correlate with BI or PAS. BI significantly discriminated between patients with near-normal (PAS 1–3) and impaired (PAS 4–8) swallowing safety ($p = 0.01$, sensitivity: 87%, specificity: 71.4%, cutoff value $BI > 4.6$). Presence of laryngeal tremor or supraglottic hyperfunction were not significantly predictive of swallowing dysfunction.
Conclusions (Including Clinical Relevance): Our results demonstrate that vocal fold atrophy is an important factor contributing to poor swallowing safety in PD independent of age and disease duration. Specifically, it appears that a $BI > 4.6$ may predict airway invasion to at least the vocal folds ($PAS \geq 4$). Based on these preliminary findings, future research should be conducted to determine whether interventions to treat vocal fold atrophy such as injection augmentation or medialization laryngoplasty could play a role in improving swallowing safety in patients with PD. **Relevant Financial Relationships:** Yin Yiu: Nothing to Disclose | James Curtis: Nothing to Disclose | Sarah Perry: Nothing to Disclose | Michelle Troche: Has affiliations to disclose; Michael J Fox Foundation: Grant: Other Activities; CurePSP Foundation: Grant: Other Activities.
Relevant Non-financial Relationships: Yin Yiu: Nothing to Disclose | James Curtis: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership | Sarah Perry: Nothing to Disclose | Michelle Troche: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership.

The Effect of Dual Tasking on Cough Reflex Sensitivity in People with Parkinson's Disease

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Purpose: Reflex cough is an essential airway protective mechanism. Recent evidence suggests that increasing cognitive demands may reduce reflex cough sensitivity. This may have implications for populations who present with cognitive decline, impaired dual tasking, and/or airway invasion during swallowing. We present findings from a study testing the effects of performing concurrent cognitive and coughing tasks via a dual task paradigm on measures of reflex cough in adults with Parkinson's disease, and draw comparisons to previous work in healthy adults.
Method(s): Adults with idiopathic Parkinson's disease (n = 10, age range 59–79 years, median disease duration = 8 y) underwent four blocks of capsaicin-induced cough challenges. Within each block, six concentrations of capsaicin were presented in a randomized order: 0, 10, 20, 50, 100 and 200 μM. Two blocks consisted of cough testing only (single task). During the other two blocks, participants counted tones whilst simultaneously undergoing cough testing (dual task).

Measures of cough motor response, self-reported 'urge to cough' (UTC), cough frequency and cough airflow were collected.
Result(s): Analyses revealed that participants coughed more in the single task condition (Mdn = 6.5 coughs) compared to the dual task condition (Mdn = 4 coughs). Participants' UTC ratings were lower in the dual task condition [mean = 1 ("very slight")] compared to the single task condition [mean = 2 ("slight")], p = .02. There was a non-significant trend towards decreased cough peak expiratory flow rates in the dual task compared to the single task condition [p = .06].
Conclusions (Including Clinical Relevance): Somatosensation of tussive stimuli changes in response to cognitive load. This phenomenon has been described in healthy adults, but results from this study suggest that the effects of dual tasking on reflexive cough outcomes may be exacerbated by Parkinson's disease. Abnormal cognitive resource allocation may be a mechanism influencing silent aspiration; therefore, cognitive rehabilitation should be considered as a viable therapeutic target in those at risk of aspiration during swallowing.
Relevant Financial Relationships: Sarah Perry: Nothing to Disclose | Michelle Troche: Nothing to Disclose.
Relevant Non-financial Relationships: Sarah Perry: Nothing to Disclose | Michelle Troche: Nothing to Disclose.

Reproducibility and Minimal Detectable Change of Hyolaryngeal and Pharyngeal Movement During Swallowing: Kinematic Analysis Using 3D Dynamic Computed Tomography

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Purpose: In our previous variability study, timing of each swallowing event had good intra-class correlation (ICC = 0.75) suggesting that in normal subjects the timing of swallowing events is consistent between two immediately consecutive swallows. The current study aimed to analyze the test-retest reproducibility and minimal detectable change (MDC) of hyolaryngeal motion, UES opening, and pharyngeal contraction using 320 area-detector CT (ADCT) for swallow occurring at different time points.
Method(s): Ten healthy volunteers (3 Males, 7 Females, age: 28–68 years) swallowed two 10 mL of honey thick liquid (5%w/v, 1700 mPa) boluses under ADCT one week apart. The two swallows were analyzed for hyolaryngeal anterior and superior displacement, UES maximum cross-sectional area (UES area), pharyngeal volume constriction ratio (PVCR), and duration of pharyngeal constriction. PVCR was calculated by (maximum volume – minimum volume)/maximum volume. Analysis of ICC and calculation of minimal detectable change 95 (MDC95) was performed to examine the intra-subject variability.
Result(s): Measures of hyoid/larynx displacement had average ICC 0.84/0.70 (anterior displacement) and 0.91/0.76 (superior displacement), respectively. Average ICC of UES area, PVCR, and duration of pharyngeal constriction were 0.96, 0.64, and 0.73. MDC95 for all the aforementioned displacement measures ranged from 1.2 to 3.05 mm, for UES area it was 11.04 mm^2, and for PVCR it was 7.30%.
Conclusions (Including Clinical Relevance): We report relatively high level of concordance between two one-week-apart swallows with ICC ranging from 0.64 to 0.96 for hyolaryngeal movement, UES movement, and pharyngeal contraction. These findings suggest that the studied swallowing kinematics follow a fixed pattern in the same individual and supports the use of only one swallow per condition (bolus consistency/size) when performing ADCT to maintain minimal radiation exposure time. The MDC95 may be used to evaluate the minimal change in movement considered meaningful in dysphagia patients.
Relevant Financial Relationships: Yoko Inamoto: Nothing to Disclose | Eiichi Saitoh: Nothing to Disclose | Yuriko Sato: Nothing to Disclose | Yuriko Ito: Nothing to Disclose | Yoichiro Aoyagi: Nothing to Disclose | Seiko Shibata: Nothing to Disclose | Hitoshi Kagaya: Nothing to Disclose | Keiko Aihara: Nothing to Disclose | Marlis Gonzalez-Fernandez: Nothing to Disclose.
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Dysphagia Boot Camp-Evidence-Based Dysphagia Training

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Purpose: The present study evaluated the effectiveness of an intensive exercise-based program for head and neck cancer patients referred to as "Dysphagia Boot Camp" (DBC) for treating dysphagia in oropharyngeal squamous cell carcinoma (OSCC) patients and neurologically impaired patients. Our objectives were (1) to determine whether swallowing outcome was better for patients following DBC compared to patients who did not undergo DBC, (2) to determine whether early intervention with DBC led to better swallowing outcomes for patients than for late intervention with DBC.(3) The effectiveness of DBC for neurologically impaired patients
Method(s): This was a retrospective observational study of patients who underwent DBC after surgical resection of OSCC and neuroloogically impaired patients. The outcome was swallowing function as measured by the functional oral intake score (FOIS) and gastrostomy-tube (G-tube) status. First, we tested whether outcomes improved for patients following DBC compared to patients who did not undergo DBC by comparing the post-DBC FOIS and G-tube status of early-intervention patients (DBC before surgery, during and after adjuvant therapy) with the pre-DBC FOIS and G-tube status of late-intervention patients (DBC > 6 months after surgery). Second, we tested whether early intervention with DBC led to better outcomes for patients than for late intervention with DBC by comparing the post-DBC outcomes of early-intervention patients with the post-DBC outcomes of late-intervention patients. Third, we analyzed if DBC could improve dysphagia treatment outcome for neurologically impaired patients.
Result(s): Ninety-four OSCC patients and 10 neuroloigally impaired patients were included. Swallowing function and G-tube status improved for patients after DBC compared to a control group of patients who did not undergo DBC. Neither swallowing function nor

G-tube status improved more for patients who received early intervention than for patients who received late intervention. 100% of the neuro patiens has improved their swallowing functions. The average gain for FOIS is from 3.2 to 5.9

Conclusions (Including Clinical Relevance): Swallowing function and G-tube status improved for patients who underwent DBC compared to patients who did not undergo DBC. Neurologially impaired adults also benefit from DBC. Early intervention with DBC was an effective treatment for dysphagia in OSCC patients and neurologially impaired adults.

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Enhancing Effectiveness of Active Tongue Strengthening Exercise using Mental Practice

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Purpose: Mental practice (MP) using motor imagery is the mental rehearsal of physical movement without any body movement. A regimen of both active exercise and MP has been shown to increase performance in limb muscles. In these two studies, a feasibility study and a pilot study, we are the first to explore using MP to increase tongue strength in healthy, aging adults.

Method(s): In the feasibility study, six female adults (mean age 64) performed only MP of resistive tongue exercises over 6 weeks. Pre and post max lingual pressure data were collected using the Iowa Oral Performance Instrument (IOPI). A repeated-measures ANOVA was performed to identify the effect of MP on tongue strength. A multisite, randomized study is now being conducted to compare MP to active tongue exercise in over 25 adults aged 60–89.

Participants are randomized to one of four groups: control, active exercise, MP, and combined active exercise/MP. A mixed repeated-measures ANOVA will compare tongue strength and swallow pressure (IOPI) at weeks 0, 2, 4, and 6 to identify the effect of intervention on tongue strength, with post-hoc analyses of group differences.

Result(s): The feasibility study results demonstrated a significant increase in mean max lingual pressure at Weeks 4 and 6 compared to baseline ($P = .013$; $P = .032$, respectively). Data collection and analysis for the larger study will be completed during fall 2018; however, initial pilot data review indicates greatest gains in tongue strength and swallowing pressure using both active exercise and mental practice.

Conclusions (Including Clinical Relevance): Mental practice has the potential to augment swallowing rehabilitation without additional physical fatigue or the risk of aspiration. Investigation of MP as a novel clinical tool to enhance current active swallowing exercise protocols is warranted.

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Developing an Adapted Therapy Outcome Measure for Paediatric Dysphagia

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Purpose: In the UK commissioning of healthcare is increasingly based on outcomes rather than output. A challenge for speech and language therapists (SLTs) working in paediatric dysphagia is the lack of an agreed outcome measurement tool. Internationally, intervention studies rely heavily on locally agreed measures of impact. The resultant lack of psychometric robustness weakens the evidence base for such interventions. An outcome measurement tool which adequately captures the impact of intervention for this vulnerable patient population is urgently needed.The Therapy Outcome Measure(TOM)(Enderby and John 2015), based on the WHO ICF(WHO 2001) is now endorsed by the Royal College of Speech and Language Therapists(RCSLT)(Moyse 2016).The aim of this study was to develop an adapted Therapy Outcome Measure scale for paediatric dysphagia.

Method(s): The study began as a service improvement project, using the Institute for Healthcare Improvement's Model for Improvement(NHS Wales 2013). A paediatric SLT team contributed to an initial case note audit followed by a focus group to identify aims of SLT intervention. The original TOM dysphagia scale was revised in line with the domains and approach detailed by Enderby and John(2015).Revisions were informed by SLTs' feedback, the TOM's author and the literature reflecting objectives of SLT intervention for paediatric dysphagia. Repeated audits identified increased agreement of wording and use. The tool was then subjected to an iterative process of intra and inter-rater reliability studies, resulting in further revisions.

Result(s): Results of audits showed an increase over 18 months in the tool's use, from 1%-83%. However the approach did not capture all aspects of SLT intervention for this patient population.To reflect missing objectives, new domains were added, including parent/carer understanding and confidence, widely considered essential factors in paediatric dysphagia(Lefton-Greif et al.2014).Subsequent reliability studies achieved 84% agreement, guiding further revisions.The current version of the PaedD TOM, along with relevant TOM-accompanying scales will be included in the User-Guide, currently in preparation for publication.

Conclusions (Including Clinical Relevance): The new PaedD TOM measures the impact of SLT intervention with this patient population. Further work by SLTs working in paediatric dysphagia in the UK is ongoing, aiming to improve the psychometric properties of this tool.

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Swallowing Biomechanical Analysis Following Lingual Strengthening Therapy in Patients with Post-Stroke Dysphagia

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Purpose: Dysphagia affects up to 76% of acute post-stroke patients. Lingual strengthening therapy is a potential treatment modality, but the effects on the biomechanics of pharyngeal swallowing are not well understood. Using Computational Analysis of Swallowing Mechanics (CASM) with videofluoroscopic swallow study (VFSS) images, our purpose was to assess the biomechanical changes of swallowing-related structures following device-facilitated lingual strengthening as compared to usual care in a group of patients with post-stroke dysphagia.

Method(s): VFSS images from 20 patients within 6 months of stroke onset were analyzed before and after treatment. Nine patients (6 male, 3 female) were randomized to usual care and eleven patients (7 male, 4 female) to lingual strengthening using the SwallowStrong® device. The lingual strengthening group performed 10 press repetitions against pressure sensors in a mouthpiece at the front and back tongue locations 3 times per day, 3 days per week for 8 weeks. Multivariate morphometric analyses of VFSS images were performed to assess the effects of lingual strengthening in comparison to usual care on swallowing biomechanics in post-stroke patients.

Result(s): Biomechanics of the pharyngeal phase of the swallow were significantly altered following 8 weeks of lingual strengthening in post-stroke patients compared to baseline (CV1 = 64.9%; D = 1.67, $p < .0001$) and compared to those who received 8 weeks of usual care (CV1 = 52.5%; D = 4.66, $p < .0001$). Posthoc discriminant function analyses suggest improvements in pharyngeal biomechanics following lingual strengthening therapy. More specifically, we observed increased laryngeal elevation, hyoid excursion, and tongue base retraction with 8 weeks of lingual strengthening.

Conclusions (Including Clinical Relevance): These results suggest that pharyngeal swallowing biomechanics in patients with post-stroke dysphagia are positively influenced by a lingual strengthening protocol as compared to usual care. Future studies will apply this analysis to determine relationships among pharyngeal biomechanical changes post-treatment and swallowing-related outcomes, such as airway invasion and pharyngeal residue.

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The Impact of Neurologic Injury on Gastroesophageal Reflux Phenotypes via pH-Multichannel Intraluminal Impedance in Premature Infants

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Purpose: Esophageal manometry studies have shown that the lower esophageal sphincter of infants with neurological injury (NI) have negative pressure, prolonged nadir pressure, and relaxes sooner compared to neurologically normal (NN) infants. The impact of NI on pH-multichannel intraluminal impedance (pH-MII) characteristics of premature infants is unknown.

Method(s): We reviewed premature infants, born < 37 weeks gestational age (GA), with and without NI who underwent pH-MII testing due to concern for gastroesophageal reflux disease (GERD) from January 2012 to December 2016. NI was defined as intraventricular hemorrhage, hypoxic ischemic injury, periventricular leukomalacia, and stroke. The following pH-MII variables were evaluated: Boix-Ochoa Score, total duration of pH < 4, bolus exposure time, proximal esophageal reflux, total number of reflux events, refluxate type (liquid, gas, or mixed liquid and gas), and acidity (acid, weakly acidic, and non-acidic).

Result(s): Sixty-nine premature infants (28.1 ± 3.4 wks GA born at 1.15 ± 0.6 kg) had pH-MII studies at 41.6 ± 3.6 wks corrected gestational age due to concerns for GERD. Of those, 28 had NI born at 26.8 ± 3.1 wks GA weighing 1.01 ± 0.5 kg and 41 were NN born at 29 ± 3.4 wks GA ($p < 0.01$) weighing 1.28 ± 0.74 kg ($p = 0.17$). The number of infants with chronic lung disease were similar (NI = 20 vs NN 22, $p = 0.1$). Length of stay, incidence of gastrostomy tube placement, and Nissen fundoplication were similar in both cohorts. There were 21 NI and 27 NN infants with Boix-Ochoa score > 11.9 (NI = 19.6 (11–43.2) vs NN 18.8 (3.5–43), $p = 0.44$). Total duration of pH < 4 were similar between groups (NI 5% (2–8.5%) vs NN 3% (0–9%), $p = 0.27$). Bolus exposure time, 0.2 (0.2–0.4, $p = 0.69$), and proximal esophageal reflux were similar (NI 45% (22.7–66.7%) vs NN 50% (28.8–71.4%), $p = 0.69$). The number of reflux events, distribution of acidity and types of refluxate were not observably different among study cohorts.

Conclusions (Including Clinical Relevance): While manometry characteristics of the LES of infants with and without NI are distinct, their pH-MII characteristics are similar in regard to Boix-Ochoa Score, total duration of pH < 4, bolus exposure time, proximal esophageal reflux, number of reflux events, type and acidity of refluxate. Although NI is a risk factor for dysphagia, it doesn't play a major role

in the pH-MII characteristics of premature infants being evaluated for GERD.
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Use of Novel Dysphagia Index for Grading for Swallow Toxicity (DIGEST) to Assess Short Term Functional Swallow Outcomes in Patients with Oropharyngeal Carcinoma Treated with Transoral Robotic Surgery (TORS)

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Purpose: Poor swallow outcomes are most significant side effects of treatment of oropharyngeal cancer (OPC). Currently, there is not a standardized method to objectively measure functional swallow outcomes in patients undergoing transoral robotic-assisted surgery (TORS) treatment for oropharyngeal cancer (OPC). Recent development of the novel dynamic index for grading for swallow toxicity (DIGEST) was described in attempts to measure swallow function in patients with head and neck cancer based on the interpretation of modified barium swallow studies. Here, we aim to determine if the DIGEST scale can be reliably used in patients to determine swallow function in patients with oropharyngeal cancer undergoing TORS.
Method(s): We performed a retrospective review of patients that have undergone TORS at the University of Miami between 2012 and 2017. Two certified speech language pathologists performed a blinded review of modified barium swallow studies using the DIGEST score. Patient charts reviewed and all statistics analysis performed using cutoff of DIGEST score greater than 1 indicating severe dysphagia. Functional Oral Intake Scale (FOIS) was additionally recorded to determine accuracy of DIGEST score.
Result(s): Our analysis included 41 patients who received TORS, 30 men and 11 women. The average age at time of TORS was 61 years old, (range 38–84 years old). 29 patients analyzed had primary tonsillar cancer, 7 patients had base of tongue cancer and 5 patients had lateral pharyngeal or unknown primary. The average time to follow up was MBS was 34 days (range 8–119 days). FOIS scores were lower on average, indicating worse functional swallow status, for patients with DIGEST score greater than 1. We found no correlation between T stage at time of surgery and DIGEST score greater than 1. Additionally, There was good inter-user reliability amongst independent graders for DIGEST scores.
Conclusions (Including Clinical Relevance): Here we show that DIGEST can be reliably used to determine risk of aspiration in patients treated with TORS for OPC. In this series, T stage and location of primary tumor does not appear to predict swallow outcomes with regard to DIGEST or FOIS scores. Thus, we feel that MBS studies and DIGEST scores should be regularly determined postoperatively following TORS to determine which patients are at risk of aspiration and may benefit from early interventions.
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Functional Swallow-Related Outcomes Following Transoral Robotic Surgery for Base of Tongue Carcinoma: A Pilot Study

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Purpose: This study aimed to determine whether transoral robotic surgical resection as the primary management strategy for early-stage base of tongue squamous cell carcinoma affected: (a) lingual strength, (b) swallow safety and efficiency, (c) oral intake, and (d) swallowing-related quality of life.
Method(s): Nine individuals meeting the inclusion criteria for this study were recruited to participate from March 2017 to April 2018. Each participant was evaluated at four distinct time points: (a) pre-operatively, (b) 1-week postoperatively, (c) 1-month postoperatively, and (d) 3-months postoperatively. The following data were collected at each time point: (a) maximum isometric lingual pressure, (b) Penetration–Aspiration Scale scores as observed during a FEES examination, (c) The Yale Pharyngeal Residue Severity Rating Scale scores as observed during a FEES examination, (d) The Functional Oral Intake Scale (FOIS) score, and (e) The Eating Assessment Tool (EAT-10) score.
Result(s): Based on analysis of the data, it was shown that a significant decline in maximum isometric lingual pressure, EAT-10 scores, and FOIS scores occurred between preoperative baseline measurements and 1-week post-surgery. All participants in the study demonstrated a return to levels at or near their baseline level of function for maximum isometric lingual pressure, EAT-10 score, and FOIS score by 1- or 3-months post-surgery. There were no significant changes in swallow safety or efficiency observed at any time point during the study.
Conclusions (Including Clinical Relevance): The results of this study may play an important role in the pre- and postoperative assessment and counseling of individuals with planned TORS for resection of BOT SCCA. Patients can be provided with a reasonable expectation that they will experience a decline in their swallow function and oral intake as well as tongue strength in the immediate postoperative period. However, they can expect a gradual recovery of function to a level near-baseline by one to three months post surgery. The expectation for the gradual recovery of swallow function also confirms the overall likelihood of positive functional outcomes in the absence of adjuvant treatment(s) in individuals undergoing TORS as the definitive management strategy for their BOT SCCA.
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Factors Associated with Functional Swallow Status Before and After Treatment for Laryngeal Carcinoma

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Purpose: Little is known about the prevalence of enteral feeding tubes and the impact of tumor site and tracheostomy in patients with laryngeal cancer. This study aims to determine predictors of functional swallowing outcomes before and after laryngeal cancer treatment with radiation or chemotherapy.

Method(s): A retrospective review of 74 patients with laryngeal carcinomas referred for swallowing assessment was conducted. T(-tumor) stage, tumor site (supraglottis vs glottis/subglottis), tracheostomy status and treatment modality were reviewed. Primary outcomes were Functional Oral Intake Scale (FOIS) and tube-feeding status pre-treatment, and within 1, 3, 6, and 12 months post-treatment. Patients who received surgery including total laryngectomy, declined treatment or defaulted all reviews were excluded from post-treatment analyses. Binary and ordinal logistic regression analyses examined predictors of feeding outcomes.

Result(s): 14% of patients were on feeding tubes pre-treatment. Patients with supraglottic tumors and tracheostomies were 12 and 20 times more likely to be tube-fed ($p = .033$, $p = .009$ respectively, $R^2 = .45$, 80% correct prediction). T-L2 2stage did not further improve prediction of tube feeding dependence pre-treatment (χ change = 2.7, $p > .05$, R_L change = .04). Among 51 patients without tracheostomies, higher pre-treatment FOIS was associated with tumors smaller than T4 ($p < .007$, 71% correct FOIS prediction) but not tumor site ($p = .6$).

Change in FOIS from pre-treatment to 1 month post-treatment was unrelated to radiotherapy dose, tracheostomy, tumor site or stage. The proportion of tube-fed patients increased significantly in this period to 20% ($p = .016$). 71% of patients who went from oral to tube feeding during treatment had T3 or T4 tumors, with similar distributions in tracheostomy status, treatment modality (chemoradiation versus radiation) and tumor site.

Of 18 patients who attended at least two post-treatment reviews, 9 had diet upgrades, 78% of whom in the first 3 months. None of those on tube feeding were weaned off tube.

Conclusions (Including Clinical Relevance): Supraglottic cancer and tracheostomy were associated with greater pre-treatment dysphagia severity. Improvement in orally-fed patients tended to occur in the first 3 months post-treatment. Future research regarding patterns of swallowing dysfunction and rehabilitation in this population is warranted.

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Dysphagia as an Independent Risk Factor for Burden Among Caregivers of Aging Parents

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Purpose: The healthcare system relies on informal caregivers. These caregivers can experience high levels of emotional, financial and physical difficulties, negatively impacting the health and wellbeing of the caregiver and the care recipient. Therefore, reducing sources of burden is a health priority. The presence of dysphagia in care recipients is one factor suggested to contribute to increased caregiver burden. The purpose of this study was to determine the type and extent of caregiver burden uniquely experienced by adult children caring for aging parents with dysphagia.

Method(s): Using the Round 1 surveys from the National Health and Aging Trends Study and the National Study of Caregiving, we analyzed data from 895 children providing care for an aging parent. Care recipients (719 female) were community-dwelling adults aged 65–103 (mean 82.8 $\pm$ 7.8 years) receiving care from an adult child (630 female) aged 19–77 (mean 54.1 $\pm$ 9.1 years). Care recipients were asked if they had any difficulties chewing or swallowing.

Caregivers were asked about emotional, physical and financial burden associated with caregiving. Additional variables extracted included care recipient and caregiver health status, caregiver education and workload, care recipient medical diagnoses, memory status, fall status and degree of disability, and family conflict.

Result(s): Approximately 20% of caregivers were caring for a parent with reported swallowing difficulties. Logistic regression analyses revealed that caregivers of parents with dysphagia were significantly more likely to experience emotional ($p = 0.032$; OR = 1.61; 95% CI 1.04–2.48) and physical burden ($p = 0.035$; OR = 1.71; 95% CI 1.03–2.81), when controlling for other factors known to influence burden. Of the caregivers of care recipients with dysphagia experiencing emotional burden, 15% rated the emotional difficulty as 1 (a little difficult), 20% as 2, 25% as 3, 21% as 4 and 19% as 5 (very difficult). Of the caregivers of care recipients with dysphagia experiencing physical burden, 7% rated the physical difficulty as 1, 18% as 2, 23% as 3, 34% as 4 and 18% as 5.

Conclusions (Including Clinical Relevance): Emotional and physical burden are increased in children caregivers of community-dwelling older adults with dysphagia. A more comprehensive approach to dysphagia management, that incorporates caregiver third-party disability, is necessary in order to maximize intervention outcomes.

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Validation and Reliability of the Arabic Version of the MD Anderson Dysphagia Inventory (A-MDADI)

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Purpose: Systematic dysphagia assessment from patients' perspective is essential in head and neck cancer (HNC), with the MD Anderson Dysphagia Inventory (MDADI) being the most commonly used HNC patient-reported swallowing outcome measure. Currently, however, there is a lack of patient reported outcome measures for Arabic HNC patients. We aimed to create and evaluate a novel Arabic version of the MDADI (A-MDADI).
Method(s): The official guidelines for cross-cultural adaptation of QOL measures were followed. Arabic-speaking HNC participants were asked to complete four Arabic questionnaires (A-MDADI, Dysphagia Handicap Index (DHI), EORTC QLQ-C30, and EORTC-HN35) and then to re-fill the A-MDADI for re-test purposes with a mean of 16 days between test and re-test. Internal consistency reliability was calculated by Cronbach's alpha test for the composite score, and for the emotional, functional and physical domains. Intra-class correlation coefficient (ICC) was assessed for test-retest reliability. The construct validity was tested against the DHI and the EORTC-HN35 scores with Spearman's Rho test.
Result(s): Fifty-four HNC patients completed all questionnaires and n = 30 were included in the test-retest analysis. Internal consistency for the composite score was 0.95 and ranged from 0.79 to 0.91 for the other domains. As for test–retest reliability, ICC values were 0.92 for the composite score, and ranged from 0.82 to 0.93 for the sub-domains. For the construct validity, the correlation between the composite score of the A-MDADI with the DHI-total and the EORTC-HN35 subscales were rho = − 0.8 and ranged from rho = − 0.3 and −0.7, respectively.
Conclusions (Including Clinical Relevance): The A-MDADI showed an excellent internal consistency, test-retest reliability and construct validity, suggesting that this instrument can be a useful tool in assessing dysphagia-specific QOL for an Arabic-speaking HNC population.
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Relevant Non-financial Relationships: Jenan Altamimi: Nothing to Disclose | Joanne Patterson: Nothing to Disclose | Janet Wilson: Nothing to Disclose.

Hyolaryngeal Musculature Activation in Response to a Respiratory Resistance Device

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Purpose: Resistance to airflow during expiration can elicit increased activity in the submental musculature. These muscles influence hyolaryngeal excursion during swallowing. However, little is understood regarding a sustained expiratory or inspiratory resistive protocol in hyolaryngeal muscle function. In this study, we examined overall activation of the hyolaryngeal muscles via surface electromyography (sEMG) in response to a resistive load applied to expiration and inspiration.
Method(s): Data collection is ongoing – here we report on the first 10 healthy normal participants. All participants had no prior dysphagia or neurological impairment history. Participants completed a protocol utilizing a resistance breathing device (The Breather®) for both exhalation and inhalation tasks, 3 times at each resistance level. Baseline and peak amplitudes were collected from each trial, and then averaged across each trial. Baseline amplitude was subtracted from peak amplitude means, providing a normalized amplitude for each resistance level.
Result(s): Separate ANOVA's on expiratory and inspiratory normalized peak versus baseline amplitude revealed a significant difference ($p < .05$ for both analyses), where contraction amplitude was increased during the application of resistance. There were no significant differences between levels of resistance for either expiration or inspiration.
Conclusions (Including Clinical Relevance): This study found that the utilization of a respiratory resistance protocol increased hyolaryngeal musculature activation to significant levels over baseline on both expiratory and inspiratory trials. These findings align with related research regarding increased submandibular musculature activation during an expiratory resistance task. Continued trials in healthy normals are ongoing to determine the consistency of effects.
Relevant Financial Relationships: Matthew Dumican: Nothing to Disclose | Christopher Watts: Nothing to Disclose.
Relevant Non-financial Relationships: Matthew Dumican: Nothing to Disclose | Christopher Watts: Nothing to Disclose.

Swallowing Outcomes in Patients Using a Mobile Application (App) to Support Swallowing Therapy During Radiation-Based Head and Neck Cancer Treatment

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Purpose: To describe the swallowing outcomes of a cohort of patients using a mobile app during radiation therapy for head and neck cancer.
Method(s): Modified barium swallow studies were conducted 2–3 months following radiation-based treatment in a cohort of patients using a mobile application to support swallowing therapy during radiation treatment (Vibrent™).
This mobile app has been previously described in an initial feasibility study (Starmer et al, 2018). Swallowing variables rated included the MBSimp, Penetration Aspiration Scores (PAS) (worst across trials), and Dynamic Imaging Grade of Swallowing Toxicity (DIGEST)

scores. Diet level at the time of the MBS was recorded using the Functional Oral Intake Scale (FOIS).

Result(s): Swallowing outcomes were available for 18 participants who completed radiation-based treatment for oropharyngeal carcinoma and used the Vibrent™ mobile app during treatment. Mean time post-treatment was 9.78 weeks. No patients had feeding tubes at the time of assessment. Median oral impairment score was 2, with oral residue being the most common impairment (67%). Median pharyngeal domain score was 3, with deficits most commonly seen in regards to pharyngeal residue (100%), tongue base retraction (67%), and laryngeal vestibular closure (39%). Despite oropharyngeal deficits observed, overall swallowing function was good with average overall DIGEST score = 0.33, DIGEST safety = 0.39, and DIGEST efficiency = 0.17. Eighty-three percent of patients had normal PAS scores of 1–2. Average FOIS score was 5.94 suggesting minimal diet restriction at this early stage of recovery.

Conclusions (Including Clinical Relevance): Compared to recent reports on post-radiation dysphagia in similar populations (Xinou et al, 2018), the MBSimp scores in this cohort were superior, suggesting greater functional levels. While correlation to the use of the mobile app cannot be assigned, given the lack of a control group, this is a promising finding and suggests the potential additive value of a mobile health application to optimize swallowing outcomes.

Continued research regarding the impact of mobile technology is ongoing.

Relevant Financial Relationships: Heather Starmer: Nothing to Disclose | Beth Beadle: Nothing to Disclose | rina Abrams: Nothing to Disclose | Kimberly Webster: Nothing to Disclose | Harry quon: Nothing to Disclose | Jennifer Kizner: Nothing to Disclose | Jeremy Richmon: Nothing to Disclose.

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Use of the Dysphagia Handicap Index (DHI) to Determine Onset of Self-perceived Dysphagia in Parkinson Disease

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Purpose:

(1) To determine when individuals with Parkinson disease (IWP) identify emotional, functional and physical signs of swallowing impairment
(2) To improve timing of dysphagia intervention in individuals with Parkinson disease

Method(s): The DHI was administered to 348 IWP who attended the movement disorders clinic at Henry Ford Hospital and who had no documented cognitive impairment. Of the 348 IWP, 142 (41%) were female and 206 (59%) were male. The mean age was 70 years with a range from 35 to 95. The mean duration of PD was 5.9 years with a range from 0 to 26 years. The patients were divided into three groups based on their duration of PD; 0–4 years (n = 165, 47%), 5–9 years (n = 120, 35%) and 10 + years (n = 63, 18%). Demographic and DHI information were compared among the three duration groups using chi-squared tests (gender), analysis of variance (ANOVA) methods (age and DHI scores) and Wilcoxon two sample tests (self-severity score). Since all three pairwise comparisons of duration were of interest, an alpha level of 0.05 was used for all comparisons. No adjustments were made for multiple comparisons.

Result(s): There were no significant differences in gender distribution or age among the three groups. There were no significant differences for the DHI measurements and self-severity score when comparing the duration groups of 0–4 years with 5–9 years. However, the differences between the longest duration (10 + years) and the shortest duration groups were significant for all DHI measurements (emotional subscale, p = 0.038; functional subscale, p = 0.001; physical subscale, p = 0.003; total score, p = 0.005) as well as for the self-severity of dysphagia score (p = 0.003). When comparing the 5–9 years and 10 + years duration groups, the differences were significant for the functional (p = 0.040) and physical DHI measurements (p = 0.031) and the self-severity score (p = 0.023).

Conclusions (Including Clinical Relevance): Self-perception of physical and functional handicapping effects of dysphagia and self-perceived severity of dysphagia appear to worsen as PD progresses and becomes most apparent at 10 years or longer duration of disease. The relationship between duration of PD and the emotional aspects of dysphagia does not appear to be as strong as the other sub-scales or perceived severity of dysphagia. This information further contributes to timing of dysphagia intervention and counseling IWP on the effect of the disorder on swallowing.

Relevant Financial Relationships: Alice Silbergleit: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment | Lonni Schultz: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment | Ramya Konnai: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment | Christos Sidiropoulos: Has affiliations to disclose; Michigan State University: Salary/Stipend: Employment | Peter LeWitt: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Alice Silbergleit: Nothing to Disclose | Lonni Schultz: Nothing to Disclose | Ramya Konnai: Nothing to Disclose | Christos Sidiropoulos: Nothing to Disclose | Peter LeWitt: Has a Non-Financial Disclosure Affiliation; Clinical Neuropharmacology: Professional: Board membership; Journal of Neural transmission: Professional: Board membership; Journal of Parkinson's Disease: Professional: Board membership; Translational Neurodegeneration: Professional: Board membership.

Clinical Progression and Outcome of Swallowing Impairment Following Non-traumatic Subarachnoid Hemorrhage: A Retrospective Cohort Study

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Purpose: Little is known regarding the pattern of recovery and resolution of dysphagia for individuals following non-traumatic SAH. This study aims to establish the clinical profiles of individuals with and without dysphagia following non-traumatic SAH, and further describe the clinical progression and outcome of dysphagia within the acute phase for those individuals with dysphagia. Study findings will better inform clinical care pathways and rehabilitation decisions for this population.

Method(s): Retrospective chart review of 250 patients consecutively admitted with non-traumatic SAH to a major, tertiary neurosurgery referral centre in Australia over a three-year period. Information associated with usual clinical care was collected for the duration of the acute hospital admission. Characteristics of participants with dysphagia (n = 73/250) were further analyzed to evaluate dysphagia progression and recovery.
Result(s): Participants with dysphagia took 10.93 times longer to commence oral intake following admission than those without dysphagia ($p < 0.01$). Those with dysphagia took approximately 12.86 times longer to reach total oral feeding than those without dysphagia ($p < 0.01$). There was no statistically significant difference between groups for time to SLP referral ($p = 0.549$) or commencement of supplemental feeding ($p = 0.256$). Safe management of thin fluids occurred for > 50% of participants by weeks 2 and 3 following admission, with 75.34% of participants with dysphagia resuming thin fluids by discharge. Safe management of full diet took slightly longer with 32.88% of participants resuming unmodified diet by week 3. By discharge, only 53.42% of participants resumed a full diet.
Conclusions (Including Clinical Relevance): The clinical progression and recovery of dysphagia within the acute phase following non-traumatic SAH can be protracted for some patients, necessitating ongoing speech-language pathology (SLP) input after discharge. The study findings will enhance SLP assessment processes, management focuses, and guide prognostic decision making for this population.
Relevant Financial Relationships: Katrina Dunn: Has affiliations to disclose; West Moreton Health: Salary/Stipend: Employment; Metro North Hospital and Health Service: Salary/Stipend: Employment | Anna Rumbach: Has affiliations to disclose; The University of Queensland: Salary/Stipend: Employment.
Relevant Non-financial Relationships: Katrina Dunn: Nothing to Disclose | Anna Rumbach: Nothing to Disclose.

First Validation of a Novel Ultra-thin Wearable Electromyography Sensors Patch for Monitoring Submental Muscle Activity During Swallowing

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Purpose: The purpose of this study is to validate a prototype ultra-thin wearable surface electromyography (sEMG) sensors patch (patent pending) in monitoring submental muscle activity during swallowing in healthy older adults.
Wearable sEMG technology can allow clinicians to remotely monitor patients' exercise performance and improve access and quality of care.
Method(s): A randomized crossover design was employed to compare the performance of the new wearable sensors patch with the performance of conventional, commercially available snap-on sensors. Twenty healthy adults have participated thus far (11F; age range 53–85). Participants completed the same experimental protocol with both sensor types in a counterbalanced order. Comparisons were made on: (a) Pre-clinical factors: Adverse effects and satisfaction; (b) Sensors' related factors: Signal-to-noise ratio (SNR), baseline amplitude (μV), and normalized amplitude (%) of 5/10 mL water and 5 cc pudding swallows. Satisfaction was compared using a superiority test, SNR and baseline amplitude were compared using non-inferiority tests, and swallow amplitude was compared using an equivalency test.
Result(s): Pre-clinical factors: No pain or adverse effects were reported with either sensor type. Satisfaction was significantly higher with the wearable sensors ($p < .0001$, $d = .04$). Sensors' related factors: Mean SNR for the conventional sensors (9.4–left, 9.2–right) was non-inferior to the mean SNR for the wearable sensors (9.8–left, 9.4–right) ($p = .0005$ & $.0006$, for left & right channels, respectively). Mean baseline amplitude (μV) of the conventional sensors (2–left, 2.2–right) was non-inferior to the mean baseline amplitude of the wearable sensors (1.7–left, 1.8–right) ($p < .0001$ & $.0001$, respectively). The mean difference of the normalized amplitude during swallows was within the equivalence margin for all consistencies ($p(5\ mL) = .0002$, $p(10\ mL) = .0065$, $p(pudding) = .0003$) for the left, and for pudding ($p = .0015$) for the right channel.
Conclusions (Including Clinical Relevance): Our findings show that the newly developed wearable sEMG sensors patch is safe, obtains equivalent signal quality with the conventional sensors, and older adults prefer it to the conventional sensors. Upon optimization and validation of this prototype in patients with dysphagia, this new technology has the potential to improve the monitoring of patients' swallowing exercise performance and improve quality of care.
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Clinical Profile and Recovery Pattern of Dysphagia Following Inhalation Burn Injury

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Purpose: The presence of inhalation injury is a predictor of dysphagia for patients with burn injury. However the nature of dysphagia associated with inhalation injury is not well understood. The aim of this study was to describe the clinical profile and recovery pattern of swallowing following inhalation burn injury.
Method(s): All patients admitted between 2008 and 2017, with confirmed inhalation burn injury on laryngoscopy were included. A medical record audit examined demographic, burn and critical care

data along with the nature of dysphagia presentation and recovery pattern. Clinical outcomes for dysphagia were reported using the Functional Oral Intake Scale (FOIS) and dysphonia was assessed clinically as a dichotomous rating. Persistent laryngeal/pharyngeal injury was documented using laryngoscopy. Dysphagia prevalence and recovery was compared to published outcomes data from a large clinical cohort of adults admitted post burn injury.

Result(s): Inhalation injury was confirmed in 38 patients (26 male; mean age 40.8 years; range 17–71). The percent total body surface area burn ranged from 1–90%, 100% had head and neck burns, 97% required mechanical ventilation (mean 9.4 days, range 0–24), 18% required tracheostomy and 100% had dysphonia. Incidence of dysphagia in this cohort of patients with inhalation injury was significantly higher (89.47% vs 11.18%; Chi:148.604, $p < 0.001$) than reported for the admitted adult population post burn injury. Comparing to published data of patients post burn injury (not specifically with inhalation injury), the average dysphagia severity was higher (88.24% vs 40.82% severe dysphagia), duration to initiate oral intake longer (mean 27.03 vs 18.77 days) and resolution of dysphagia slower (mean 52.13 vs 33.55 days). Enteral feeding duration was also longer at a mean of 49.55 vs 34.23 days. Persistent laryngeal pathology (aryepiglottic fold contracture, posterior glottic scar tissue) was present in 47.37% at 6 months post injury.

Conclusions (Including Clinical Relevance): The incidence of dysphagia in patients with inhalation injury is 8 times greater than in the general admitted burn injury population. The presence of laryngeal pathology due to inhalation injury increases dysphagia severity and duration to dysphagia recovery. Whilst most patients will adapt initially post burn trauma, laryngeal pathology may be long term and influence future physiological reserve.

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Coordination Between Tongue Pressure Production and Hyoid Excursion During Squeezing

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Purpose: Tongue squeezing is one of the oral strategies for processing of soft foods which is often provided to dysphagic patients. However, the bio-mechanics of squeezing (i.e., tongue compression against hard palate), has not been clarified yet. The aim of this study was to investigate the coordination between tongue pressure production and hyoid excursion during squeezing gels by the synchronous measurement of videofluorography, electromyography and tongue pressure sensor.

Method(s): 15 healthy men (mean age, 31.0 ± 4.1 years) without dysphagia were recruited. Hyoid excursion, suprahyoid muscle activity and tongue pressure production during squeezing 5 mL of gels were recorded with videofluorography, surface electromyography and a 0.1-mm-thick pressure sensor sheet with five measuring points respectively. Onset time of hyoid excursion was set as a reference time. Sequential order of hyoid excursion, suprahyoid muscle activity and tongue pressure during initial squeezing was analyzed. Differences in hyoid position on the onset, peak and offset of hyoid excursion were also analyzed. Friedman test and post hoc test were used for these analyses ($p < 0.05$).

Result(s): Hyoid bone moved in superior-inferior direction during initial squeezing without jaw movement. Mean distance of hyoid excursion during initial squeezing was 8.38 ± 2.88 mm. At the beginning of initial squeezing, hyoid excursion, suprahyoid muscle activity and tongue pressure at the middle area of the hard palate were appeared almost simultaneously followed by tongue pressure at the anterior area and then at the posterior area. When the hyoid was at the most superior position, the amplitude of suprahyoid muscle activity and tongue pressure reached their peak. At the end of initial squeezing, hyoid position of the offset of hyoid excursion was superior to that of the onset.

Conclusions (Including Clinical Relevance): During initial squeezing, hyoid excursion was coordinated with tongue movement for generating squeezing pressure against hard palate. At the end of initial squeezing, hyoid was kept elevated position which might be beneficial for subsequent squeezing.

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Relevant Non-financial Relationships: Kazuhiro Murakami: Nothing to Disclose | Kazuhiro Hori: Nothing to Disclose | Yoshitomo Minagi: Nothing to Disclose | Shigehiro Fujiwara: Nothing to Disclose | Takahiro Ono: Nothing to Disclose | Kazunori Ikebe: Nothing to Disclose.

Identifying Eating, Appetite and Weight Changes as Key Concerns for Patients Diagnosed with Cancer Using an Holistic Needs Assessment (HNA)

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Purpose: People diagnosed with cancer experience a wide range of biopsychosocial issues prior to, during and following cancer treatment. National guidance recommends the use of an Holistic Needs Assessment (HNA) tool with all people diagnosed with cancer. The tool has 6 domains including practical, physical, emotional, spiritual, mental and social concerns. It can be administered by any health care professional (HCP) and used to highlight concerns regarding eating ability, appetite, weight changes. It can can inform referral to the Speech-Language Pathologist (SLP) and dietitian for assessment of swallowing and nutritional well-being, including those diagnosed with head and neck cancer (HNC).

Method(s): Data were collected in 2016 across London. Patients were offered the HNA electronically by HCPs during their care pathway.

The physical domain data was analysed to identify how non-HNC prioritise eating, appetite and weight changes. We also analysed the data to look at the key physical concerns for patients with HNC.
Result(s): An e-HNA was completed by 1,182 patients, including 999 non HNC patients (278 patients with lung cancer, 341 lower GI and 380 upper GI cancer patients) and 183 HNC patients. In the non-HNC group, eating/appetite and weight changes were in the top 10 priority concerns for all three tumour groups. Eating and appetite concerns were reported in 23.7% of lung patients, 12.6% of lower GI patients and 35% in upper GI. Concerns with weight changes were reported in 24.5% (lung cancer), 12.6% (lower GI), and 38.7% (upper GI) of patients. In 183 HNC patients, eating and appetite were the second highest concern in 37.7% (n = 69) of cases with sore/ dry mouth highlighted in 25.1% (n = 46).
Conclusions (Including Clinical Relevance): The e-HNA has been designed for use across tumour groups and may be useful in identifying those with oropharyngeal dysphagia and associated nutritional issues. It is critical that HCPs are sufficiently informed to explore concerns and signpost patients to the most appropriate service to provide ongoing management of their eating, appetite and nutritional concerns. While this tool provides a forum to open discussion about these concerns, patients, in particular HNC patients, require bespoke tools and specialist SLP assessment to measure severity and impact of dysphagia on function and quality of life in the context of the individuals' overall wellbeing.
Relevant Financial Relationships: Justin Roe: Nothing to Disclose | Grainne Brady: Nothing to Disclose | Penelope McTaggart: Nothing to Disclose | Stephen Scott: Nothing to Disclose | Natalie Doyle: Nothing to Disclose.
Relevant Non-financial Relationships: Justin Roe: Nothing to Disclose | Grainne Brady: Nothing to Disclose | Penelope McTaggart: Nothing to Disclose | Stephen Scott: Nothing to Disclose | Natalie Doyle: Nothing to Disclose.

Association Between Disordered Swallowing and Duration of Oral Endotracheal Intubation in Critically Ill Patients: A High Resolution Pharyngeal Manometry Study

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Purpose: Dysphagia is common in intensive care unit (ICU) patients after extubation of an oral endotracheal tube (ETT). The risk factors and motor correlates of this are however unclear. High resolution pharyngeal manometry (HRPM) is a catheter based swallowing technique that enables objective evaluation of swallow function. This has not previously been used in ICU patients. The aim of the current study was to prospectively assess swallow biomechanics in critically ill patients using HRPM.
Method(s): Nineteen (7 female, mean age 68 years, range 61–75 years) ICU patients (> 48 h of mechanical ventilation) underwent HRPM testing with 5 mL & 10 mL boluses of thin (IDDSI 0) and extremely thick liquids (IDDSI 4). All patients were assessed within 24 h of extubation and compared to 24 age-appropriate healthy participants (mean age 65 years, range 50–73 years). Biomechanical swallow metrics were derived using a web-based analysis application (swallowgateway.com) to determine swallow function metrics, together with the Swallow Risk Index (SRI), a global measure of swallow function. Repeated measures ANOVA across bolus types was performed with Group as Factor. Data are marginal means (95% CI).
Result(s): Mean SRI was higher in ICU patients compared to controls (7 (4–11) vs. 3 (0–6); $p < 0.05$). Compared to healthy participants, ICU patients had longer Hypopharyngeal Bolus Presence Times (1.0 [0.8–1.2] vs. 0.7 [0.5–0.9] sec, $p < 0.05$), lower UES Basal Pressures (61 [40–81] vs. 90 [71–108] mmHg, $p < 0.05$) and higher UES Integrated Relaxation Pressure (12 [8–16] vs. 5 [1–8] mmHg, $p < 0.05$). Pharyngeal Contractility Integrals were similar between ICU patients and controls (455 [360–550] vs. 444 [359–529] mmHg.cm.s). Eight (42%) patients had an abnormal SRI (> 90th percentile of controls). These patients had a longer duration of ETT (12(6–18) vs. 6 [4–8] days, $p < 0.05$). Only 1/8 patients undergoing < 7 days ETT had an abnormal SRI compared to 7/11 of patients with ≥ 7 days ETT ($p = 0.037$, Fisher's Exact Test).
Conclusions (Including Clinical Relevance): Critically ill patients who undergo 7 days or more of oral endotracheal intubation have increased disordered swallowing. HRPM examination may identify patients at risk for dysphagia.
Relevant Financial Relationships: Mistyka Schar: Nothing to Disclose | Taher Omari: Nothing to Disclose | Robert Fraser: Nothing to Disclose | Andrew Bersten: Nothing to Disclose | Shailesh Bihari: Nothing to Disclose.
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Norm-Referenced Videofluoroscopic Profiles in Survivors of Traumatic Cervical Spinal Cord Injury

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Purpose: Videofluoroscopic evaluation of swallowing post-traumatic cervical spinal cord injury (tCSCI) has been limited to case reports and qualitative assessment. This pilot investigation aimed to describe post-tCSCI swallowing physiology in this under-studied population using norm-referenced, temporal and displacement measures from videofluoroscopy (VFS) and to explore their relation to the penetration/aspiration scale (PAS) and to clinical swallowing measures.
Method(s): Ten tCSCI survivors (C3 to C7 injury) within inpatient rehabilitation (8 M; 2F, age 30 – 77; M(SD) days post injury = 36.2(27.9)) completed clinical (i.e., Mann Assessment of Swallowing Ability, tongue strength, the Repetitive Saliva Swallow Test, and maximum expiratory pressure) and VFS examinations. Trained raters, blinded to clinical measures, completed VFS measures (i.e., norm-

referenced z-scores using Swallowtail 2.0 and median PAS) with strong reliability (Cronbach's $\alpha > .9$; ICC > .88).
Result(s): All subjects exhibited significantly delayed airway closure (AEc) beyond 1 SD (M = 3.9(2.3)) of age- and gender-matched norms. Dysphagia post-tCSCI was also characterized by elevated pharyngeal constriction ratios (90% of the sample); delayed arytenoid (80%) and hyoid excursion (70%); prolonged total pharyngeal transit time (TPT; 70%); and reduced hyoid excursion (60%) beyond 1 SD of norms. Aspiration occurred in 70% of the sample, with 86% of aspirators demonstrating silent aspiration. Controlling for age, PAS significantly correlated with z-scores for time to airway closure ($r > .950$, $p < .001$), time to peak hyoid excursion ($r = .765$, $p = .010$), and TPT ($r > .700$, $p < .024$), but not displacement measures. None of the clinical measures significantly correlated with videofluoroscopic deficits when controlling for age, except tongue strength inversely correlated with PAS ($r > c.665$, $p < .05$), time to airway closure, and extent of hyoid displacement.
Conclusions (Including Clinical Relevance): Post-tCSCI dysphagia is characterized by delayed mechanisms of airway closure, weak pharyngeal constriction, and prolonged pharyngeal transit. Aspiration is common, often silent, and may be largely related to timing deficits. Clinical inference regarding the integrity of the pharyngeal phase at bedside is limited in post-tCSCI survivors, future research should investigate tongue strength as a clinical indicator of post-tCSCI dysphagia.
Relevant Financial Relationships: Valerie Hamilton: Has affiliations to disclose; Shirley Ryan AbilityLab: Salary/Stipend: Employment; Craig H Neilson Foundation: Grant: Employment | Laura Pitts: Has affiliations to disclose; University of Northern Iowa: Salary/Stipend: Employment; Craig H Neilson Foundation: Grant: Consulting | Chih-hung Chang: Has affiliations to disclose; Shirley Ryan Ability Lab: Salary/Stipend: Employment; Northwestern University: Salary/Stipend: Employment; Washington University School of Medicine: Salary/Stipend: Employment; Craig H Neilson Foundation: Grant: Consulting | Kristen Forand: Has affiliations to disclose; Shirley Ryan Ability Lab: Salary/Stipend: Employment; Craig H Neilson Foundation: Grant: Employment | Lindsay Giewont: Has affiliations to disclose; Shirley Ryan AbilityLab: Salary/Stipend: Employment; Craig H. Neilson Foundation: Grant: Employment | Mallory Adams: Has affiliations to disclose; University of Northern Iowa: Salary/Stipend: Employment | Leora Cherney: Has affiliations to disclose; Shirley Ryan Ability Lab: Salary/Stipend: Employment; Northwestern University: Salary/Stipend: Employment; Craig H Neilson Foundation: Grant: Employment.
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The Effect of Head and Neck Stretches on Range of Motion and Dysphgia in Post-RT Individuals with Head and Neck Cancer

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Purpose: To determine if improved neck range of motion improves swallowing in individuals with head and neck cancer post-RT.
Method(s): Neck range of motion (ROM) data pre and post daily neck stretching for a subset of 119 subjects from a 170 subject group enrolled in a previously published clinical trial (Langmore et al, 2016) was analyzed for the effect of changes on swallowing function. Subjects were randomized into an active or sham neuromuscular electrical stimulation (NMES) group. Subjects performed neck stretches for 5 min before a home swallowing exercise program which occurred twice a day, six days a week for 12 weeks. Regular clinic visits included a videofluorographic swallowing study and patient reported outcomes measures. The Penetration–Aspiration Scale and the Head and Neck Cancer Inventory (HNCI) were used to assess swallowing outcomes. Paired t-tests compared pre and post neck ROM measurements within each treatment group. Two-sample t-tests were used to compare the changes (post to pre) for these measurements between the two treatment groups. Pearson's correlation coefficients were computed to assess the associations of the changes in the ROM measurements with changes in the swallowing outcome measurements. For those significant associations, regression analyses were done to estimate the magnitudes of these associations. All testing was done at the alpha level of 0.05
Result(s): No differences were detected comparing changes in the ROM data between the NMES and sham groups. The groups were combined to assess their associations with changes in swallowing outcomes. The change in ROM had positive associations with changes in HNCI eating score ($r = 0.253$, $p = 0.007$). None of the other associations of changes in ROM with the changes in swallowing outcomes were significant.
Conclusions (Including Clinical Relevance): The results of this study indicate no significant associations between improved neck ROM and swallowing ability as measured by PAS scores. However, results appear to indicate that neck stretches improved ROM and they may have had a significant and positive influence on how patients perceived diet and quality of life. It is possible that the routine twice a day physical activity of moving one's neck in multiple directions provided subjects with a sense of control over their health, contrary to their medical and surgical experiences, and led them to a perception of improvement years after radiation treatment.
Relevant Financial Relationships: Alice Silbergleit: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment | Lonni Schultz: Has affiliations to disclose; Henry Ford Health System: Salary/Stipend: Employment | Gintas Krisciunas: Has affiliations to disclose;Boston Medical Center: Salary/Stipend: Employment | Langmore Susan: Has affiliations to disclose; National Institutes of Health: Grant: Other Activities.
Relevant Non-financial Relationships: Alice Silbergleit: Nothing to Disclose | Lonni Schultz: Nothing to Disclose | Gintas Krisciunas: Nothing to Disclose | Langmore Susan: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership.

Internal Validation of the Physiologic Risk Index for Swallowing Impairment (PRISIM)

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Purpose:

(1) Identify simple clinical physiologic markers to reliably detect swallowing impairment in ALS

(2) Develop a clinically feasible and predictive model of dysphagia risk for implementation in ALS clinics (Physiologic Risk Index ofSwallowing Impairment, PRISIM)

Method(s): 205 individuals with ALS completed the: Eating Assessment Tool-10 (EAT-10), Center for Neurological Study Bulbar Function Scale (CNS-BFS), voluntary peak cough flow (PCF), cough reflex testing (CRT), lingual strength (IOPI instrument), and 3 ounce Water Swallow Test (WST). Patients underwent videofluoroscopic evaluation with studies rated by two blinded raters using the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST, Hutcheson, 2017) to index global dysphagia status. Univariate and multivariate logistic regression models were run to determine diagnostic utility of individual and combined tests to detect dysphagia.
Result(s): Discriminant Ability of individual clinical tests to detect dysphagia:
Mean scores for normal vs. dysphagic (DIGEST > 2) with associated ROC results are provided below.

(1) EAT-10: 4.7 vs. 16.3 ($p < 0.05$). EAT-10 > 4: sensivity: 87%, specificity: 57%
(2) CNSBFS: 38.9 vs. 56.5 ($p < 0.05$). CNSBFS > 31: sensivity: 82%, specificity: 42%
(3) PCF: 379 vs. 288L/min ($p < 0.05$). PCF < 375L/min: sensivity: 78%, specificity: 55%
(4) Lingual MAIP: 42.6 vs. 28.9 kPa ($p < 0.05$). MAIP < 41Kpa: sensivity: 82%, specificity: 53%
(5) WST: sensivity: 77%, specificity: 76%
(6) CRT 200 μm Capcaisin: sensivity: 0%, specificity: 98%

PRISIM Dysphagia Risk Index: The strongest, most parsimonious predictive model of dysphagia status included: age, EAT-10, PCF and 3 oz WS, $X_2 = 18.2$, $p < 0.001$, AUC: 0.88 (95% CI 0.79, 0.95). Model optimization identified that a PRISIM cut score of 6 yielded a sensitivity of 85%, specificity of 82% and a likelihood ratio of 4.7. A PRISIM score of 0–4 indicated a relatively low risk of having dysphagia (LR: 1–1.5); a score of 5 moderate risk (LR 2.7); while a PRISIM score of 6 or higher indicated a high risk of dysphagia (LR: 4.7–10.0).
Conclusions (Including Clinical Relevance): PRISIM represents a feasible and pragmatic dysphagia risk index screening tool for use in busy multidisiciplinary ALS clinics for the identification of high risk individuals for a comprehensive evaluation of swallowing function. Future work will externally validate the PRISIM model.
Relevant Financial Relationships: Emily Plowman: Has affiliations to disclose; NINDS: Grant: Other Activities; ALS Association: Grant: Other Activities; NICHD: Grant: Other Activities | Jennifer Chapin: Nothing to Disclose | Raele Robison: Nothing to Disclose | Lauren Tabor-Gray: Nothing to Disclose | Terrie Vasilopoulos: Nothing to Disclose | Amber Anderson: Nothing to Disclose | Lauren DiBiase: Nothing to Disclose | Kelby Magennis: Nothing to Disclose | James Wymer: Nothing to Disclose.
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Assessing Infant Feeding: A Physiological and Parental Report Comparison

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Purpose: The goal of this study was to compare objective infant suck and feed physiology to a parental report of infant sucking and feeding skills.
Method(s): Infants sucked on our custom research pacifier for 2-min, which yielded the following quantitative
non-nutritive suck (NNS) measures: bursts/min, cycles/min, cycles/burst, burst duration (sec), amplitude (cmH_20), and frequency (Hz). Next, infants were observed during their bottle feed and researchers completed the Oral Feeding Skill (OFS) Scale (Lau, Sheena et al. 1997, Lau and Smith 2011). The OFS yields the initial bottle amount, milk transfer volume, proficiency, and rate of the bottle feed. Parents then completed the Neonatal Eating Assessment Tool (Neo-EAT), which is a validated parent-report tool used to examine problematic eating behaviors (Thovre. S. M. 2014) and the Child Oral and Motor Proficiency Scales (ChOMPS) (Thoyre 2017).
Result(s): Thus far, 30 full-term participants (16 female/14 male) have completed this ongoing study (projected n = 50). Preliminary results show that OFS transfer volume was significantly correlated with NNS Frequency ($r = .373$, $p = .046$) and NNS Bursts/min ($r = .389$, $p = .041$). Initial bottle amount was significantly correlated with NNS Burst/min ($r = .445$, $p = .018$). NeoEAT Bottle Gastrointestinal ($r = .505$, $p = .039$) and NeoEAT Breast Symptoms ($r = -.516$, $p = .014$) were significantly correlated with NNS Bursts/min. No other comparisons were significant.
Conclusions (Including Clinical Relevance): Preliminary results suggest that certain aspects of infant suck and feed physiology relate to parental report measures. This is the first time these specific measures of infant sucking and feeding have been compared. Knowledge of how physiological and parental reports align are critical for early feeding assessments and timely interventions.
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Relevant Non-financial Relationships: Emily Zimmerman: Nothing to Disclose | Kelsey Thompson: Nothing to Disclose | Morgan Hines: Nothing to Disclose | Alaina Martens: Nothing to Disclose.

Quality of Evidence Concerning Dysphagia Following Tracheostomy Placement: Should We Believe What We Read?

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Purpose: Complex medical conditions often necessitate tracheostomy placement following which many are diagnosed with dysphagia. Key

metrics in quality health care provision are the utilization of clinical practice guidelines. In their absence, clinicians are tasked with assimilating the available evidence, determining its relevance and assessing its quality. Given the lack of available practice guidelines for the assessment and management of swallowing following tracheostomy placement in adults in acute care, we sought to systematically screen and assess literature quality.

Method(s): A systematic search was conducted including: 8 databases, 10 journals (handsearching) and citation chasing (forward and backward chaining). Using inclusion criteria determined a priori, two blinded reviewers screened abstracts and then full-texts for inclusion. We included acutely ill adult patients with tracheostomy but without head and/or neck cancer. Included study designs were: randomized controlled trials, prospective and retrospective observational studies, and case series ($n > 10$). We stratified studies according to content domain. Two blinded reviewers assessed studies using a modified Cochrane Rias of Bias (RoB) tool. All disagreements were resolved by consensus. Bias risk was reported descriptively across all studies according to RoB domains.

Result(s): We identified a total of 6,396 unique references, of which, 85 (N) met inclusion criteria. Of those, 3 (4%) were randomized controlled trials and 82 (96%) were observational (retrospective: 29 [35%]; prospective: 53 [65%]). Each study was stratified according to content (n,%): dysphagia frequency (29,34%), swallowing physiology (18,21%), dysphagia risk factors (15,18%), intervention (14,16%), and assessment comparison (9,11%). Across all studies, 64 (75%) were without selective outcome reporting, 63 (74%) defined participant selection, 50 (59%) had consistent assessment across participants, 37 (44%) operationally defined tracheostomy information and 15 (18%) included assessor blinding.

Conclusions (Including Clinical Relevance): This is the first large-scale quality assessment of dysphagia evidence following tracheostomy, which may guide clinical practice. High bias risk was evident across assessment consistency, operational definitions and blinding. In order to minimize bias, future studies should include these methodological components.

Relevant Financial Relationships: Stacey Skoretz: Has affiliations to disclose; UBC: Salary/Stipend: Employment | Nekesia Abrams: Nothing to Disclose | Stephanie Riopelle: Nothing to Disclose | Camilla Dawson: Has affiliations to disclose; NHS: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Stacey Skoretz: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership | Nekesia Abrams: Nothing to Disclose | Stephanie Riopelle: Nothing to Disclose | Camilla Dawson: Nothing to Disclose.

Effectiveness of Chin-Down Swallowing: Secondary Analysis of Existing Data

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Purpose: The chin-down position is one of the most commonly prescribed postural techniques for reducing penetration and aspiration in patients with dysphagia. In particular, the chin-down is applied to minimize early entry of the bolus into the pharynx relative to swallow onset. However, the effectiveness of the chin-down maneuver for this particular problem is debatable.

Method(s): To determine the effectiveness of the postural technique, swallowing data from 15 patients were examined. Each patient had a swallow in the chin-down and neutral position consisting of the matching bolus types and modes of bolus delivery. Swallows were randomized and individually rated for kinematic events, bolus flow events, duration of swallowing events, swallowing frequency, and penetration and aspiration status.

Result(s): The primary finding was chin-down posture swallows prolonged the elapsed time between when the prematurely spilled bolus entered the pharynx relative to swallows onset compared to the neutral head position ($p = .006$). In other words, the prematurely spilled bolus dwelled longer in the pharynx prior to swallow onset with chin tuck. We explored the relationship between head position and PAS scores and found there to be no significant difference. A PAS score of 1–2 (normal range) occurred in 23% of neutral and 23% of chin-down swallows. A score between 3–5 (indicating penetration) was reported for 15% of neutral and 19% of chin-down swallows, and scores between 6–8 (aspiration) were noted for 13% of neutral and 8% of chin-down swallows.

Conclusions (Including Clinical Relevance): Our findings suggest that use of the chin down posture can impact bolus flow kinematics prior to swallow onset, but there were no trends in whether the position influenced penetration or aspiration status. It is notable that the chin down posture increased penetration in 16% of swallows and aspiration in 6% of swallows. To understand the variability in bolus flow outcomes of the chin down posture, further studies with a larger sample should include an analysis of the underlying cause of aspiration among individuals with dysphagia.

Relevant Financial Relationships: Jessica Forbes: Nothing to Disclose | Carol Smith: Has affiliations to disclose; University of Florida: Salary/Stipend: Employment | Alicia Vose: Nothing to Disclose | Ianessa Humbert: Has affiliations to disclose; University of Florida: Salary/Stipend: Teaching and speaking.

Relevant Non-financial Relationships: Jessica Forbes: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership | Carol Smith: Nothing to Disclose | Alicia Vose: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership | Ianessa Humbert: Has a Non-Financial Disclosure Affiliation; Dysphagia Research Society: Professional: Membership.

Infant-Driven Feeding Systems: Do They "normalize" the Feeding Experience of Infants with Cleft Palate?

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Purpose: Infants with cleft palate struggle to create the suction required to draw liquids from the breast or standard bottles. Specialized feeding systems are used to overcome feeding challenges and avert failure to thrive (FTT). The Dr. Brown's® Specialty Feeding System, which uses a one-way flow valve to aid in milk extraction, is the most popular such system in the U.S. Despite its popularity, no studies have shown if the Dr. Brown's® System offers an efficient and effective way to feed infants with cleft palate.

Method(s): Fifteen infants with unrepaired cleft palate, with or without cleft lip (CP ± L group) and 15 infants without clefts (Control group) were enrolled. Infants were full term, between 1 and 12 weeks of age, and used either the Dr.

Brown's® Specialty Feeding System (CP ± L group) or Dr. Brown's Natural Flow® Original or Options™ bottles (Control group) on a Level 1 or 2 nipple. Medical and feeding history, growth measurements, and developmental milestones were obtained. Parents completed the Ages & Stages Questionnaires-3 to screen

development. Infants were videotaped while feeding to assess proficiency, duration, and overall milk transfer. Signs of feeding difficulty were also analyzed.

Result(s): Mean age for participants was 67 ± 16 days. All control infants used the Level 1 nipple, while CP ± L infants used the Level 1 (n = 7) or Level 2 (n = 8). Five-minute feeding proficiency differed significantly between groups, with controls taking 45% of their feed compared to 16% for the CP ± L group on Level 1 ($p < 0.001$) and 30% on Level 2 ($p < 0.001$). Overall milk transfer was 96 ± 7% for controls and 75 ± 24% for the CP ± L group (p = 0.013). Feeding duration (minutes) differed between controls (13 ± 3) and the CP ± L Level 1 (29 ± 16; p = 0.003) and Level 2 (32 ± 11 p = 0.001) subgroups. Milk transfer rate (mL/min) was 9 ± 3 for controls compared to 3 ± 1 ($p < 0.001$) for infants with CP ± L on Level 1 and 5 ± 1 on Level 2 (p = 0.007). Coughing was observed in 40% of CP ± L infants and 27% of controls.

Conclusions (Including Clinical Relevance): Even when using specialty bottle systems, infants with CP ± L may differ from their noncleft peers in feeding proficiency, duration, and overall intake. Due to the risk of FTT from lengthy feedings with reduced caloric intake, providers should adopt a low threshold for other interventions such as milk/formula fortification. Future studies should explore further innovations in cleft feeding systems to safely maximize feeding success.

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Relevant Non-financial Relationships: Lauren Madhoun: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership; ACPA: Professional: Membership | Meghan O'Brien: Nothing to Disclose | Adriane Baylis: Has a Non-Financial Disclosure Affiliation; ASHA: Professional: Board membership; ACPA: Professional: Board membership, PHACE Syndrome Community: Professional: Board membership; international 22q Society: Professional: Membership.

Does Epiglottic Deflection Contribute to Airway Protection in Patients with Dementia?

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Purpose: A major consequence of dysphagia is aspiration, and epiglottic inversion is thought to help prevent aspiration by sealing off the airway during a normal swallow. The effects of aging and disease on the epiglottis have been minimally researched. The purpose of the current study was to examine epiglottic deflection and its relationship to airway protection in patients with dementia.

Method(s): Through a retrospective analysis of videofluoroscopic swallow studies, thin liquid swallow trials from 44 subjects (mean age: 84; range 46–100 years) were extracted and analyzed in duplicate by blinded raters. The raters judged epiglottic deflection using Component 10 (Epiglottic Movement) of the Modified Barium Swallow Impairment Profile, and airway invasion during the swallow using the Penetration–Aspiration Scale (PAS). Both epiglottic inversion and PAS scores were converted to binary variables in order to conduct Chi-square tests: PAS of 1 versus PAS of 2 + , and complete versus incomplete epiglottic inversion.

Result(s): Analyses revealed no significant differences in swallow safety based on epiglottic deflection in this population (p = 0.983). Given the research suggesting epiglottic deflection is linked to hyoid movement and pharyngeal constriction, post-hoc analyses were conducted to determine if incomplete epiglottic deflection was the result of reduced hyoid movement using normative values published by Molfenter and Steele (2014), and/or reduced pharyngeal constriction based on cutoffs from research by Stokely et al. (2015). Peak hyoid position was measured as a percentage of the C2–C4 reference scalar, and anatomically normalized pixel-based measures of maximum pharyngeal constriction were expressed as a percentage of the squared C2–C4 reference area. Analyses showed that epiglottic inversion had no relationship with peak hyoid displacement (p = 0.229), nor was there a relationship with pharyngeal constriction in this population (p = 0.136).

Conclusions (Including Clinical Relevance): In conclusion, the current study suggests that the epiglottis does not play a vital role in airway protection in patients with dementia, and it's deflection is unrelated to hyoid displacement and pharyngeal constriction in this population. Future research should investigate the physiological impairments interfering with mechanisms of airway protection in this population, as well as the kinematics related to epiglottic deflection.

Relevant Financial Relationships: Brianna Rider: Nothing to Disclose | Lauren Attner: Nothing to Disclose | Luis Riquelme: Has affiliations to disclose; New York Medical College: Salary/Stipend: Employment;Barrique SLP: Salary/Stipend:Ownership | Ashwini Namasivayam-MacDonald: Has affiliations to disclose; Adelphi University: Salary/Stipend: Employment; ASHA: Grant: Other Activities.

Relevant Non-financial Relationships: Brianna Rider: Nothing to Disclose | Lauren Attner: Nothing to Disclose | Luis Riquelme: Has a Non-Financial Disclosure Affiliation; ASHA: Professional: Membership; DRS: Professional: Membership; American Board of Swallowing and Swallowing Disorders: Professional: Membership | Ashwini Namasivayam-MacDonald: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership; ASHA: Professional: Membership.

Effect of Head Turn on Pharyngeal and Upper Esophageal Sphincter Pressures: A Study Using High-Resolution Manometry

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Purpose: Head and/or neck turn has been occasionally considered as a compensation technique for pharyngeal dysphagia patients. However, very few studies have investigated the physiological effects of head rotation in detail. In the present study, we monitored changes in pharyngeal and upper esophageal sphincter (UES) pressures during

swallowing in healthy individuals using high-resolution manometry (HRM).
Method(s): Fifteen healthy participants (mean age: 33 ± 8 years) were enrolled. Each participant was seated in an upright position and an HRM catheter was transnasally inserted. The patient was instructed to swallow 3 mL of a thick liquid in the neutral head position as well as with head positions rotated 30° and 60° toward or away from the neutral position. Swallowing for each of the head positions was repeated twice in a random order. Videoendoscopy was performed to confirm the location of HRM catheter at the UES level. The maximum pressures in the upper pharynx and at the tongue base, UES pressures, and UES activity time (i.e., the time lapse between maximum pressures prior and post UES opening) were measured.
Result(s): UES pressure measured at rest was the highest during ipsilateral head rotations and 60° and the lowest during contralateral head rotations of 30°. Friedman test and Wilcoxon signed-rank test revealed that UES pressures at rest were significantly higher during ipsilateral head rotations at 60°, and lower during contralateral head rotations at 30° and 60° compared to the neutral head position. UES activity time and nadir pressure were not significantly changed during the rotations. The maximum pressure in the upper pharynx was significantly lower at the contralateral head rotation at 60°.
Conclusions (Including Clinical Relevance): Head rotation may facilitate food transfer during swallowing by decreasing the pressure in the contralateral side of UES. Although further studies are needed in dysphagia patients with UES dysfunction, we suggest that head rotations of 30° may be appropriate and effective to decrease UES pressure.
Relevant Financial Relationships: Yoichiro Aoyagi: Nothing to Disclose | Yoko Inamoto: Nothing to Disclose | Keiko Aihara: Nothing to Disclose | Makoto Hirumuta: Nothing to Disclose | Seiko Shibata: Nothing to Disclose | Hitoshi Kagaya: Nothing to Disclose | Eiichi Saitoh: Nothing to Disclose.
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Jaw-Opening Exercise Effects on Geniohyoid Muscle Morphology and Function in Nursing Home Residents: A Randomized Controlled Study

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Purpose: Although the suprahyoid muscle is known to be affected by sarcopenia, the effectiveness of suprahyoid resistance training (RT) on increasing muscle mass is unknown. We aimed to determine the effects of jaw-opening exercise (JOE) on the morphology and function of the geniohyoid muscle (as a representative suprahyoid muscle) in nursing home residents.
Method(s): A parallel, randomized controlled study was conducted. 22 participants were allocated to either the intervention or control group. In the intervention group, JOE was performed daily (5 trials, 1 set) for 3 months. The control group did not perform JOE. Geniohyoid morphology, including the muscle area of the geniohyoid (MAGH) in the coronal and sagittal planes and geniohyoid thickness and length, were evaluated on ultrasonography as the primary outcomes. The anterior, superior hyoid, and hyoid displacements during swallowing were evaluated on ultrasonography as the secondary outcomes. Wilcoxon-signed rank test was used to compare the outcome measurements between baseline and follow-up within each group. A p-value < 0.05 was considered statistically significant. The effect size (ES) was also calculated.
Result(s): Twenty-one participants (age, 85.9 ± 6.2 years; 8 men) completed the study. In the intervention group(n = 10), sagittal MAGH was significantly larger (p = 0.02; effect size, r = 0.73) and GH length was significantly shorter at follow-up than at baseline (p = 0.009; large ES). Additionally, GH thickness tended to be larger at follow-up than at baseline (p = 0.11; large ES). In the control group (n = 11), MAGH in the coronal (p = 0.02; large ES) and sagittal planes (p = 0.006; large ES), and GH thickness (p = 0.01; large ES) were significantly smaller at follow-up than at baseline. In the intervention group, anterior hyoid movement tended to be greater at follow-up than at baseline (p = 0.24; medium ES). In the control group, hyoid superior (p = 0.11; medium ES) and hyoid displacement (p = 0.25; medium ES) tended to be smaller at follow-up than at baseline.
Conclusions (Including Clinical Relevance): JOE improved geniohyoid morphology, while geniohyoid morphology and function worsened with non-intervention. Thus, JOE, along with nutritional intervention, might help prevent sarcopenia of the geniohyoid muscle.
Relevant Financial Relationships: Koji Hara: Nothing to Disclose | Haruka Tohara: Nothing to Disclose | Chizuru Namiki: Nothing to Disclose | Kohei Yamaguchi: Nothing to Disclose | Ariya Chantaramanee: Nothing to Disclose | Yukiko Kurosawa: Nothing to Disclose | Kazuharu Nakagawa: Nothing to Disclose | Ayako Nakane: Nothing to Disclose | Shunsuke Minakuchi: Nothing to Disclose.
Relevant Non-financial Relationships: Koji Hara: Nothing to Disclose | Haruka Tohara: Nothing to Disclose | Chizuru Namiki: Nothing to Disclose | Kohei Yamaguchi: Nothing to Disclose | Ariya Chantaramanee: Nothing to Disclose | Yukiko Kurosawa: Nothing to Disclose | Kazuharu Nakagawa: Nothing to Disclose | Ayako Nakane: Nothing to Disclose | Shunsuke Minakuchi: Nothing to Disclose.

Diagnostic Accuracy of an Esophageal Sweep Protocol

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Purpose: Oropharyngeal (OP) and esophageal dysphagia may occur simultaneously. However, these symptoms are often evaluated separately. The modified barium swallowing study (MBSS) is commonly used by speech pathologists (SLPs) to assess OP swallowing. To date, there are few standardized protocols incorporating multiple bolus textures for screening of esophageal bolus flow in the upright position as an addition to the MBSS. Given the current gap in MBSS evaluation standards, health care providers may be lacking information needed to fully assess the swallowing process and work in multidisciplinary teams to create appropriate dysphagia management plans.The aim of the current study was to assess the diagnostic accuracy of a standardized esophageal sweep protocol in the upright position performed by an SLP during the MBSS compared with formal reference esophageal examinations.
Method(s): We performed a retrospective cross sectional analytic study. Consecutively referred patients with complaint of "dysphagia" who underwent a same day consult with the SLP and a gastroenterologist were included. All patients underwent an MBSS with inclusion of an esophageal sweep following a set protocol. The presence or absence of abnormal bolus flow from an anatomic

abnormality, dysmotility, or combined cause was identified using protocol definitions. Same day formal esophageal testing was completed and included timed barium emptying study or high-resolution manometry. Summary diagnostic accuracy measures were calculated.
Result(s): In total, 73 patients matched inclusion criteria. The median age of the cohort was 61.5 years (25–85) 55% were female. The sensitivity of esophageal sweep screenings for detection of esophageal abnormality was 89% (95% CI 75–96%). The specificity was 83% (CI 64–94%). The positive likelihood ratio was 5.14 (95% CI 2.3–11.49) whereas the negative likelihood ratio was 0.14(CI 0.06–0.32). The positive and negative predictive values were 89% and 83% respectively.
Conclusions (Including Clinical Relevance): The use of a systematic, multi-texture esophageal sweep protocol helps accurately identify multiphase dysphagia and should be considered for use in addition to standard MBSS testing. The inclusion of a cursory esophageal view may more adequately assess a person's dysphagia symptoms and help to promote multidisciplinary care.
Relevant Financial Relationships: Stephanie Watts: Nothing to Disclose | Joy Gaziano: Nothing to Disclose | Ambuj Kumar: Nothing to Disclose | Joel Richter: Nothing to Disclose.
Relevant Non-financial Relationships: Stephanie Watts: Nothing to Disclose | Joy Gaziano: Nothing to Disclose | Ambuj Kumar: Nothing to Disclose | Joel Richter: Nothing to Disclose.

The C3 Unit: A Visual Approximation of Hyoid Displacement During VFSS

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Purpose: Clinicians must consider patient size differences when analyzing swallow physiology during videofluoroscopy studies (VFSS). A strong correlation exists between patient height and the distance between the C2 (inferior-anterior) and C4 (superior-anterior) vertebral bodies. Clinicians plot and calculate this anatomical scalar after completion of the exam. Judging hyoid displacement using the C2–C4 scalar is impractical, given the clinician's goal to examine hyoid displacement and trial treatment options in real-time. The purpose of this feasibility study was to determine if the height of the C3 vertebral body can be used as a valid, visual approximation of hyoid displacement for use during VFSS. Our hypothesis is that the height of one C3 unit will approximate the horizontal and vertical displacements of the hyoid bone.
Method(s): 190 patients, grouped into Penetration–Aspiration Scale (PAS) score groups (1&2, considered "normal airway protection", 3–6, and 7&8), underwent VFSS. Trained raters identified the inferior-anterior corner of the C2 and the superior-anterior corner of the C4 vertebral bodies to determine C2–C4 distance; the anterior-inferior and anterior–superior corners of C3 vertebral body to determine C3 height; and the anterior-inferior and posterior-superior corners of the body of the hyoid bone. Maximum horizontal and vertical displacements of the hyoid bone were calculated in terms of C2–C4 and C3 segments as units. An ANOVA was performed.
Result(s): The proportion of C3 to C2–C4 was 0.385 (range 0.383–0.386). Hyoid bone displacement approximated one C3 unit in horizontal and vertical directions. Horizontal and vertical displacements of the anterior-inferior and posterior- superior corners of the hyoid body in C3 units, respectively, were: 0.78–0.88 and 1.09–1.05 (PAS 1&2); 0.72–0.82 and 1.06–1.03 (PAS 3–6); and 0.72–0.83 and 1.02–0.98 (PAS 7&8). Significant differences were found in the horizontal displacement of the anterior–inferior ($p = 0.005$) and posterior-superior ($p = 0.02$) corners of the hyoid body between patient groups with PAS scores of 1&2 and 3–6.
Conclusions (Including Clinical Relevance): The C3 unit provides a valid and convenient visual estimation of hyoid displacement for use during VFSS. Future work will examine this scalar with healthy participants and will investigate the difference between horizontal and vertical displacements, and whether the C4 scalar provides similar results.
Relevant Financial Relationships: Amanda Mahoney: Has affiliations to disclose; NIH/NSF: Salary/Stipend: Independent contractor (Including contracted research) | Jim Coyle: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH/NSF: Salary/Stipend: Independent contractor (Including contracted research) | Yassin Khalifa: Has affiliations to disclose; NIH/NSF: Salary/Stipend: Independent contractor (Including contracted research) | Aliaa Sabry: Nothing to Disclose | Ervin Sejdic: Has affiliations to disclose; University of Pittsburgh: Salary/Stipend: Employment; NIH/NSF: Salary/Stipend: Independent contractor (Including contracted research).
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Central Versus Peripheral Contributions to Post Stroke Lingual Weakness in a Rat Model

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Purpose: Lingual weakness after stroke is associated with dysphagia and is often targeted by exercise interventions. Chronic weakness after stroke is attributed to both impaired ability to centrally activate target muscles and reduced force generating capacity within muscles. However, how these factors contribute to lingual weakness after stroke is not known. The middle cerebral artery occlusion (MCAO) rat model of post stroke dysphagia is associated with both chronic lingual weakness and deficits in swallowing function. We used this model to test the hypotheses that both reduced muscle force generating capacity (maximum stimulated force) and reduced ability to activate the muscle (Percent Voluntary Activation) contribute to lingual weakness (maximum voluntary force).
Method(s): Six-week-old rats were randomLy assigned to MCAO ($N = 8$) or sham ($N = 9$) surgeries and trained to press an instrumented disk with the tongue for a water reward. Maximum voluntary tongue force was determined prior to MCAO and at 8 weeks post-surgery, which represents the chronic phase of stroke in rodent models. At 8 weeks, bilateral stimulation of the medial hypoglossal nerve was used to determine maximum protrusive force generating capacity. Swallowing function was assessed by videofluoroscopy.
Result(s): Maximum stimulated force was not significantly different between groups (MCAO = 408.3 ± 184.1 mN, Sham = 327.9 ± 117 mN, $p = 0.147$). Percent Voluntary Activation (voluntary force/stimulated force) was significantly reduced in the MCAO group (MCAO = 26.7 ± 15.6%, Sham = 41.9 ± 10.2%, $p = 0.015$) and moderately correlated with mean bolus area (Pearson's $r = 0.438$, $p = 0.003$), a measure of swallowing function previously found to be reduced in the MCAO model.

Conclusions (Including Clinical Relevance): These data suggest that the primary cause of chronic lingual weakness after stroke is an impairment in central control of muscle activation rather than a deficit of force generating capacity in lingual muscles. Percent Voluntary Activation deficits in the absence of muscle force deficits have also been reported in select hand and leg muscles. Further assessments of lingual muscle physiology in this stroke model, including muscle cross sectional area and fiber diameter, will augment this initial assessment of central and peripheral contributions to post stroke lingual weakness.

Relevant Financial Relationships: Miranda Cullins: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | John Russell: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | Linda Rowe: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | Nadine Connor: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Miranda Cullins: Nothing to Disclose | John Russell: Nothing to Disclose | Linda Rowe: Nothing to Disclose | Nadine Connor: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership.

Effectiveness of Direct vs Indirect Treatment for a Specific Swallowing Pathophysiology

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Purpose: A primary goal of dysphagia therapy should be to apply treatments that target specific swallowing impairment(s). However, connecting treatments to specific impairments is challenging because several research studies include patients with heterogeneous pathophysiologies (i.e. poor UES opening, swallow onset delays, poor pharyngeal constriction) to test the effects of a single treatment modality (i.e. effortful swallow), yet report findings without consideration of the varied pathophysiologies in the study sample. The goal of this study was to compare the immediate effectiveness of a therapy that directly targets a specific pathophysiology to others that are known to have indirect effects on the same impairment.

Method(s): We targeted laryngeal vestibule closure (LVC), because it is the primary mechanism for preventing food or liquid from penetrating the airway. 28 patients with LVC impairments were divided into 2 groups. Group 1 (direct LVC training group) received LVC training by performing the volitional LVC (vLVC) maneuver which explicitly instructs patients to prolong LVC for > 2 secs. Group 2 (indirect LVC training group) received a series of traditional dysphagia therapies that have been shown to have an effect on LVC (i.e. chin tuck, effortful swallow), but do not require patients to specifically modulate LVC. Videofluoroscopy was used to image, record, and analyze LVC timing (duration and reaction time) and LVC range of motion (MBSImP Component 11-LVC and Component 10-Epiglottic Inversion) to determine if strategies were 1 = effective or 0 = not effective in improving LVC physiology compared to baseline natural swallows (swallowing without a therapeutic technique) completed prior to training.

Result(s): Patients with a primary pathophysiology of LVC impairment who received direct LVC training (Group 1) had a significant improvement in LVC compared to those who received indirect LVC training or traditional dysphagia therapies (Group 2) ($p < 0.001$). In Group 1, increased arytenoid approximation to the base of epiglottis and increased duration of LVC were the most notable functional improvements in LVC.

Conclusions (Including Clinical Relevance): Implementing treatment strategies that directly target a physiologic impairment might be essential for a better understanding of treatment efficacy for specific swallowing impairments.

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Relevant Non-financial Relationships: Alicia Vose: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.

A High Resolution Pharyngeal Manometry Protocol and Metrics: Recommendations of an International Working Group

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Purpose: The establishment of a recommended protocol and swallow function metrics for High Resolution Pharyngeal Manometry (HRPM) would provide a starting point for the development of a framework for unambiguous scientific and clinical communication. A HRPM International Working Group was formed to address the diagnostic and therapeutic utility of HRPM technology in relation to oropharyngeal dysphagia. The Working Group aimed to establish a consensus on the minimum standard protocol (MSP) for conducting a HRPM procedure and to develop a core outcome set (COS) of swallowing metrics.

Method(s): The Working Group developed via questionnaire surveying current practices in dysphagia, and undertook literature review and Delphi consensus considering 22 published HRPM metrics (with associated definitions).

Consensus required 70% agreement and no more than 20% disagreement. Scores and commentary were anonymized prior to re-scoring.

Result(s): The questionnaire was completed by experts from 8 referral Centers that utilize HRPM (4 United States, 2 Australia, 1 Europe and 1 New Zealand). The MSP included; use of topical anesthesia with 5 min allowed for catheter accommodation, delivery of test boluses by syringe, testing with triplicate 5 mL and 10 mL boluses of International Dysphagia Diet Standardization Initiative (IDDSI) Level 0 and 4 consistency, and the possibility of 20 mL on a case by case basis.

Four Delphi voting rounds reached a stable consensus for eight HRPM metrics describing relevant swallow phenomena. The COS included the following: Integrals of pressure (over span x time) to measure lumen occlusive pressure, which should be determined for the whole pharynx and at the velum, mesopharynx and hypopharynx.

Hypopharyngeal intrabolus pressure, UES integrated relaxation pressure and UES relaxation time to measure UES restriction. Inference of UES opening extent by intraluminal impedance was also recommended.

Conclusions (Including Clinical Relevance): This minimum protocol and outcomes set represents the first step in an evolving process

and will require revision based on future objective evidence. However, it is envisaged that a classification framework for pharyngeal disorders, akin to Chicago Classification, could ultimately emerge from this and future efforts.

Relevant Financial Relationships: Taher Omari: Has affiliations to disclose; Women's and Children's Health Network Inc: Hold Patent on equipment: Other Activities | MIchelle Ciucci: Has affiliations to disclose;1R01DC14358-01, R01 DC008149 T32DC009401, NIDCD R21DEC016071: Grant: Other Activities | Kristin Gozdzikowska: Nothing to Disclose | Ester Hernández: Nothing to Disclose | Katherine Hutcheson: Has affiliations to disclose; Medtronic Inc: Honoraria: Other Activities | Corinne Jones: Nothing to Disclose | Julia Maclean: Nothing to Disclose | Nogah Nativ- Zeltzer: Nothing to Disclose | Emily Plowman: Has affiliations to disclose; NIH 1R01 NS100859-01: Grant: Other Activities | Nicole Rogus-Pulia: Nothing to Disclose | Nathalie Rommel: Has affiliations to disclose; Women's and Children's Health Network Inc: Hold Patent on equipment: Other Activities | Ashli O'Rourke: Has affiliations to disclose; Medtronic Inc: Consulting fee: Consulting; Carolina Speech Services: Honoraria: Board membership; Medical University of South Carolina: Salary/Stipend: Employment.

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Characterization and Mechanism of Esophago-Esophageal Contractile Reflex of Striated Muscle Esophagus

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Purpose: Prior studies have characterized esophago-esophageal reflexes within the smooth muscle esophagus, but not the striated muscle esophagus. The aim of this study was to characterize the esophago-esophageal contractile reflex (EECR) of the striated muscle esophagus and determine its mechanism of initiation.

Method(s): Cats (N = 30) were decerebrated and esophageal motility recorded using EMG or manometry. Reflexes were stimulated by balloon distension of the esophagus. The effects of HCl (pH 1.2) or NaCl (pH 5.6) esophageal perfusion (1 mL/min for 15 to 30 min); transecting the pharyngo-esophageal nerve (PEN, N = 3), recurrent laryngeal nerve (RLN, N = 2), or vagus nerve (X, N = 3); or the administration of hexamethonium (HEX, 5 mg/kg, IV, N = 3) on EECR were determined.

Result(s): We found that distension of all portions of the striated muscle esophagus caused contraction of the esophagus rostral to the distension and the UES, however, stimulation of the smooth muscle portion activated only the UES. The threshold stimulus needed to activate the esophagus increased (27 $\pm$ 3 to 42 $\pm$ 6 mmHg) caudally in a linear fashion ($P < 0.05$) which resulted in progressively greater delay (1.2 $\pm$ 0.1 to 1.8 $\pm$ 0.3 s) to activate the esophagus in a caudal direction. The magnitude of the EECR was greatest at proximal thoracic esophagus. During HCl, but not NaCl, perfusion a series of EECR (rate of 1/44 $\pm$ 5 s) was activated. After 15 to 30 minute of HCl, but not NaCl, perfusion the threshold to activate EECR was increased or EECR was blocked. Transection of the PEN blocked the EECR of the proximal 5 to 6 cm of the esophagus, RLN blocked the EECR at 6 to 8 cm from the UES, and X blocked the entire EECR. HEX administration did not block the EECR but did block esophageal peristalsis in the lower 6 to 8 cm of the esophagus.

Conclusions (Including Clinical Relevance): We conclude that distension of the striated muscle esophagus activates contraction above the point of distension, i.e. the EECR, and both its sensory and motor components are in the striated muscle esophagus, Activation of the EECR by a non-rapidly distending stimulus can make the EECR look like esophageal peristalsis. Acid exposure of the esophagus tends to repetitively activate the EECR. The EECR is activated by a vago-vagal reflex, as the vagus nerve in animals is composed of multiple vagal branches, i.e. PEN, RLN, and X. This EECR may have a role in preventing supra-esophageal reflux.

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Relevant Non-financial Relationships: Ivan Lang: Nothing to Disclose | Bidyut Medda: Nothing to Disclose | Reza Shaker: Nothing to Disclose.

Changes in Tongue Muscle Gene Expression Following Chemoradiation

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Purpose: Concurrent chemoradiation (CCRT) for head and neck cancer treatment exposes normal tissues to radiation, which has many devastating effects and often results in difficulty with swallowing. While muscle weakness and fibrosis are possible etiologies for disruptions in critical communicative and deglutition functions following radiation, very little research has been performed on underlying molecular changes within muscles of the head and neck following chemoradiation.

Method(s): Twenty Sprague-Dawley rats received a dose Cisplatin (3 mg/kg) prior to being exposed to 10 fractions of 4.5 Gy/day of radiotherapy (LINAC). Rats were divided and euthanized at 2 weeks and 3 months post-radiation. Ten additional rats served as controls. Rat tongue muscle tissue was used to perform next-gen RNA sequencing experiments.

Result(s): There were more than 880 genes (FDR adjusted $p < .05$) that demonstrated significant differences between the control and 3-month group. Two weeks following chemoradiation therapy, treated rats showed a gene expression profile that is indicative of cell death including BTG2, EGR1, and FOS. When comparing the 2-week to the 3-month post-chemoradiation group, we saw increased gene expression related to collagen biosynthesis (Adamts2, Col15a1, Col1a1, Col3a1, Col4a1, and Col4a3) and a reduced expression of genes involved in mitochondrial metabolism (Acot2, Adhfe1, and Ldhb).

Conclusions (Including Clinical Relevance): We describe molecular signatures at different time points following CCRT for tongue muscle. Understanding the time course of molecular changes occurring in head and neck muscles following CRRT is critical to identify molecular targets for future treatments of patients with HNC to prevent CRRT induced dysphagia.

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Effects of a Resistance Exercise Device on Pharyngeal Manometric Isocontours in the Elderly

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Purpose: Previous studies of pharyngeal pressure metrics in otherwise healthy elderly subjects have shown evidence of diminished striated muscle strength resulting in suboptimal deglutitive biomechanics. Recent development of a swallow resistance exercise device (sRED) has shown six weeks of swallow training during externally applied force resisting deglutitive hyo-laryngeal elevation improves some metrics of deglutitive pressure phenomena like peak peristaltic pressures and contractile integrals. Analysis of metrics derived from manometric isocontours do not give a complete picture of where, with respect to the isocontour, the exercise has effect and when in the swallowing sequence these effects are prominent. Purpose: Evaluate pharyngeal deglutitive pressure before and after six weeks of sRED training across multiple subjects using an innovative analysis technique utilizing measures of centrality and variation for investigating the entirety of the pharyngeal isocontour.
Method(s): A total of 18 elderly volunteers (75 + 7 years; 8 females) with no complaint of dysphagia were studied using high-resolution pharyngeal manometry before and after six weeks of the swallow strength training exercise. During the manometric studies, subjects performed five repetitions of dry, 5 mL and 10 mL water swallows. Bolus volume and exercise effects on pressure were tested using two-way analysis of variance spanning the entire space-time isocontours.
Result(s): The effects of exercise were mapped on the normalized average isocontours revealing significant differences after sRED training. Differences were in the contractile portion of the isocontour in the mesopharynx and hypopharynx wherein average pressures were greater after six weeks of sRED exercise. Significant differences in the UES region were also shown in the portion of the isocontour showing deglutitive relaxation wherein average pressures were lesser after six weeks of sRED exercise.
Conclusions (Including Clinical Relevance): Manometric analyses utilizing the normalized isocontour across space and time in the pharynx shows significant effects of six weeks of swallow resistance exercise in elderly subjects. These insights into pharyngeal pressure phenomena are not afforded by analysis of derived global metrics like contractile integral or peak peristaltic pressures.
Relevant Financial Relationships: Mark Kern: Nothing to Disclose | Dilpesh Agrawal: Nothing to Disclose | Reza Shaker: Nothing to Disclose.
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High Flow Oxygen Therapy via Nasal Prongs ($HF0_2NP$) and Swallowing: An Evidence Review and a Snapshot of Clinical Practice Data of Australian Speech Pathologists

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Purpose: High flow nasal therapy (HFO_2NP) delivers a high flow mix of humidified air and/or oxygen via nasal cannula. HFO_2NP use is increasing, particularly within the intensive care unit to support patients' respiratory function. In Australia, anecdotally, Speech Pathologists (SP) have reported increased requests to assess swallow function for patients on HFO_2NP in the absence of national clinical guidelines. Speech Pathologists from the NSW Critical Care and Tracheostomy Evidence Based Practice group noted variable practice among members in the assessment and management of patients on HFO_2NP. In response to this reported variability, elements of E^3BP methodology were applied to provide further insight for the Australian context.
Method(s): A scoping literature review was conducted with 22 articles identified; 2 papers addressed the clinical question and were critiqued. Results from the literature review alone were inconclusive to guide clinical practice and a quality improvement framework was used to further explore practice. A national web survey containing 8 questions was distributed to SP working in adult practice areas via the Critical Care and Tracheostomy listserve, SPECS listserve and NSW Speech Pathology managers network.
Result(s): A total of 97 Speech Pathologists responded. Of these, 49.5% were aware of the unclear research evidence. In regard to HFO_2NP and swallow function, 49.5% felt $HF0_2NP$ impairs the swallow, 27% were unsure, 7% felt $HN0_2NP$ improves swallow function and 16.5% felt dysphagia was resultant from other comorbidities. Practice was variable: 4% reported not assessing patients on $HF0_2NP$, 25% offered all patients an assessment and 71% considered feeding assessment considering other patient factors. As flow and oxygen rates increased, 68% choose not to assess/feed (> 50L/M). Under a third of SPs considered an assessment regardless of flow rate or 0_2support.
SPs wanted guidance in this area and that they felt "high flow" was not clearly defined in the literature.
Conclusions (Including Clinical Relevance): Elements of the E^3BP framework provided a more holistic understanding of SP practice. The majority of clinicians reported assessing patients on an individual basis versus assessing to a set oxygen/flow rate. This infers $HF0_2NP$ is not seen as an independent barrier but a possible factor to assessment; with clinicians considering many possible causative factors of dysphagia.
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Relevant Non-financial Relationships: Amy Freeman-Sanderson: Has a Non-Financial Disclosure Affiliation; DRS: Professional: Membership | Klint Goers: Nothing to Disclose | Alyssa Karanges: Nothing to Disclose.

Aural Stimulation with Capsaicin Ointment Can Prevent Pneumonia in Elderly Dementia Patients with a High Risk of Aspiration

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Purpose: In the present study, we examined the effects of daily application with capsaicin ointment to the external auditory canal for

6 months on the development of pneumonia in elderly dementia patients with a high risk of aspiration.
Method(s): Twenty-nine oldest-old bedridden inpatients with a high risk of aspiration, who suffered from dementia with a history of cerebrovascular disease were enrolled. Ointment containing 0.025% capsaicin was alternatively applied to each external auditory canal with a cotton swab once a day for 6 months.
Result(s): The incidence of pneumonia for 6 months before the intervention was 1.80 ± 0.37 in the patients. During daily aural application with capsaicin ointment, the incidence of pneumonia for 6 months were significantly decrease to be 0.40 ± 0.29 ($p < 0.01$). No adverse effects such as otalgia were induced.
Conclusions (Including Clinical Relevance): These findings suggest that daily long-term aural stimulation with capsaicin ointment enhanced the cough reflex via Arnold's ear-cough reflex, resulting in the reduction of incidence of pneumonia in elderly dementia patients with a high risk of aspiration. The daily aural stimulation with capsaicin ointment may be a safe and promising intervention to prevent aspiration pneumonia in elderly.
Relevant Financial Relationships: Osamu Jinnouchi: Nothing to Disclose | Eiji Kondo: Nothing to Disclose | Hiroki Onishi: Nothing to Disclose | Ikuji Kawata: Nothing to Disclose | Hiroyasu Bando: Nothing to Disclose | Noriaki Takeda: Nothing to Disclose.
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Respiratory (de)Coupling in Healthy Swallows: Head Position Effect

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Purpose: Earlier studies have established differences in pharyngeal structure and swallow dynamics with a chin-down posture. These changes may influence the measures of respiratory de-coupling but have not been a subject of scientific research till date.
Method(s): Thirty healthy individuals were recruited from among the staffs and students of a professional college. All were screened for any structural, functional, systemic, neuro-muscular deviations in swallowing, speech, language, or cognitive skills. Data was recorded using the synchronized modules of Swallowing Signals Lab during swallow of three bolus types in two volumes in two positions in random order. Each of the 1080 swallows obtained were analyzed for swallow apnea duration, duration and slope of the respiratory cycle before and after swallow, and five pre-defined event intervals across modules.
Result(s): Friedman test revealed significant differences across measures considered ($c^2 = 742.59$, $P = 0.00$). Wilcoxon comparisons revealed significant differences in event intervals in larger bolus volumes in all bolus types ($p < 0.05$) across neutral and chin-down position. There was no significant difference in the duration and slope of respiratory cycles across head position in both volumes and all consistencies. Apnea duration was significantly longer in chin-down position for larger bolus volume in honey-thick ($Z = 2.95$, $p = 0.00$) and pudding bolus ($Z = 2.03$, $p = 0.04$).
Conclusions (Including Clinical Relevance): The findings of this study suggested that changes in head position do not directly influence the respiratory measures before, during or after small bolus swallows. Chin-down position demand more extended airway closure and hence longer swallow apnea. Inferring from the results, lung volume at swallow initiation is independent of the head position in which swallow is executed or the duration for which an airway de-coupling is anticipated. Changed head position influenced the onset and offset of various events for larger bolus volumes included in this study, irrespective of the bolus type. A typical individual may be able to sustain this longer breathing arrest, but one needs to be cautious while implementing this postural strategy in persons with inadequate respiratory reservoir. This study also indicates the need for deriving separate norms for non-invasive measures of respiratory-swallow coordination across positions before making any comparison with the clinical group.
Relevant Financial Relationships: GAYATHRI KRISHNAN: Nothing to Disclose | Goswami S. P.: Nothing to Disclose.
Relevant Non-financial Relationships: GAYATHRI KRISHNAN: Nothing to Disclose | Goswami S. P.: Nothing to Disclose.

Factors Influenced on Pharyngeal Residue at Valleculae and Pyriform

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Purpose: Pharyngeal residue in the valleculae or pyriform sinuses poses a risk for post-swallow aspiration. Several possible reasons for pharyngeal residue may include: weakness of pharyngeal constriction, velopharyngeal closure incompetence, reduced UES opening, etc. However, it is hypothesized that factors for residue in the valleculae and pyriform sinuses may be different. This study aimed to investigate the factors influenced on the pharyngeal residue at vallecula and pyriform.
Method(s): Twenty-three dysphagic patients participated. Videofluorography (VF) was recorded during 10 mL thin barium swallows. Pharyngeal residue was assessed using the normalized residue ratio scale (NRRS). Distance of hyoid movement, larynx movement, and UES opening, and angle change of epiglottis during swallowing was also calculated by VF images using Image J. Pharyngeal pressure during 10 mL saline swallows was measured with high-resolution manometry (HRM). Magnitude and duration of velopharynx (VP), tongue base (TB), hypopharynx (HP), and UES pressure was calculated. The relation between pharyngeal residue at vallecula and pyriform, VF biomechanics, and HRM was investigated using Pearson's correlation coefficient. Furthermore, factors influencing pharyngeal residue was assessed using multiple liner regression analysis. Statistical significance level was set at $p = 0.05$.
Result(s): The NRRS at the valleculae had significant correlation with magnitude of pharyngeal pressure at VP ($r = -0.644$), TB ($r = -0.720$), HP ($r = -0.531$), and amount of hyoid movement ($r = -0.570$) and UES opening on VF ($r = -0.588$). With multiple regression for vallecular residue, the amount of hyoid movement and pharyngeal pressure at tongue base were the only significant items. The NRRS at pyriform had significant correlation with the magnitude of pharyngeal pressure at VP ($r = -0.472$), TB ($r = -0.495$), HP ($r = -0.425$), and amount of UES-opening on VF ($r = -0.542$). In the multiple regression analysis for pyriform sinus reside, amount of UES opening was the only significant item. There was no relationship between pressure durations and pharyngeal residue.
Conclusions (Including Clinical Relevance): Pharyngeal residue in both the valleculae and pyriform sinuses were related to pharyngeal pressure amplitude and UES opening on VF. The most salient factors for vallecular residue were hyoid movement and mid-pharyngeal pressure while that for pyriform sinus residue was the amount of UES opening on VF.

Relevant Financial Relationships: Kazuhiro Hori: Nothing to Disclose | Corinne Jones: Nothing to Disclose | Sarah Rosen: Nothing to Disclose | Suzan Abdelhalim: Nothing to Disclose | Takahiro Ono: Nothing to Disclose | Timothy McCulloch: Nothing to Disclose.
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Establishing Consensus on the Nature of Risk and Comfort Feeding in Stroke and Geriatric Healthcare

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Purpose: Risk and/or comfort feeding scenarios, when a person eats/drinks despite the risk of negative health consequences, arise often. Recent research has focused on devising management protocols despite the fact that little has been done to investigate the nature of these feeding situations or agree on terminology. Recognising this research gap, we sought to establish consensus on the nature of risk and/or comfort feeding situations in stroke and geriatric healthcare.
Method(s): A modified electronic delphi technique was used to establish expert consensus on the nature of these dysphagia management approaches. Experts included physicians, speech and language pathologists, dietitians and nurse specialists. Thematic analysis was performed on data from round one to develop statements on the nature of risk and/or comfort feeding. Statistical analysis, including percentage agreement/disagreement, measures of central tendency and dispersion, was used to establish consensus on statements and provide statistical feedback.
Result(s): A nuanced relationship exists between risk and comfort feeding, although not felt to be the same dysphagia management approach they were determined to be related. Consensus was reached for 103/114 statements defining the nature of risk and comfort feeding. Alternative terminology, 'eating and drinking at risk' and 'eating and drinking for comfort' were suggested.
Conclusions (Including Clinical Relevance): This study provides insights into the nature of risk and comfort feeding approaches in stroke and geriatric healthcare which will improve understanding of these clinical scenarios and inform future management protocols.
Relevant Financial Relationships: Julie Keane: Has affiliations to disclose; The Meath Foundation, Tallaght University Hospital: Scholarship: Other Activities | Éanna Horan: Nothing to Disclose | Desmond O'Neill: Nothing to Disclose.
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Navigated Transcranial Magnetic Stimulation to Evoke Lingual Pressure in Stroke Survivors and Controls

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Purpose: Reduced cortical excitability and lingual pressure dysfunction may occur following stroke. It remains unknown if transcranial magnetic stimulation (TMS) directed to the lingual cortex could potentially aid in recovery by directly facilitating lingual pressure generation. This proof of concept trial explored if single-pulse, navigated TMS (nTMS) would directly evoke higher lingual pressure during a sustained, submaximal isometric press in intact and disrupted neural networks.
Method(s): Co-registration of brain regions activated during task-based functional magnetic resonance imaging (Siemens Tim Trio 3T scanner with 32-channel head coil) with external cranial coordinates using the eXimia neuronavigation system determined nTMS stimulation site within the stronger hemisphere in five controls (Mage = 67.0(11.2)) and in the contralesional hemisphere for four stroke survivors with dysphagia (Mage = 66.3(7.0). Evoked lingual pressures were sampled using the Iowa Oral Performance Instrument and WinDaq software across 45–65% of maximum stimulator output (28T; Magstim 200^2) in 5% increments. Controls repeated nTMS trials at 65% maximum output with a bite block to explore potential off-target interference of mandibular elevators on lingual pressure measurement.
Result(s): Only one subject of nine (Control 2) had a nTMS stimulation site within commonly reported ranges of external cranial coordinates for the lingual cortex (i.e., 8–11 cm lateral and 2–4.25 cm anterior from vertex). Lingual pressure increased linearly with intensity for both groups ($p = .005$). Active motor thresholds were elevated in the experimental group compared to controls ($p = .025$). Lingual pressure latency from stimulus to peak was stable across intensities ($p > .05$). Jaw stabilization reduced the mean magnitude of evoked lingual pressure by 16%.
Conclusions (Including Clinical Relevance): nTMS can directly upregulate peak lingual pressure and suggests potential application in defining active motor thresholds in intact and disordered corticolingual pathways. Corticolingual stimulation sites in older adults and after stroke largely differed from optimal external coordinates in the literature, many of which were established in young adults. Optimal procedures to elicit and determine active motor thresholds for lingual pressure generation warrant continued investigation as does the therapeutic role of nTMS to address impaired corticolingual pathways following stroke.
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Dose in Exercise-Based Dysphagia Therapies: A Systematic Review

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Purpose: Dose is a critical determinant of treatment efficacy in exercise-based therapies. In dysphagia management, the range of exercise dose used clinically and in research is variable, and optimal doses for many exercise treatments have not been determined. The primary goal of this systematic review was to create a directory of the dose ranges that have been reported in the literature.
Method(s): Abstracts related to any adult, exercise-based dysphagia treatment program were collected from four databases. Any stimulation-based or manual manipulation programs were excluded in that these methods may involve different physiological constructs. Our search revealed 1367 abstracts with 149 full text articles examined, with 63 included in final review.
Result(s): A majority of papers (20) involved protocols with multiple exercise components, involving at least 2 or more therapy approaches (e.g. effortful paired with Shaker). The second most commonly cited exercise was the Shaker or head lift exercise, studied in 12 papers. Other exercise protocols examined included tongue (9), EMST or respiratory training (4), Mendelsohn (3), TheraBite (2), Head Matters (2), among other, single studies of specific or unique protocols (9).
Doses prescribed in these various exercise protocols varied greatly. Broadly, 16 different protocols were cited for sessions/day and days/week of exercise. The most consistently used protocol for exercise dose was 3 sessions/day, 7 days/week, cited in 24 studies. Within specific therapy categories, variability was still present: although 3 sessions/day. 7 days/week was most commonly prescribed in Shaker/Headlift (7/12 studies), however 4 other dose protocols were also used. The only consistently prescribed protocol by exercise type was for Mendelsohn, citing 2 sessions/day, 7 days/week and the Head Matters program, 3 sessions/day, 7 days/week.
Conclusions (Including Clinical Relevance): This review demonstrates the lack of consensus in dose prescription for most exercise-based therapies in dysphagia management. Further, 17 papers considered in this review could not be included as sufficient dose information was not provided in the methods. These findings suggest that dose-related mechanisms could be examined further in future scientific study and that dosing information should be reported in methods to promote better data sharing and rigor.
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Pharyngeal Bolus Clearance in Patients with Non-tuberculous Mycobacteria

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Purpose: Non-tuberculous mycobacteria (NTM) is an intracellular microorganism that causes cavitary disease and nodular bronchiectatic disease of the lung. Common symptoms include chronic cough, sputum production and frequent pneumonias. Patients with NTM appear to have impaired swallow function as represented by impaired airway protection. Our aim is to determine bolus clearance in patients with NTM compared with a control.
Method(s): Videofluoroscopy (VF) was prospectively collected from 195 patients:132 patients with NTM (90 females; ages 30–90) and 63 age- and sex-matched normal controls with normal pulmonary function tests and no pulmonary disease (39 females; ages 27–92).Two boluses of 3, 5, 10 mL thin liquid, two 5 mL puree Varibar, and cracker were analyzed per subject (N = 1,755 swallows).Outcome measures included ordinal ratings of residue in the valleculae and pyriform sinuses. The correlation between clinical information and the present of pharyngeal residue structures was analyzed by Fisher's exact test for categorical variables and Wilcoxon's rank sum test for comparisons of continuous variables between groups.
Result(s): Inter- and intra-rater reliability of the ordinal ratings were assessed using two-way random intraclass correlation coefficients (ICC(2,1)) on 20% of the data with good results (intra-rater: ICC = 0.92, 95% CI 0.70–0.97 and inter-rater: ICC = 0.92, 95% CI 0.81–0.97).The ratings of residue in the valleculae were significantly higher in the NTM group compared to the control group for one of the 3 mL bolus ($p = 0.008$), for 5 mL boluses ($p = 0.009$ and $p = 0.004$), 10 mL boluses ($p = 0.0005$ and $p = 0.0006$), puree ($p = 0.006$), cracker ($p = 0.005$).The ratings of residue in the pyriform sinuses were also significantly higher in the NTM group for 3 mL boluses ($p = 0.0002$ and $p = 0.01$), 5 mL boluses ($p = 0.0003$ and $p = 0.002$), 10 mL boluses ($p = 0.001$ and $p = 0.001$), puree trials ($p < 0.0001$ and $p < 0.0001$).Wilcoxon's rank sum test determined no age difference and Fisher's exact test determined no gender difference between the NTM and control groups.
Conclusions (Including Clinical Relevance): Patients with NTM appear to have reduced bolus clearance than healthy individuals with no pulmonary disease, as represented by ratings of residue in the valleculae and pyriform sinuses.Future work is needed to elucidate the interaction between the respiratory-swallowing systems and airway protection and responsiveness to swallowing treatment for patients with NTM.
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Predictors of Functional Oral Intake Status in Individuals with Dysphagia

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Purpose: To identify demographic and clinical factors predictive of functional oral intake status of persons undergoing a video fluoroscopic swallow study (VFSS).
Method(s): Individuals undergoing VFSS between 01/01/12 and 06/30/15 were identified from an electronic database (n = 776). Demographic information at the time of the VFSS including age, gender, presence of tracheostomy, smoking status and BMI were derived from the medical chart. Additionally, data from the VFSS were extracted, including the Penetration Aspiration Scale (PAS) score and objective temporal and biomechanical measurements. EAT-10 questionnaire and Functional Oral Intake Scale (FOIS) scores obtained on the date of the VFSS were also collected. Data were analyzed using ordinal regression to assess their association with FOIS score.
Result(s): PAS score, pharyngeal constriction ratio (PCR), EAT-10 score, gender and trach status were significantly predictive of functional oral intake status ($p < 0.05$). An EAT-10 score of more than 14 was significantly more likely to result in a more severe (FOIS < 5) functional oral intake score (odds ratio = 11.95, 95% CI 6.48–22.05) ($P < 0.001$). An elevated PCR score (> 0.18) was significantly more likely to result in a more severe functional oral intake status (odds ratio = 8.61, 95% CI 5.66–13.10) ($P < 0.001$).
Conclusions (Including Clinical Relevance): Among patients undergoing VFSS in a tertiary center, PAS score, PCR, EAT-10 score, gender and tracheostomy status were strongly associated with functional oral intake status.
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Expiratory Muscle Strength Training (EMST) for Radiation-Associated Dysphagia (RAD): Results of a Pilot Prospective Trial

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Purpose: To examine feasibility and outcomes of expiratory muscle strength training (EMST) among patients with radiation-associated dysphagia (RAD) after treatment for head and neck cancer (HNC). We hypothesized EMST is a safe and feasible paradigm to improve airway closure and/or airway clearance mechanisms in survivors with RAD.
Method(s): 30 disease-free HNC survivors ≥ 3-months post-radiotherapy (median: 39 months) enrolled in an 8-week single arm pilot clinical trial of EMST (25 repetitions, 5 days/week, 75% load adjusted weekly per individualized maximum expiratory pressure [MEP]). MEP, peak cough flow (PCF), videofluoroscopy, and questionnaires were conducted pre-post 8-weeks of EMST. The primary endpoint was change in MEP after EMST.
Result(s): The trial completion rate was 87% (26/30). Adherence was high among completing participants (186/208 [89%] therapy sessions attended, and 23,620/26,000 reps [91%] exercise adherence self-reported). 23% of participants experienced adverse events unrelated to EMST per DSMB. MEPs significantly improved by 67% ($p < 0.001$) and PCF increased non-significantly by 8% ($p = 0.23$). Three of 5 pre-EMST feeding tubes were removed and diet improved per IDDSI-FDS ($p = 0.05$). Analyses of videofluoroscopy are ongoing.
Conclusions (Including Clinical Relevance): Preliminary results suggest that EMST is feasible and safe among aspirating HNC survivors. Expiratory function increased after EMST which could translate into improved airway protection among HNC survivors. Randomized trials are supported.
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Changes in Infant Suck Function Throughout a Suck Sample

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Purpose: The goal of this study was to compare how infants' suck changes throughout a suck sample.
Method(s): Infants (< 6 months of age) sucked on our custom research pacifier for 2-min. The first five bursts of non-nutritive (NNS) suck were compared across infants examining the following dependent measures: NNS cycles/burst, NNS frequency (Hz) and NNS Amplitude (cmH_20). These data were collected from various studies performed in the Speech and Neurodevelopment Lab where a 2-min NNS sample was part of the study procedure.
Result(s): Thus far, 74 participants have had their NNS sampled from our lab. However, various studies in the lab are still underway that will yield data that can be added to this dataset for analyses, therefore, the projected sample size is n = 150. Repeated Measures ANOVA (RM ANOVA) revealed a significant main effect of NNS cycles/burst across burst number ($F(4, 292) = 6.786$ $p < .001$, $\eta p2 = .085$). Pairwise comparisons, with a Bonferonni post-hoc adjustment, revealed that NNS cycles/burst was significantly longer during the first NNS burst compared to Burst 3 (p = 0.002, 95% CI [1.582, 10.121]), Burst 4 (p = 0.001, 95% CI [1.934, 10.660]), and Burst 5 (p = 0.001, 95% CI [1.743, 10.770]). RM ANOVA did not reveal a significant main effect of NNS frequency ($F(4, 284) = .858$ $p = .362$, $\eta p2 = .012$) or of NNS Amplitude ($F(4, 292) = 1.166$ $p = .362$, $\eta p2 = .016$) across burst number.
Conclusions (Including Clinical Relevance): Preliminary results suggest that only NNS cycles/burst change throughout a suck sample. These data indicate that the spatiotemporal complexity of suck diminishes across bursts but that the suck amplitudes and inter-burst frequencies remain stable. Further analysis is needed to examine how these trends change across development and between sexes. Knowledge of how NNS changes across a suck sample is imperative when developmental specialists assess infant suck.
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Relevant Non-financial Relationships: Emily Zimmerman: Nothing to Disclose | Morgan Hines: Nothing to Disclose | Alaina Martens: Nothing to Disclose | Kelsey Thompson: Nothing to Disclose.

Creating a Cross-species Conceptual Framework: An Analysis of Spontaneous Sucking in Wild Seal Pups Following Feeding and Swallowing Rehabilitation

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Purpose: Orphaned harbor seal pups admitted to our rescue centre receive life sustaining medical management and feeding/swallowing rehabilitation including oral gavage followed by weaning to whole fish. This process has similarities to human infant rehabilitation where bridging therapies facilitate oral intake transition. We hypothesize swallowing interventions have cross-species application, however, determining whether anatomical, physiological and behavioral similarities exist between seals and humans are necessary first steps. Our objectives were to investigate spontaneous sucking behaviors and develop a parallel behavioral taxonomy.
Method(s): Using a cross-sectional design, we observed spontaneous sucking behaviors in seal pups over 10 sessions. Demographic and medical variables were extracted from patient charts. We reported data as frequencies and means (± SD). Those presenting with sucking were compared to those without using unpaired 2-sided t-tests and Pearson's X_2 with Bonferroni correction as appropriate. Independent predictors were explored through a main-effect logistic regression. Significance was $p < .05$. To create the behavior taxonomy, 2 dysphagia experts observed previously recorded video. A list of feeding and swallowing behaviors comparable to humans was compiled, in consultation with 3 veterinary experts, until saturation was achieved.
Result(s): In 2018, we observed 112 (N) seals (44 M; 66F; 2 unreported) aged 56.3d (± 13.8). All required tube feeding on admission and 10 (8.9%) were premature. All but one were eating fish independently at observation. Stratified according to care level, 70 (62.5%) were in communal tanks, 29 (25.9%) in single tubs and, 13 (11.6%) in intensive care. Sucking behaviors were observed in 55 (49.1%) and when compared to those without, differed significantly according to care level ($p < .001$) but not by age, weight, sex or gestation. Care level was an independent predictor of sucking ($p = .001$). Behavioral taxonomy included: vocalizing, sucking behaviors, postural characteristics, and rooting.
Conclusions (Including Clinical Relevance): For the first time, spontaneous sucking behaviors have been documented in wild seal pups and associated with medical acuity in a rehabilitative setting. Additionally, this is the first time a parallel conceptual framework has been developed across seals and humans identifying numerous potential benefits of a cross species swallow rehabilitation model.
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Outcomes of a Standardized Exercise Protocol in Healthy Adults with Incidental Findings of Swallowing Impairment on Videofluoroscopy

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Purpose: Despite being widely adopted in clinical practice, the rehabilitative potential of swallowing exercises is not well documented (Langmore & Pisegna, 2015). While collecting a sample of 98 videofluoroscopies (VF) from healthy individuals to serve as a control group for an unrelated study, we discovered 13 subjects with incidental findings of impaired swallowing (safety and/or efficiency

deficits). Our purpose was to explore the impact of a standardized 'one-size-fits-all' treatment (tx) protocol on impaired swallowing function in this cohort of otherwise healthy individuals.
Method(s): 13 healthy individuals (9 F, mean age = 71.5, SD = 11.9) completed 8 weeks of swallowing exercises. Treatment sessions (once per week) consisted of 20 repetitions of each of the following exercises: effortful swallows, tongue hold swallows, supraglottic swallows, Shaker exercises and Mendelsohn maneuvers, as well as 10 repetitions of effortful pitch glides. Subjects were also asked to complete daily homework consisting of 3 additional treatment sets per day. VF was collected pre- and post-tx with a standardized protocol and scored using the MBSimP^{TM} method.
Scores for components 1–5 and 6–16 were combined for an oral total (OT) and pharyngeal total (PT) respectively. Wilcoxon rank sum tests compared OT and PT scores from pre- to post-tx.
Result(s): The pre-tx and post-tx OT median scores remained unchanged (4). The median PT score was 10 pre-tx (range 2–14) and reduced to 7 post-tx (range 3–11), though this change narrowly missed statistical significance ($Z = -1.99$; $p = .058$). Post-hoc evaluations revealed that 8 subjects demonstrated improved PT scores, 2 worsened, 3 were unchanged and that the greatest changes came from components 6 (initiation of the pharyngeal swallow), 8 (laryngeal elevation), 15 (tongue base retraction) and 16 (pharyngeal residue).
Conclusions (Including Clinical Relevance): Our sample of otherwise healthy individuals with VF evidence of impaired swallowing completed a standardized 'one-size-fits-all' approach to dysphagia rehabilitation that is common place in clinical practice. The approach appeared to rehabilitate aspects of swallowing function—especially in the pharyngeal phase—for the majority of subjects. Future research should compare physiologically-targeted exercises with one-size—fits all approaches. Further investigations into dose, frequency and maintenance of exercise interventions will be vital contributions.
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Tongue Pressure Variability in Persons with Parkinson's Disease Compared to Healthy Older Adults

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Purpose: Intertrial variability in motor performance of both axial and pharyngeal muscles has shown to differentiate persons with idiopathic Parkinson's disease (PwPD) from healthy older adults. It is unknown if pressures generated by the tongue demonstrate similar patterns. The present investigation explored intertrial variability in peak anterior tongue pressure generated during both maximum isometric and swallowing tasks for PwPD compared to healthy adults.
Method(s): Fifty-three PwPD without DBS (age 57–88; Hoehn Yahr stages 1 through 5; Functional Oral Intake Scale (FOIS) ratings of 5–7) and 53 age- and sex-matched controls were evaluated with the Iowa Oral Performance Instrument and completed three trials of maximum isometric pressure (MIP) and peak lingual pressure during swallows of 10 mL of water (LSP). PwPD were tested during an ON state, following an individual dose (M(SD) Levodopa Equivalency Dosage = 232.4(189.7)), to reflect typical behavior. Intertrial variability was calculated as a coefficient of variance (CV) or SD in the presence or absence of significant group differences in pressure magnitude, respectively.
Result(s): Age was not significantly correlated with intertrial variability in MIP or LSP ($p > .05$). MIP was significantly reduced in PwPD compared to controls ($p < .001$). CV of MIP correlated with MIP magnitude in opposing directions for PwPD ($r = -.360$, $p = .008$) and controls ($r = .425$, $p < .001$). CV of MIP did not significantly differ between groups ($p > .05$); however, it related to FOIS in PwPD ($r = -.409$, $p = .002$). Mean LSP was similar between groups ($p > .05$). SD of LSP was reduced in PwPD (M(SD) = 2.8(2.0)) compared to controls (M(SD) = 4.2(3.6); $p = .025$), but did not exhibit a significant relation to FOIS ($p > .05$).
Conclusions (Including Clinical Relevance): PwPD exhibit patterns of intertrial variability during lingual pressure generation that differ from healthy adults and by task. Findings suggest increased variability within a static task, such as maximum isometric pressure, is concerning for PwPD in addition to reduced maximum capacity. For healthy adults with greater capacity, increased variability during static tasks may reflect flexibility in motor control. In contrast, reduced variability during a dynamic task, such as water swallowing, may be indicative of pathology. Future research may explore such patterns of lingual pressure variability in relation to swallowing physiology under imaging.
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Impact of Sensory Stimulation on Pharyngeal Swallowing Biomechanics in Adults with Dysphagia: A High Resolution Manometry Study

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Purpose: High resolution manometry (HRM) has established biomechanical changes to pharyngeal swallowing with increasing bolus volume and consistency. The effects of sensory stimulation on pharyngeal pressures during swallowing have not been investigated to date using HRM. Evidence to support sensory stimulation as a dysphagia intervention based on videofluoroscopy and fiberoptic endoscopy is limited. In this feasibility study, the impact of sensory stimulation on pharyngeal swallowing biomechanics in adults with dysphagia was investigated for the first time using HRM.
Method(s): Fifteen adults (8 males; age range 45–86 years) with mixed etiology dysphagia (min < 6 FOIS) who were attending for HRM as part of their usual care were recruited within an acute teaching hospital over a three month period. Manoscan HRM equipment was used with a 4.5 mm pressure catheter. The protocol included duplicate 10 mL neutral, sour, ice-cold and carbonated liquid swallows (IDDSI Level 0) in randomized order (eight swallows). Analysis was completed using an online portal (www.swallowgateway.com). Feasibility outcomes included completion rate and adverse events. Selected pressure measures were (i) UES relaxation time (secs); (ii) Integration Relaxation Pressure (IRP); (iii) UES Basal Pressure (BP) and (iv) Peak Pharyngeal Pressure (mmHg).
Result(s): There were no adverse events. All participants tolerated the procedure. Pressure data from 265 swallows was analysed. Baseline UES relaxation time (0.58 secs) increased significantly with sour bolus (0.68 secs); carbonated bolus (0.66 secs) and ice-cold bolus (0.69 secs) ($p < 0.001$). Baseline IRP (7.74 mmHg) reduced significantly with ice-cold bolus (5.17 mmHg) ($p < 0.05$). UES basal pressure (71.27 mmHg) increased signficantly with carbonated bolus (84.24 mmHg) and ice-cold bolus (93.06 mmHg) ($p < 0.05$). Peak pharyngeal pressure (276.44 mmHg) reduced significantly with ice-cold bolus (248.42 mmHg) ($p < 0.05$).
Conclusions (Including Clinical Relevance): Sensory stimulation induced marked biomechanical changes to UES opening during swallowing in adults with dysphagia. Unlike VFS or FEES, HRM can be used to objectively quantify impact of sensory stumLation on pharyngeal swallowing. While this study contributes to the evidence base supporting sensory stimulation as a dysphagia intervention, further HRM studies using combined pressure impedance in specific clinical populations are ongoing.
Relevant Financial Relationships: Julie Regan: Nothing to Disclose.
Relevant Non-financial Relationships: Julie Regan: Nothing to Disclose.

Swallowing Outcomes Associated with Late Lower Cranial Neuropathy in Long-Term Oropharyngeal Cancer Survivors: A Cross-Sectional Survey Analysis

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Purpose: To quantify the association of late lower cranial neuropathy (LCNP) with swallowing-related quality of life (QOL) and functional status among long-term oropharyngeal cancer (OPC) survivors.
Method(s): 889 OPC survivors (median survival:7 years) treated 2000–2013 completed a cross-sectional survey (56% response rate) including MD Anderson Dysphagia Inventory (MDADI). The 19-item composite MDADI score of overall swallowing-related QOL was the primary outcome. MDADI subscale scores and functional status metrics were secondary outcomes. Late LCNP events ≥ 3-months post-cancer therapy were chart abstracted. Multivariate models regressed MDADI scores on late LCNP status adjusting for clinical covariates.
Result(s): 4.0% (n = 36) of survivors developed late LCNP with median onset time 5.3 years post-therapy. LCNP cases reported worse mean composite MDADI (LCNP: 68.0 vs. no LCNP: 80.2, $p < 0.001$), independently associated ($\beta = -6.7$, $p = 0.015$) after adjusting for age, survival time, sex, education, subsite, T-stage, smoking, therapeutic modality, RT modality, baseline solid food diet, and stricture. LCNP cases were more likely to have poor (< 60) composite scores (LCNP: 38.9% vs. no LCNP: 12.9%, OR = 4.3; 95% CI, 2.2–8.6). Late LCNP also associated with worse emotional ($\beta = -5.9$, $p = 0.038$), physical ($\beta = -7.7$, $p = 0.018$), functional ($\beta = -6.0$, $p = 0.028$), and global ($\beta = -9.1$, $p = 0.023$) scores in adjusted models. LCNP cases were significantly more likely to have a feeding tube (LCNP: 28.6% vs. no LCNP: 1.9%, OR = 20.5; 95% CI, 8.6–48.9), history of aspiration pneumonia (LCNP: 32.3% vs. no LCNP: 2.0%, OR = 23.5; 95% CI 9.6–57.6), tracheostomy (LCNP: 8.8% vs. no LCNP: 0.4%, OR = 26.9; 95% CI 6.0–121.7), and dilation for stricture (LCNP: 13.9% vs. no LCNP: 1.3%, OR = 12.3; 95% CI 4.2–36.3). LCNP cases were more likely to report restricted diets (LCNP: 81.8% vs. no LCNP: 56.3%, OR = 3.5; 95% CI 1.5–8.3), restrict diet in public (LCNP: 45.2% vs. no LCNP: 23.1%, $p < 0.001$) and report higher mean weight loss (LCNP: mean 11.7% ± 10.4 vs. no LCNP:6.0% ± 10.7, $p = 0.002$).
Conclusions (Including Clinical Relevance): In our large survey study, OPC survivors with late LCNP reported significantly poorer swallowing on all survey metrics examined. Further efforts are necessary to optimize swallowing outcomes and swallowing-related QOL in this subgroup of survivors.
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Swallowing Against Laryngeal Restriction (SALR) Exercise Technique Significantly Increases the Duration of UES Opening in Both Healthy Elderly and Dysphagic Patients

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Purpose: To determine and the effect of SALR exercise technique on duration of UES opening in healthy elderly volunteers and dysphagic patients.
Method(s): We studied 26 elderly (76 ± 7 years [SD])) without any complaint of dysphagia and 25 dysphagia patients (65 ± 11 years [SD]) by video fluoroscopy (30 frame/sec; 1,3,5 mL, 40% W/V Barium X3 each) before and after 6 weeks of exercise using the SALR technique. Exercise consisted of 30 swallows at 15 s intervals with Swallowing Resistance Exercise Device (sRED) strapped around the neck providing 40 mmHg external pressure to laryngeal excursion. Exercises were performed 3 times a day for 6 weeks. We measured duration from initial opening to start of maximal opening, duration of maximum opening, duration from end of maximal opening to close, and total duration of UES opening. Statistical analysis was performed using a 3-way repeated measures ANOVA with within-subject volume and measurement time factors, and a between group factor.
Result(s): All participants tolerated the exercises well. For both groups, the SALR exercise technique for 6 weeks resulted in a significant increase in total duration of UES opening and duration of maximal UES opening for all tested volumes ($p < .0001$) with no significant difference between the two groups. For duration from end of maximal opening to closure, there was a significant difference between the two groups ($p < .0001$), in that the dysphagia group had a significantly greater increase in duration compared to the healthy elderly group ($p = 0.03$). For the duration from initial opening to start of maximal opening, while there was a significant volume effect for both groups, but no significant exerciser effect.
Conclusions (Including Clinical Relevance): Duration of UES deglutitive opening can be increased by SALR exercise in both healthy elderly and dysphagic patients. This finding presents the opportunity of improving trans-sphincteric UES flow in dysphagic patients as well as the healthy elderly with incomplete bolus transit.
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Interactive Website for Head and Neck Cancer Patients: Adherence and Coping Program to Prevent Dysphagia After Radiation

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Purpose: Pharyngeal and laryngeal cancers are highly curable; however survivors are at high risk for long-term dysphagia after radiation. To address lack of access to preventive care, we developed a responsive web-based application to help patients adhere to preventive swallowing exercises and cope with radiation side effects.
Method(s): Participants at community outpatient clinics in Texas received preventive and diagnostic speech pathology services. They were then taught to navigate the interactive website (www.project-prepare.org) and given access to new weekly modules every week for 10 weeks. The program (English and Spanish) features tracking logs for preventive exercises, instructional videos, patient stories and search features.
Result(s): 174 patients have been enrolled; the accrual rate is 95%. The average age of the sample is 63 (SD = 12.1), 44% have a high school education or lower, 30% of the accrued sample are uninsured. The dropout rate after the initial session was 32.6%. The average number of visits was 5.25 (SD = 11.0) and the average duration in minutes was 6.1 min (SD = 6.0). Initial analyses indicate that there is a highly significant relationship between average number of sets of exercises performed per day during the 10 week project and resulting self-reported swallowing function after radiation ($p = .010$; $r = .378$)
Conclusions (Including Clinical Relevance): Our website showed significant effects in promoting adherence to swallowing exercises and improved function. However, our return visit rate showed that the platform needs improvement in navigability and usability for this older population undergoing challenging treatment in community settings with low resources.
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Relationships Between Gestational Age, Morbidities, and Feeding Method in Premature Infants

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Purpose: Historically, premature infant feeding milestone attainment was thought to be a function of gestational age/neurodevelopmental maturity. However, some researchers have suggested that concomitant morbidities may have greater impact. Still, others have reported that feeding method (volume-driven or infant cue-based) may have the greatest impact. This retrospective study investigated the possible relationships between gestational age, concomitant morbidities, and feeding method on time to full oral feeding attainment in preterm infants.
Method(s): In 2016 Rush University Medical Center transitioned its neonatal feeding protocol from volume-driven to infant cue-based. For this study, data collected came from randomLy selected medical records of preterm infants admitted both before and after this transition. 67 infants (40%) were fed via volume driven protocol; the remainder via cue-based protocol. Independent variables were gestational age at birth categorized into 3 groups: 23–24; 6, 25–27; 6, and 28–36; 7 weeks; morbidity severity measured by the "Morbidity Assessment Index for Newborns" and categorized into 4 groups (very mild, mild, moderate, severe); and feeding method. Dependent variable was time from first to exclusive/full oral feeding. Summary and correlational statistics described relationships between categorical variables and time to full feeding. A 3-way univariate ANOVA (age group, morbidity severity, feeding method) examined interaction effects on time to full oral feeding.

Result(s): Within a single feeding method, time to full feed was correlated with gestational age [Volume-Driven: $r = -0.614$ ($p < 0.0001$); Cue-Based: $r = -0.289$ ($p = 0.004$)] and morbidity severity [Volume Driven: $r = 0.489$ ($p < 0.0001$); Cue-Based: $r = .476$ ($p = < 0.0001$)]. Between feeding methods, ANOVA identified a 2-way interaction effect for gestational age x feeding method [$F(2) = 3.148$, $p = 0.046$]. Infants fed via the cue-based method achieved full feeding 20% faster overall; the youngest infants achieved full feeding 92% faster than infants fed via the volume-driven method.

Conclusions (Including Clinical Relevance): When feeding method was not considered, both gestational age and morbidity severity were independently associated with time to full oral feeding attainment. But, when feeding method was considered, the cue-based protocol resulted in faster time to full oral feeding, especially among the youngest infants, regardless of concomitant morbidity.

Relevant Financial Relationships: Lisa LaGorio: Has affiliations to disclose; Rush University Medical Center: Salary/Stipend: Employment;Beijing Language and Culture University: Honoraria: Teaching and speaking | Alexa Rogers: Has affiliations to disclose; VA Loma Linda: Salary/Stipend: Employment | Anna Manilla: Has affiliations to disclose; Advocate Christ Children's Hospital: Salary/Stipend: Employment | Erin Miller: Has affiliations to disclose; Rush University Medical Center: Salary/Stipend: Employment; innara: Consulting fee: Other Activities.

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Hyoid Kinematics During Swallowing in Patients with Dementia

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Purpose: Several parameters of hyoid movement have been shown to vary as a function of bolus consistency in healthy adults and as a function of disease. Such examination of hyoid kinematics has not yet been explored in patients with dementia. The purpose of this study was to (1) characterize hyoid kinematics in a sample of patients with dementia; (2) explore differences in hyoid movement related to bolus consistency; (3) compare differences in hyoid movement in males and females; and (4) determine if hyoid kinematics change as a function of age.

Method(s): Videofluoroscopy swallowing studies were retrospectively analyzed from 46 adults diagnosed with dementia (mean age: 84; range 59–100). Three different measures were collected from both thin and extremely thick liquid swallows: peak hyoid position, superior hyoid displacement, and anterior hyoid displacement. Hyoid position was measured as a percentage of the C2–C4 reference scalar. Descriptive statistics were used to calculate means and confidence intervals, and t-tests were conducted in order to analyze the differences in hyoid movement in relation to bolus consistency and gender. A linear regression was used to determine if hyoid displacement changed with age.

Result(s): Mean peak hyoid displacement was 177.8% (95% CI 164.4–191.2) of the C2–4 reference scalar for thin liquids and 166.6% (95% CI 155.0–178.1) for extremely thick liquids. Mean anterior displacement was 29.4% (95% CI 22.6–36.2) for thin liquids and 27.9% (95% CI 22.7–33.1) for extremely thick liquids. Analyses revealed a significant difference in superior hyoid displacement between thin liquids (45.3% [95% CI 35.4–55.2]) and extremely thick liquids (102.8% [95% CI 81.5–124.0]) ($p < 0.001$). The were no other significant differences between thin liquid and extremely thick liquids, and no significant differences found between males and females. There was also no relationship between hyoid displacement and age.

Conclusions (Including Clinical Relevance): This study highlights that bolus consistency modulates superior hyoid movement in patients with dementia. Future research should focus on analyzing hyoid kinematics across all consistencies and standardized bolus volumes. Further work is also needed to examine laryngeal vestibule closure and UES opening in relation to hyoid displacement in order to better understand measures of pharyngeal residue and the clinical implications of these results.

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Exploring the Effects of Thermal Tongue Stimulation on Cortical Excitability in the Human Pharyngeal Motor Pathways

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Purpose: One of swallowing therapies for dysphagic patients includes thermal tactile oropharyngeal stimulation to facilitate swallowing initiation. We previously showed that the stimulation applied to the oral cavity exhibited significant increase in pharyngeal motor cortex excitability. The aim of this present study was to investigate whether the thermal stimulation can produce a long-term effect on the cortico-pharyngeal neural pathway or not.

Method(s): Eleven healthy volunteers participated and were randomized to attend on three separate occasions at least four days apart. In each visit, they were intubated with an intraluminal catheter with bipolar electrodes for recording pharyngeal electromyography. Each participant underwent baseline cortico-pharyngeal and hand motor evoked potential (MEP) measurements bilaterally evoked by transcranial magnetic stimulation (TMS). Subjects then received one of three intermittent thermal stimulus patterns; cold (15 degrees Celsius (°C)), warmth (36 °C) and hot (45 °C) for 10 min. Pharyngeal and control hand MEPs were re-measured every 15 min up to 60 min following either 10-min stimulation. Averaged amplitude changes

were analyzed using repeated measures ANOVA and post hoc t-tests with Bonferroni correction.
Result(s): Repeated measures ANOVA for each stimulation showed a slight but significant increased change in pharyngeal MEP amplitude following cold thermal stimulation compared with hot stimulation. No changes were observed in hand MEPs over the measurement time.
Conclusions (Including Clinical Relevance): Oral thermal stimulation, especially cold stimulation, can possibly induce persistent changes in pharyngeal cortical excitability.
Relevant Financial Relationships: Jin Magara: Nothing to Disclose | Masahiro Watanabe: Nothing to Disclose | Takanori Tsujimura: Nothing to Disclose | Makoto Inoue: Nothing to Disclose.
Relevant Non-financial Relationships: Jin Magara: Nothing to Disclose | Masahiro Watanabe: Nothing to Disclose | Takanori Tsujimura: Nothing to Disclose | Makoto Inoue: Nothing to Disclose.

Barium Paste as a Routine Trial in Videofluoroscopy

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Purpose: Videofluoroscopy (VFS) is widely used in swallow assessment with most clinicians employing liquid barium plus additional textures ranging from puree to solids. Typically there is a lack of standardization in offering these additional textures and also limited information regarding the additional value of these thicker textures in providing diagnostic or therapeutic guidance. As VFS exposes patients to ionizing radiation we should optimize the study by including all necessary trials but refrain from including non-informative tasks. To assess whether texture swallowing during VFS provided novel information, this study compared quantifiable timing and displacement measures of barium paste swallows with liquid swallows in healthy adults.
Method(s): 139 adults (79 female, mean 59 years, range 20–99 years) underwent a standardized VFS, including 3 mL barium paste (E-Z-Paste 60% w/w) and 20 mL liquid barium (E-Z-Paque 96% w/v diluted to 19%). Videos were analyzed using quantitative digital measures of timing and displacement. A split-plot ANOVA was performed to determine effects of age and bolus type.
Result(s): Significantly reduced pharyngeal constriction ($p < .01$) and increased pharyngeal residue ($p < .01$) were observed with paste compared to liquid barium, with no age effects. Pharyngeal transit times (PTT) significantly increased with age irrespective of bolus type. For 40–64 years and 80 + years, paste PTT was longer than liquid barium PTT ($p < .05$), with no significant difference for 20–39 years or 65–79 years. Esophageal transit times (ETT) of paste were longer than liquid barium ETT ($p < .001$), and significantly longer in those > 80 years compared to < 65 years ($p < .05$). Maximum opening of the pharyngoesophageal segment (PES) was wider with paste than liquid barium for 80 + years only ($p < .001$). For paste swallows no aspiration occurred, whereas for liquid barium two post-deglutitive aspiration events occurred.
Conclusions (Including Clinical Relevance): Barium paste is a standardized texture that is clinically available. The paste bolus is cohesive and viscous, challenging bolus propulsion, pharyngeal constriction and PES distension particularly in 80 + yr olds. Paste potentially may unmask dysfunction where liquid barium does not. Comparison to those with swallow impairment is needed.
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The Effect of Gender and Age Differences on Echo Intensity of Tongue

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Purpose: The tongue plays an important role during the oropharyngeal phase of swallowing. Aging cause changing the muscle in quantity and quality. The quantitative muscles change regarding a decrease in muscle size and number. The qualitative muscles change, such as increase intramuscular adipose tissue, can be obtained by measuring the grey-scale level of ultrasonography image which is defined as echo intensity. Enhancement of echo intensity represents augmented fat and connective tissue within the muscles. Previous studies have indicated that echo intensity of abdominal muscles, biceps brachii, and quadriceps femoris exhibit age-related change, especially in women. A few studies have been reported about echo intensity of tongue. This study aimed to determine the associations among age, gender and echo intensity.
Method(s): A total of 167 people who reported normal swallowing were enrolled and stratified by age into young (23–44) and elderly (65–86) groups, subgroup by gender. Twenty-six young women with mean age 28.9 ± 4.8 years, 29 young men with mean age of 27.7 ± 3.5 years, 74 elderly women with mean age of 70.9 ± 4.6 years and 37 elderly men with mean age of 73.1 ± 4.5 years. Echo intensity was obtained from each participant.
Result(s): The mean echo intensity for young women and men were 38.11 ± 8.25 and 39.88 ± 8.69, respectively. The mean echo intensity for elderly women and men were 48.08 ± 8.59 and 43.91 ± 9.28, respectively. Echo intensity in elderly group was significantly higher than a young group for both women and men ($P < 0.001$). Women had echo intensity significantly higher than men, but only in elderly group ($P = 0.03$). However, there was significant effect of age and gender on echo intensity ($P = 0.045$).
Conclusions (Including Clinical Relevance): The results of this study indicated that age and gender effected the echo intensity, especially in elderly women had the highest echo intensity, lowest muscle quality of the tongue. Ultrasound is a non-invasive, radiation-free, accessibility and reliable tool for assessment of muscle quality.
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Modifying Fluid Consistency to Prevent Aspiration in Dementia: A Systematic Review of the Evidence

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Purpose: Modification to fluid consistency is a frequently used management strategy to prevent aspiration for people with dementia. The aims were to examine the effectiveness of thickened fluids in preventing aspiration in people with dementia and to evaluate the adverse effects associated with modification of fluids in this population.
Method(s): This Cochrane systematic review included randomised controlled trials (RCTs) and quasi-RCTs published in any language. Participants were adults with a clinical diagnosis of dementia with symptoms and/or signs of dysphagia and in whom aspiration has been confirmed by clinical assessment. Relevant databases including ALOIS (Cochrane Dementia and Cognitive Improvement Group's Specialized Register), reference lists, and abstracts of conference proceedings were searched. Authors assessed risk of bias for each study using the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011).
Result(s): Two studies met the inclusion criteria. Data specific to people with dementia were not available in the published reports. Original, unpublished data from the trial authors was obtained. High viscosity fluids (3000 cPS) had a more positive immediate impact on preventing aspiration during videofluoroscopy compared with less thick fluids (300 cPs) and regular thin liquids with a chin down posture. However, during the three-month follow-up period there were a significantly greater number of incidents of pneumonia in people with dementia receiving high viscosity fluids, when compared to those receiving less thick fluids and those receiving regular liquids with chin down posture. The subtype of dementia may be important in influencing outcomes.
Conclusions (Including Clinical Relevance): While thickening fluids may have an immediate positive effect on swallow function, clinicians should consider the long term effects of thickened fluids on the person with dementia. They should also consider the subtype and severity of dementia. Overall risk of bias of included studies is high. Quality of evidence using GRADE is low. Directions for clinical trials in this area are provided.
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The Impact of Supplementary and Targeted Training on Accuracy in Adult Videofluoroscopy Analysis in Trained Speech and Language Therapists

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Purpose: Many Speech and Language Therapists (SLTs) complete once off training in the analysis of videofluoroscopy (VFSS) exams. Research suggests training is effective in improving the accuracy of VFSS analysis. Despite this, the interpretation of VFSS exams remains subjective and there are no best practice recommendations to guide maintenance of competency in this area. This study aims to examine the impact of refresher, targeted training sessions on accuracy in VFSS analysis in VFSS trained SLTs.
Method(s): This pre/post-test quantitative study is the second phase in a two-part project. Participants included 24 SLTs who had previously attended a postgrad accredited course in adult VFSS analysis. SLTs independently analysed six VFSS clips of individual bolus swallows before and after four one-hour training sessions over one month. SLTs reported on the following outcomes; presence of swallow reflex delay, quantity of residue post swallow, adequacy of anterior hyoid movement and hyo-laryngeal elevation and airway penetration/aspiration. Ratings from three expert SLTs were considered to be the correct answer. Expert SLTs had greater than 9 years VFSS experience and who analyse at least one exam per month. Non-parametric statistical analyses of ratings were completed.
Result(s): VFSS analysis experience ranged from 0.5 to 16 years (M = 4.77, SD = 4.75). Participants were most accurate in rating the quantity of residue in the pyriforms (M = 78%) and least accurate in rating the level to which the swallow reflex was delayed (M = 44%). Statistically significant improvements were noted within a number of outcome measures following targeted training sessions.
Conclusions (Including Clinical Relevance): This study suggest that targeted, refresher training can have a postive impact on the accuracy in adult VFSS analysis in trained Speech and Language Therapists. It also indicates the need for ongoing training and formal evidence based guidelines outlining requirements to maintain competency in VFSS analysis.
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Relationship Between Cervical Perimeter and Cross Sectional Area of Geniohyoid Muscle of Healthy Elderly

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Purpose: Muscles around the neck are associated with swallowing and supporting the head. There are reports that the neck circumference length (NC) increases as compared with before and after the training of the neck. It is known that sarcopenia reduces the swallowing muscles including suprahyoid muscle group and also lowers the position of the larynx and hyoid bone, thus adversely affecting swallowing function, and it has been reported that people losing weight tend to have swallowing disorder. There is a possibility that NC may be affected in people who have decreased swallowing function due to age-related muscle mass reduction. Based on the hypothesis that the decreased muscle mass of the suprahyoid muscle affects the thickness of the neck, therefore, we examined the relationship between the sectional area of the suprahyoid muscle and the NC length.

Method(s): A total of 120 subjects are healthy elderly people aged 65 years or older (40 males, 80 females), mean age 70 years. The participants' age, gender, Body Mass Index (BMI), hand grip strength, cross sectional area of geniohyoid muscle, NC was carried out. The area of the geniohyoid was measured using an ultrasound diagnostic imaging system M-Turbo. NC is measured by unifying the measurement site at the position just above the thyroid cartilage and using a measuring tape. Multiple regression analysis was performed to determine the strongest factor influencing NC. The dependent variable was NC and independent variable were area of geniohyoid, gender, age, and BMI.
Result(s): There were significant correlations between NC with gender difference, BMI, grip strength and area of geniohyoid ($r = -0.59$, 0.47, 0.58, 0.53; $P < 0.05$). The multiple regression analysis for NC showed that gender difference ($\beta = 0.00$, $P < 0.001$), BMI ($\beta = 0.43$, $P < 0.001$) and area of geniohyoid ($\beta = 0.18$, $P = 0.02$) were significant independent variables. The adjusted coefficient of determination (R^2) = 0.57.
Conclusions (Including Clinical Relevance): It was found that NC affected the area of the geniohyoid. If it becomes clear that NC is an evaluation tool for evaluating swallowing function, it will be possible to use NC as a screening test for simple swallowing impaired people. For further study, it will be necessary to examine whether NC has an effect on other swallow related muscles, and to examine how the above relates to swallowing disabled people.
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Feasibility of the Computer-Assisted Self-administered Adjusted Dswal-Qol Questionnaire

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Purpose: Based on previous validation studies, the adjusted version of the Dutch SWAL-QoL Questionnaire (aDSWAL-QoL) has been further adapted (e.g., adjusting the rating scale structure) and converted into a computer-assisted format (CAF aDSWAL-QoL). The aim is to facilitate self-report by dysphagic patients with additional language and/or cognitive impairment (DysLC). Decreasing the amount of assistance required from a third party when completing the questionnaire could reduce the risk of different types of interviewer bias. After initial evaluation in a cohort of 15 patients (first pilot study) of the CAF aDSWAL-QoL using a qualitative interviewing analysis, further adjustments have been made. The aim of the current study was to evaluate the feasibility of the CAF aDSWAL-QoL by comparing the need for and type of assistance with the pen-and-paper format and documenting the time to complete both formats.
Method(s): Three feasibility items (i.e., the need for and type of assistance and the time required to complete the questionnaire) were assessed in two groups, a group suffering only from dysphagia (Dys group, N = 12) and a DysLC group (N = 8). Both pen-and-paper and CAF were completed by each patient, in random order with measures of assistance collected and analyzed. All statistical analyses were performed using SPSS 20.0.
Result(s): In general, the DysLC group required less assistance ($p = .018$) in completing the CAF compared to the traditional format. About 68% of the reported given assistance was no longer needed in the computer format.
Regarding the type and degree of assistance required, the DysLC group needed significantly less assistance in 'read out loud items' ($p = .016$) and 'read out loud instructions' ($p = .014$). No significant difference in assistance for the Dys group ($p = .753$) was present for the three feasibility items between the two formats. On average, there was less time needed to complete the CAF (13 versus 20 min).
Conclusions (Including Clinical Relevance): The use of the CAF aDSWAL-QoL in a DysLC population showed reduced patient reliance on other people for assistance. Even though the first experiences were positive, additional improvements based on the analysis of the required assistance (i.e., an on/off switch for pictograms) are recommended. This format also requires further validation.
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Fluoroscopic and Endoscopic Investigation of Dysphagia in a Mouse Model of DiGeorge Syndrome

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Purpose: DiGeorge/22q11.2 deletion syndrome (22q11DS) is a genetic disorder associated with dysphagia. A large proportion of children with 22q11DS fall below the 5th percentile for growth, have impaired coordination of suck-swallow-breathing and bolus transit, and develop recurrent aspiration-related respiratory inflammation/infection. We recently demonstrated diminished weight gain and milk aspiration-related inflammation/infection of the nasal sinuses, middle ear, and lungs at postnatal day 7 in the LgDel mouse model of 22q11DS. Further characterization provided novel evidence of underlying neurological defects in cranial nerve and anterior-posterior hindbrain patterning along with changes in hypoglossal motor neuron function. Here we extend this research by phenotyping dysphagia in LgDel mice using fluoroscopic and endoscopic assessments.
Method(s): LgDel mice (n = 5 females) and wild-type (WT) littermates (n = 6 females) underwent testing at 3–4 months of age. Videofluoroscopic swallow study (VFSS) was performed using our freely-behaving protocol and miniaturized fluoroscope. Approximately one week after VFSS, mice underwent transoral endoscopy

under light sedation using our established protocol for laryngeal adductor reflex testing in our miniaturized endoscopy suite. After testing, mice were euthanized and fresh lung tissue was harvested for histological detection of inflammation/infection.
Result(s): VFSS analysis revealed that LgDel mice have significantly altered swallow function compared to WT controls: slower lick rate ($p < 0.001$), faster swallow rate ($p = 0.009$), reduced lick-swallow ratio ($p = 0.005$), and shorter inter-swallow interval ($p = 0.031$). Endoscopic assessment of the oral cavity, pharynx, and larynx did not reveal any obvious structural or functional deficits. Lung tissue analysis is pending.
Conclusions (Including Clinical Relevance): This study provides novel evidence that female LgDel mice have functional swallowing deficits that mirror aspects of dysphagia in children with 22q11DS. Study replication is underway with male LgDel and WT mice to explore potential gender differences. Our assessment of hypoglossal motor neuron dysfunction and multiple cranial nerve and hindbrain patterning deficits, combined with the lack of structural deformities, point to a neurological basis for dysphagia. Based on these findings, future work will focus on neurological based therapeutic interventions to improve swallowing in 22q11DS.
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Natural History of Physiologic Swallowing Deficits in Spinal Muscular Atrophy Type 1

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Purpose: Spinal Muscular Atrophy (SMA) is a progressive neuromuscular disorder that occurs in 1 out of every 11,000 live births. Dysphagia is a leading source of morbidity and mortality among patients with the most severe form of the disease, infantile-onset type 1. The physiologic deficits that cause these detrimental clinical effects are unknown. Understanding the natural history of dysphagia in SMA Type 1 patients is critical in optimizing timing of swallow evaluations and determining the effects of new pharmaceutical agents. The aim of this pilot investigation, which is part of a larger multi-site investigation, was to characterize the deficits in oropharyngeal swallowing physiology among infants with SMA Type 1.
Method(s): Initial videofluoroscopic swallowing assessments (VFSS) conducted on infants with SMA Type 1 from two medical centers were analyzed for characteristics of oropharyngeal swallowing physiology and bolus flow using MBSImP. Overall impression scores representing the worst impairment across all viscosities were assigned. Results were summarized using descriptive statistics and reported at percent of patients and mean ± standard deviation.
Result(s): 8 infants, 3–24 months old, were included in the investigation. Average time from SMA diagnosis to initial VFSS was 2.6 ± 5.1 months. At the time of initial VFSS 75% were obtaining all nutrition by mouth, despite 50% with a history of at least 1 episode of pneumonia. The majority of infants (65%) required suctioning to aid in secretion management. VFSS revealed profound deficits in oropharyngeal swallowing physiology. Fifty-percent of infants exhibited absent pharyngeal stripping wave, absent epiglottic inversion, and absent pharyngoesophageal segment opening. These deficits caused minimal to no clearance of the bolus from the pharynx in 63% of infants, and bolus airway entry in 75% of infants.
Conclusions (Including Clinical Relevance): Infants with SMA Type 1 exhibit profound deficits in oropharyngeal swallowing physiology early in disease progression. Utilization of instrumental swallowing assessments to guide dysphagia treatment regimens early in disease progression may improve infant health outcomes. Future longitudinal investigations with larger sample sizes are necessary to determine SMA's natural progression and identify the optimal timing of instrumental swallowing assessments.
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Functional Outcomes Following Transoral Robotic Surgery for Recurrent Head and Neck Cancer (HNC): A Prospectve Observational Study

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Purpose: The standard of care for the management of recurrent HNC is open surgery, an intervention associated with high morbidity. Transoral robotic surgery (TORS) is now being considered as a minimally invasive option for selected tumours with encouraging oncological control. However, multidimensional swallowing outcomes have not been reported.
Method(s): We evaluated PSS Normalcy of diet (PSS-NOD) at baseline, 3 and 6 months post-surgery. The Wilcoxon signed ranked test was used to analyse repeated mesurements for PSS-NOD using SPSS. A subgroup treated in a single centre (London) underwent more detailed assessment using the MD Anderson Dysphagia Inventory (MDADI) and the Penetration–Aspiration Scale (PAS)

using videofluroscopy or Fibreoptic Endoscopic Evaluation of Swallowing on thin liquids only.
Result(s): Between 2014 and 2018, 30 patients underwent TORS for recurrent HNC at two tertiary cancer centres in the UK. Mean PSS-NOD scores reduced from 60 (95% CI 49.2–70.8) at baseline to 41.4 (95% CI 30.4–52.4) at 3
months (p-value = 0.02) and 42 (95% CI 26.7–57.3) at 6 months post-surgery (p-value = 0.06). A subgroup of 14 patients who had undergone previous (chemo)radiation for HNC underwent more detailed assessment. The mean age was 61 years (range 52–70) with three females in the cohort. Five patients required free flap reconstruction and 11 required tracheostomy; including one patient where a tracheostomy was in place pre-operatively. Mean time to decannulation was 10.5 days (range 5–27) (n = 13). Two patients had gastrostomy tubes (GT) at baseline and five at 3 months, decreasing to three patients at 6 months postoperatively. Mean PSS-NOD score was 68.5 (95% CI 50–87) at baseline (n = 14), 43.5 (95% CI 21.3–65.7) at 3 months (n = 14) and 55 (95% CI 33.1–76.9) at 6 months post operatively (n = 10). Swallowing function remained unchanged for three patients who have retained a gastrostomy from baseline to six months remaining nil by mouth (NBM). Median MDADI global score was 4 (range 1–5) at baseline (n = 12), 1 (range 1–5) at 3 months (n = 10) and 2 (range 1–4) at 6 months (n = 7). Median PAS score was 4 (range 1–8) at baseline (n = 11), and 8 (range 1–8) at 6 months (n = 7).
Conclusions (Including Clinical Relevance): The use of TORS for recurrent HNC may result in a decline in swallowing status in the early post-operative phase. Baseline swallowing status appears to be a key factor influencing swallowing recovery. Further research is required.
Relevant Financial Relationships: Grainne Brady: Nothing to Disclose | Lauren Leigh-Doyle: Nothing to Disclose | Sarah Stephen: Nothing to Disclose | Justin Roe: Nothing to Disclose | Vinidh Paleri: Has affiliations to disclose; intuitive: Speaking fee: Teaching and speaking.
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Impact of a Combined Inspiratory and Expiratory Muscle Strength Training Program in ALS: Results of a Sham Controlled Randomized Clinical Trial

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Purpose: Historical ALS management has been palliative in nature and focused on energy conservation and maximizing quality of life. We hypothesized that a proactive moderate intensity exercise program, applied early in the disease progression (prior to impairment onset) would increase physiologic capacity and reserve in early affected ALS patients and maintain the vital functions of breathing, airway clearance and swallowing into the disease progression.
Aim: Determine the impact of an in home combined expiratory and inspiratory respiratory strength training (RST) program on pulmonary, swallow and cough function in individuals with early stage ALS.
Method(s): RST was tested in a prospective, single center, double-blind, randomized, controlled trial in 46 individuals with ALS who completed twelve weeks of either active-RST (n = 23) or sham-RST (n = 23). RST was performed at a 30% MEP/MIP load. Efficacy of RST was assessed via change in maximum expiratory pressure (MEP), maximum inspiratory pressure (MIP), peak cough flow (PCF), swallowing, forced vital capacity (FVC), and ALSFRS-R scores. Linear (continuous outcomes) and logistic (categorical outcomes) regression were utilized to assess change score differences across outcomes from pre to post treatment time points between active-RST and sham-RST groups.
Result(s): Treatment was well tolerated with 43/46 (93.5%) enrolled patients completing the protocol and no intervention related adverse events. Significant differences in group pre-post change scores were noted for MEP, $F_{1,16} = 8.6, p = 0.01$. On average MEP increased by 21.3cmH20 (95% CI 7.5, 35.0) for the active-RST group while MEP's decreased, on average, by 2cmH20 (95% CI −10.9, 6.9) for the Sham-RST group across time points. No differences were noted for MIP, $F_{1,16} = 1.0$, $p = 0.95$. Mean MIP change across pre and post time points were 9.0 cm H_2O (95% CI 1.3, 16.9) for the active-RST group and 5cmH20 (95% CI −1.2,11.2) for the sham-RST group. Secondary data are currently being analyzed.
Conclusions (Including Clinical Relevance): A twelve-week program of RST was feasible and well-tolerated in early stage individuals with ALS and led to improvements in maximum expiratory pressure generating force but not inspiratory force. Current findings suggest ta load-dependent improvement in MEP's with our prevsious studies utilizing a 50% load resulting in a higher average increase.
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Prevention of Sequela from Tracheal Aspiration in Medical-Surgical and ICU Patients

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Purpose: Studies show nosocomial aspiration PN impacts mortality. In this study, we explored the effectiveness of a multidisciplinary approach to identification of patients at risk of dysphagia in order to prevent sequela from tracheal aspiration.
Method(s): As a patient safety initiative, nursing leadership elected to have dysphagia screening included in all admission assessments for medical-surgical and ICU units (due to members of the nursing staff having observed non-stroke related cases that exhibited overt signs and symptoms concerning for dysphagia). Nursing staff received dysphagia screening training via computer based learning and instructor led curriculum. Patients that failed the nursing bedside dysphagia screening were referred for diagnostic testing from the speech-language pathologist to diagnose/rule out aspiration. This procedure was combined with a post extubation screening by respiratory therapy designed to identify patients (that received mechanical ventilation) at greater risk of aspiration. Respiratory therapy received post extubation screening training via instructor led curriculum. A

daily electronic nursing dysphagia screening report and a daily post extubation screening report was used in conjunction with results from diagnostics performed by the speech-language pathologist to determine if the multidisciplinary protocol was accurately capturing at risk patients.

Result(s): Identified cases of aspiration pneumonia not present on admission for an initial (baseline) six month review period in 2016 were 24/per 17,704 patient days or 0.00135%. Total identified cases of aspiration pneumonia not present on admission for 2017 were 5/per 39,532 patient days or .000126%. Preliminary data for 2018 shows total identified cases of aspiration pneumonia not present on admission as 0/3,723 patient days or 0.00%.

Conclusions (Including Clinical Relevance): This study showed that a multidisciplinary approach to identification of patients at risk of dysphagia combined with diagnostics provided by a speech-language pathologist was an effective protocol for use in the prevention of sequela from tracheal aspiration in medical-surgical and ICU patients within an acute care hospital.

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Use of the Penetration–Aspiration Scale in Dysphagia Research: A Historical Review

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Purpose: The Penetration–Aspiration scale (PAS) is an 8-point scale used to characterize depth of airway invasion during videofluoroscopy (VF; Rosenbek et al., 1996). Though widely used and considered an industry-standard in the field of deglutition, statistical treatment of the PAS is not uniform across studies. Recently, Steele and Grace-Martin (2017) discussed common statistical issues and suggested a categorical, physiology-based version of the PAS. To guide education and use of valid PAS analysis, there is a need to first understand how the PAS is currently used. The purpose of this historical review was to examine trends in the statistical use of the PAS since its inception. Secondary aims were to assess variations in categorization methods and geography

Method(s): Two online databases were searched for citations of "A Penetration–Aspiration Scale" (Rosenbek et al., 1996). All original articles with statistical PAS analyses were considered. Exclusion criteria were: non-VF, pediatric or case studies, and non-English publications. The following information was extracted from each appropriate publication: handling of the PAS (continuous, ordinal, categorical), analysis level (bolus vs participant), inclusion of rater reliability, and geographic location. Both authors independently reviewed all studies. Inter- and intra-rater reliability was performed on 15% of the final list.

Result(s): The search yielded 941 unique articles with 200 studies meeting inclusion criteria. Analysis revealed that the PAS was treated as a continuous measure in 108 studies, as categorical (including binary) in 78, and as ordinal in 28. Ten studies used more than one data type across different analyses. Ten different categorical classifications were observed; the most common were PAS 1–2 vs 3–8 (28%), 1–5 vs 6–8 (22%), and 1 vs 2–8 (15%). The majority of studies (78%) reported analyses at the participant-level only. Studies came from 22 countries.

Conclusions (Including Clinical Relevance): This historical review confirms the existence of large discrepancies in statistical analyses of the PAS. A lack of consensus among researchers limits comparison between studies. Further, the approach to handling this data dictates the statistical tests used and has the potential to impact results and interpretations. Consistent application of statistically sound approaches to PAS usage is vital for the future of deglutition research.

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Sensitivity and Stasis Pharyngeal in Individuals with Chronic Obstructive Pulmonary Disease (COPD)

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Purpose: As described in previous studies, individuals with COPD have residual in pharyngeal recess as a consequence of impaired swallowing dynamics, increasing the bronchoaspiration risk. Sensory deficit in the pharynx can modify motor responses and compromise the safety of swallowing. In this study we investigated the relationship between pharyngeal sensitivity and pharyngeal stasis in individuals with COPD.

Method(s): Twenty-seven individuals (18 male) with mean age 66.9 ± 8.1 years diagnosed with COPD (FEV_1 mean 49.09 ± 21.7) participated in the study. They were undergoing the fiberoptic nasopharyngoscopy to assess pharyngeal sensitivity by means of a brief and light touch with the nasofibroscope tip in the posterior wall of the oropharynx and to verify the presence of salivary stasis in pharyngeal recess (Langmore, Schatz and Olsen (1988)). As for the statistical analysis were performed a descriptive analysis of the data, and the Spearman Correlation Test was used to verify the association between pharyngeal sensitivity and pharyngeal stasis. The results were considered significant for p values < 0.05.

Result(s): In the fiberoptic nasopharyngoscopy, 17/27 (63%) presented alterations in oropharyngeal sensitivity and 11/27 (41%) had salivary stasis in pharyngeal recess. Significant association was found between the compromise of pharyngeal sensitivity and the presence of salivary stasis in pharyngeal recess ($p = 0.01$).

Conclusions (Including Clinical Relevance): The present study shows that pharyngeal sensitivity impairment is associated with presence of salivary pharyngeal stasis in individuals with COPD.

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A Systematic Review of Physiological Changes in Swallowing in the Oldest Old

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Purpose: Age-related swallowing changes are well-researched in deglutology, usually distinguishing those over 60 yr old as aged. Further research into normal swallowing changes in the 'oldest old' is needed. This systematic review was conducted to collate and critically appraise studies that have investigated swallowing changes in adults 85 + years old using instrumental assessment.
Method(s): Criteria for inclusion were studies of swallowing in healthy subjects aged 85 + years. Exclusion criteria included studies focused on oral and esophageal phase swallowing. Studies published until Sept 2018 were retrieved from BIOSIS, CINAHL, Embase, Medline and Scopus. Our search identified 1321 articles, which were reduced after screening to 32 articles. These were further reviewed for quality, bias and data extraction.
Result(s): 31% distinguished between older age groups (e.g. 60–79 vs 80 + years). Instrumental assessments included videofluoroscopy (66%), manofluorography (13%), high-resolution manometry with impedance (9%), flexible endoscopic evaluation of swallowing (FEES) (6%), low-resolution manometry (3%) and FEES with manometry (3%). Main quantitative changes in swallowing in 80 + years included prolonged pharyngeal transit time, reduced pharyngeal contraction and narrowed upper esophageal sphincter (UES) opening. One third of studies demonstrated no aspiration events. In studies reporting aspiration (8/32), 38% reported association with age. Increased pharyngeal residue was associated with age in only 22% of studies. Scant to no residue was reported in 25% of studies. Most studies attributed age-related changes to reduced reserve, flexibility, strength, and muscle atrophy. All studies demonstrated risk of bias; only 13% detailed blinded analyses and 56% reported reliability testing.
Conclusions (Including Clinical Relevance): Age-related swallowing changes are identified however markers of risk such as aspiration and pharyngeal residue are only marginally increased in current literature. There is still a lack of research in normal deglutition in the oldest old. Logistical difficulties arise in assessing subjects 85 + years, such as transport, increasing risk of sampling bias. Therefore it is essential future studies plan accordingly to recruit healthy and dysphagic adults over 85 years old.
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EAT: A Structured Therapy Model to Facilitate Continued Oral Intake Through Head and Neck Radiotherapy: User Acceptance and Content Validation

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Purpose: Observational studies suggest benefit of maintaining oral intake throughout head and neck radiotherapy (RT) to avoid disuse of swallowing muscles. While incorporated in many clinics as a general practice, literature provides little in the way of structured guidelines. The objective was to develop and examine user acceptance and content validity of a structured program to facilitate safe but challenging oral intake through the duration of RT – the "EAT (Eat All Through)" RT program.
Method(s): EAT was developed through expert consensus of SLPs at the Princess Margaret Cancer Centre (Canada) and M. D. Anderson Cancer Center (USA) using a conceptual framework of a diet hierarchy (visually depicted by a EAT staircase) and a mealtime routine. EAT was reviewed and refined by North American SLPs practicing with the target population, then disseminated for a 4 week clinical pilot at 7 sites. Clinician surveys assessed user acceptance and content validity.
Result(s): 14 SLPs from 6 sites responded after reviewing and/or piloting the EAT illustration with its standardized patient handout. Respondents were mainly full time active clinicians with median = 13 years experience. 12 (86%) carried a caseload of > 50% HNC patients treated with RT. All respondents provided educational materials before RT, of which 4 (29%) also reported "encouraging oral intake with a structured therapy model". 13 SLPs piloted the EAT therapy with median = 6 patients before and/or during RT. Of these, 12 (92%) clinicians reported EAT added value relative to institutions' prior practices and 10 (77%) reported EAT to take similar or less time relative to prior standards. All SLPs reported that EAT harmonized well with exercises and its content was helpful. 11 (85%) SLPs responded that EAT facilitated patient understanding. 7 (54%) had no suggested edits, while others recommended minor changes to content (3, 25%) or layout (2, 17%). 11 (85%) respondents indicated desire to continue using "EAT" in the target population.
Conclusions (Including Clinical Relevance): The "EAT" program was accepted by experienced clinical SLP users across North American sites. Our findings support the content and value of the "EAT" program to facilitate oral intake in head and neck cancer patients throughout RT. (On behalf of the International Radiation Associated Dysphagia (RAD) Working Group.

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Pharyngeal Volumetric Changes in Parkinson's Disease and Its Impact on Sallowing

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Purpose: Pharyngeal lumen size is thought to increase as a consequence of muscle atrophy. Recent work in healthy older adults (HOA) found that pharyngeal lumen volume increased as a function of normal aging, and contributed to reduced pharyngeal constriction and swallowing efficiency. However, little is known about the effects of Parkinson's disease (PD) on pharyngeal volume. In this study, we compared pharyngeal volumetric changes in PD to HOA and determined the effects of these volumetric changes on swallowing kinematics, swallowing safety, and swallowing efficiency.
Method(s): A secondary analysis of videofluoroscopic swallow studies was completed comparing 41 HOA (22 males; mean age = 76.4 years) and 40 PD (29 males; mean age = 63.3 years). Pharyngeal volume (normalized, pixel-based measures of 2D pharyngeal space at rest), swallowing safety (Penetration–Aspiration Scale 'PAS'), swallowing efficiency (Bolus Clearance Ratio 'BCR'), and nine spatiotemporal kinematic variables were analyzed. All variables were confirmed to have adequate inter- and intra-rater reliability. ANCOVA was used to determine if pharyngeal volume was significantly different between PD and HOA groups, while controlling for age and sex. Multivariate regression was used to examine the influence of pharyngeal volume in PD on combined changes to swallowing kinematics, and simple linear regressions were used to examine the influence of pharyngeal volume on swallowing safety and efficiency.
Result(s): Results revealed that pharyngeal volume was significantly larger for the PD group when compared to the HOA group ($p = .021$). Therefore, the effects of pharyngeal volume on swallowing kinematics, PAS, and BCR were assessed for the PD group. Pharyngeal volume significantly influenced swallowing kinematics ($p = .027$), and resulted in significantly worse BCR ($p = .007$), but not PAS ($p = .874$).
Conclusions (Including Clinical Relevance): This study revealed that 2D pharyngeal volume at rest is significantly larger in PD compared to HOA. This finding suggests that pharyngeal muscle atrophy is exacerbated by PD, above and beyond what is seen in the normal, healthy aging. This change in pharyngeal volume significantly affected swallowing mechanics and contributed to the presence of increased amounts of residue. Rehabilitation exercises aimed at targeting muscle atrophy may be of benefit for preserving swallowing mechanics and swallowing efficiency in people with PD.
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The Effectiveness of an Ecologically Valid Telerehabilitation for Neurogenic Dysphagia Assessment and Primary Management in a Resource Constrained Country

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Purpose: Dysphagia management via TR has been delivered under controlled settings in economically advanced countries. The current study aimed to investigate the effectiveness of TR in the assessment and primary management of neurogenic dysphagia in a resource constrained country, which is India.
Method(s): A case study design was employed using PEA and Cohen's Kappa to determine the inter-rater reliability of scores between the TR-SLP and FTF-SLP on a clinical swallow evaluation proforma. Descriptive analysis was conducted to describe the main factors that affect the effectiveness of TR. Four simulated patients were used as subjects as this was the first of its kind study in a resource constrained country. One senior SLP in India posed as the FTF-SLP.
Result(s): Levels of agreement between the FTF-SP and T-SP revealed most parameters reached set levels of clinically acceptable levels of agreement. Agreement between the TR-SLP and FTF-SLP ratings for the oro-motor and laryngeal function tasks revealed levels of exact agreement ranging from 68.75%-100% (Kappa = 0.22–1.0) while the parameters relating to food and fluid trials ranged from 77.78%-100% (Kappa = 0.22–1.0).
Conclusions (Including Clinical Relevance): Despite the influence of patient-related, context-related and technology-related factors, that affect its effectiveness, TR was effective. These factors could be generalised to all resource constrained countries, since economic, political and geographical issues may be similar. An SLP considering TR for dysphagia intervention in such settings should be mindful of these factors when analysing the results.
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Objective Video-fluoroscopic Swallow Study (VFSS) Parameters Predict the Incidence of Aspiration Pneumonia

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Purpose: To identify objective VFSS parameters that predict the incidence of aspiration pneumonia.
Method(s): All individuals undergoing a VFSS between 01/01/12 and 06/30/15 were identified from an electronic database and followed historically for two years. Demographic information and objective fluoroscopic data was abstracted. Data included the pharyngeal constriction ratio, a validate surrogate of pharyngeal strength, upper esophageal sphincter opening, hyoid and larynx elevation, and pharyngeal and hypo-pharyngeal transit time. The 2-year incidence of pneumonia was obtained from the medical records and telephone inquiry. Pneumonia incidence was calculated and risk factors for pneumonia were evaluated.
Result(s): The mean age (+/− SD) of the cohort (N = 776) was 65 (+/-13) years. 47% was female. The incidence of pneumonia was 24% (184/776). The mean PCR for people who developed pneumonia was 0.45 (+/-0.32) and 0.13 (+/-0.16) for those who did not develop pneumonia (p = 0.00). Elevation of the hyoid and larynx was significantly less and pharyngeal and hypopharyngeal transit times were both significantly greater in persons who developed pneumonia (p = 0.00). Multiple logistic regression revealed that PCR and hypopharyngeal transit time were significant predictors of incident pneumonia after adjusting for all variables.
Conclusions (Including Clinical Relevance): The two-year incidence rate of pneumonia for persons undergoing a video-fluoroscopic swallow study is high (24%). Objective measures on fluoroscopy significantly predict the incidence of pneumonia with an elevated pharyngeal constriction ratio and prolonged hyophrayngeal transit time being most predictive. Development of a pneumonia risk score based on objective VFSS data is forthcoming.
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Contextualizing Dysphagia Assessments: A Paradigm Shift in Thinking and Assessment

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Purpose: The commonplace thinking around dysphagia assessment methodology is that it uses criterion based measures to create reliability and validity, which is usually conducted using the instrumental measures such as Fibreoptic Endoscopic Evaluation of Swallowing. In a perfect world, this is ideal practice, unfortunately, the majority world (mostly low-middle income countries) is far from perfect. These settings forces SLPs to rely heavily on the arguably more subjective clinical swallow evaluation (CSE). Is this poorer practice? This study aimed to investigate how the CSE could be augmented to address challenges but still be globally accessible.
Method(s): The findings from the Mann Assessment of Swallowing Ability (MASA) that was augmented with pulse oximetry (PO) and cervical auscultation (CA) was evaluated using a Wilcoxon signed rank test against those from FEES assessments conducted on the same patients presenting with acute neurogenic dysphagia. To further extend the data, the decision making processes of the SLPs using these two methods were analyzed qualitatively.
Result(s): There was a strong agreement rate between the MASA augmented with CA and PO when compared to the findings from FEES. Both the stats and qualitative data supported the suggestion that by easily augmenting what can be done at the bedside, it is possible for an accessible, holistic and reliable CSE to be conducted.
Conclusions (Including Clinical Relevance): Dysphagia assessments and the understanding of what gold standard measures are, needs to reflect real world settings in order to be holistic and contextually relevant globally. This study started to show how the concept of ecological validity can assist in need for a paradigm shift.
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Aspiration: Diagnostic Contribution from Bedside and Endoscopy

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Purpose: The aim of this study was to identify which swallowing variables, collected through bedside screening, clinical assessment and endoscopy, are either risk or protective factors for aspiration or residue.
Method(s): In a retrospective study, several variables from bedside screening, clinical assessment and endoscopy measurement were collected at our dysphagia clinic during 2016. As a first step, a bivariate analysis was performed to determine the associations (Chi-square test) of all variable with aspiration and residue (as the two dependant variables). Associations between aspiration and the following standardised outcome measures also were explored: Penetration Aspiration Scale (PAS), Functional Oral Intake Scale (FOIS), Dysphagia Outcome and Severity Scale (DOSS) and Pooling score (P-Score). As a second step, variables with significant associations with aspiration and residue at univariate level were entered into multivariate logistic models, to verify and quantify their association.
Result(s): Three hundred consecutive patients (mean age 72 years ± 14.7, range 20–98 years; 215 M/85 F) were included in the analysis. A total of 63 variables were evaluated: 12 variables were associated with aspiration and 19 with residue ($p < 0.05$). Aspiration and residue were correlated. Aspiration was also correlated with PAS, FOIS, DOSS and P-Score. Positive odds ratios from the regression model identified that the following risk factors were associated with aspiration: tracheotomy, gurgling, raclage, dysphonia, lips strength, and alternative feeding. The following risk factors were associated with residue: tracheotomy, gurgling, sensation, dysphonia, gender, drooling, tongue sensation, and direct therapy. Several variables had

negative odds ratios, which are indicative of being protective factors against aspiration (raclage, lips strength) and residue (gender, tongue sensation and direct therapy).

Conclusions (Including Clinical Relevance): Many swallowing related variables are associated with aspiration and residue, thus emphasizing the complexity of underlying processes and clinical interpretation of unsafe swallowing. More research is needed to unpack in greater detail the interaction between swallowing and person variability.

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Standardizing Dysphagia Severity Assessments in Oropharyngeal Cancer Patients

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Purpose: Dysphagia is a leading morbidity among patients with oropharyngeal cancer. Objective pre- and post-treatment oropharyngeal swallowing assessments are increasingly used to longitudinally assess patients and best target rehabilitation strategies. However, there is a paucity of data elucidating baseline and post-treatment swallowing outcomes using a standardized approach. We aimed to quantitatively describe pre- and post-treatment swallowing function among a cohort of patients treated for oropharyngeal cancer.

Method(s): A single institution retrospective chart review was conducted for adult patients treated for oropharyngeal carcinoma from 2007 to 2018. These patients prospectively underwent a functional and instrumental swallowing assessment battery as part of their clinical care. Dysphagia severity (Dysphagia Outcome Severity Scale, 1(severe) to 7(normal)), and solid and liquid intake status were collected pre- and post-treatment. Descriptive statistics were used to describe severity scores and proportion of patients with restricted diets. Unpaired t-tests were used to compare patient subsets.

Result(s): Ninety-six patients received chemoradiation +/− surgery as treatment for oropharyngeal cancer. Of these patients, 68 patients had pre-treatment dysphagia assessment and exhibited mild baseline swallowing deficits as characterized by mean (± SD) dysphagia severity scores of 5.65 (± 2.0), with modifications to solid and liquid intake in 33% and 9% respectively. Deficits increased to mild/mild-moderate at 6 months post-treatment (n = 51) with dysphagia severity scores of 3.9 (± 1.8), and the proportion of patients who had restrictions to solid and liquid intake increasing to 63% and 23% respectively. At 12 months post-treatment, dysphagia score remained relatively unchanged (3.8 ± 1.9, n = 22). There is a significant difference ($p < 0.01$) in severity score from pre-treatment to 6 months afterwards, but none between 6 and 12 months post-treatment.

Conclusions (Including Clinical Relevance): Patients with oropharyngeal cancer exhibit baseline deficits in swallowing function that increase in severity following treatment. Systematic use of instrumental swallowing assessments is key to providing targeted dysphagia interventions to improve swallowing outcomes. Future investigations with larger sample sizes are necessary to better understand the benefit of such standardized practice protocols.

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Pharyngeal Pressure Does Not Show Age-Related Functional Reserve Decline

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Purpose: Age-related decline in functional reserve has been described in tongue strength: tongue pressure during swallowing does not change with age, but maximal-effort tongue pressure decreases in older individuals. Healthy individuals have a slight increase in pharyngeal swallowing pressure with age, but it is unknown if there is a decline in pharyngeal functional reserve. We hypothesized that older individuals would generate less robust pressure increases with effortful swallowing than younger individuals.

Method(s): Fifty-six healthy adults ($n = 38 < 40$ years; $n = 18 > 60$ years) underwent pharyngeal high-resolution manometry during effortful and non-effortful thin liquid swallows. Repeated measures ANOVAs were performed on pharyngeal contractile integral (PCI) and velopharynx, tongue base, and hypopharynx maximum pressures. Age-related functional reserve decline is defined as a significant interaction effect ($p < 0.05$) between swallowing task (effortful vs. non-effortful) and age, indicating a decrease in relative pressure increase with effortful swallowing.

Result(s): Unsurprisingly, PCI and maximum pressures in all regions increased with effortful swallows ($p < 0.001$). However, there was no interaction effect between swallowing task and age ($p \geq 0.17$), indicating a lack of age-related functional reserve decline in pharyngeal swallowing pressure.

Conclusions (Including Clinical Relevance): Healthy individuals increase pharyngeal driving pressures during effortful swallows, without an age-related reduction in the magnitude of pressure increase. Muscle properties and pressure generation may be

fundamentally different between the pharynx and oral tongue. On the other hand, the effortful swallow task may not elicit maximal contractility of pharyngeal musculature. The preserved ability to increase pharyngeal pressure during effortful swallowing may support the use of the effortful swallow exercise in older adults with dysphagia.
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Relevant Non-financial Relationships: Corinne Jones: Nothing to Disclose | Timothy McCulloch: Nothing to Disclose.

Effects of Superior Laryngeal Nerve Lesion and Airway Protection on Kinematics of Swallowing in an Infant Mammal Model

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Purpose: Detailed sensory feedback is essential to facilitate airway protection during the kinematics, or complex movements, of a swallow. The superior laryngeal nerve (SLN) is the trigger for the swallow, and its sensory field is critical for swallow safety. Because of its role in initiating the swallow, we hypothesize that an SLN injury will alter the timing of events. Thus, we determined the effects of a surgical lesion of the SLN on swallow kinematics using an animal model, which permitted extensive VFSS data collection.
Method(s): Under anesthesia, we implanted radio-opaque markers into the posterior tongue, epiglottis, and hyoid bone in three infant pigs. We recorded feeding on milk with barium, while filming at 60fps. We measured three variables shown to be critical: (1) swallow duration, as measured by the time between initial flip of the epiglottis and its return; (2) anterior distance traveled by the hyoid, as well as speed; (3) posterior tongue ratio, which is the ratio of the total pathway traveled by the posterior tongue during the swallow to the pathway traveled only during the posterior flip of the epiglottis. We used the infant mammalian penetration/aspiration scale to quantify airway protection failure.
Result(s): There were no treatment (pre- versus post-lesion) effects in any kinematic variable. We found that unsafe swallows (where penetration and/or aspiration occurred) were significantly longer than safe swallows (without penetration or aspiration; $p = 0.0016$). Individual variation was high, showing marginally significant differences among subjects with respect to posterior tongue ratio, swallow duration, and hyoid movements.
Conclusions (Including Clinical Relevance): Regardless of sensory deficit, the kinematics of safe swallows did not change. This suggests that the impact of the SLN lesion can change the trigger for a swallow, but that once initiated, the kinematics follow a standard and reflexive pattern. This is different from results for other interventions, such as RLN lesion, which show distinct kinematic accommodations.
Relevant Financial Relationships: Andrew Lammers: Nothing to Disclose | Peng Ding: Nothing to Disclosel Shaina Holman: Nothing to Disclose | Regina Campbell-Malone: Nothing to Disclose | rz german: Nothing to Disclose. **Relevant Non-financial Relationships:** Andrew Lammers: Nothing to Disclose | Peng Ding: Nothing to Disclose | Shaina Holman: Nothing to Disclose | Regina Campbell-Malone: Nothing to Disclose | rz german: Nothing to Disclose.

Differences in Swallowing and Cough Function in Progressive Supranuclear Palsy and Parkinson's Disease

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Purpose: Progressive supranuclear palsy (PSP) is a rare neurological disease affecting the corticobulbar/corticospinal tracts. In the early disease stages, PSP presents similarly to Parkinson's disease (PD) and is often misdiagnosed as PD. However, symptoms usually become more severe than PD over time. Despite the high incidence of swallowing and respiratory-related complications in PSP, little is known about the specific changes to bulbar and respiratory strength, including muscle strength and functional measures of swallowing and cough. The aim of this study was to compare PSP and PD on a range of swallowing and cough-related measures.
Method(s): Participants with PSP ($n = 20$, age 60–84 y) and PD ($n = 20$, age 41–80 years) completed a range of clinical measures of swallowing, cough, and bulbar strength. PSP and PD groups were matched by disease duration (i.e. years since symptom onset; mean = 4.7, range 2–11). Bulbar strength was estimated during labial and lingual maximal isometric tasks using the Iowa Oral Performance Instrument. Functional swallowing outcome measures included degree of airway invasion during endoscopic swallowing examination (Penetration–Aspiration Scale score) and vallecular and pyriform sinus residue (Yale Residue Rating Scale). Cough outcomes were measured using spirometric techniques during a voluntary cough task. Analysis of variance was used to draw comparisons between the PSP and PD groups.
Result(s): Compared to PD, participants with PSP had significantly lower maximal isometric tongue pressures [$p = .03$], physiologic reserve [$p = .004$], and cough volume acceleration [$p = .03$]. There was a non-significant trend towards group differences in cough peak expiratory flow rate [$p = .06$]. Groups did not differ on measures of intra-swallow lingual pressure [$p = .21$], maximum intra-labial pressure [$p = .67$], penetration/aspiration [$p = .37$], vallecular residue [$p = .10$] or pyriform sinus residue [$p = .29$].
Conclusions (Including Clinical Relevance): Interestingly, measures of swallowing safety and efficiency did not differ between patients with PSP and PD who were matched for disease duration. However, specific measures of bulbar strength and cough effectiveness were different between groups. Findings support the notion that, although PSP has parkinsonian features, there are also distinct changes to swallowing and cough function which require unique rehabilitation efforts.
Relevant Financial Relationships: Sarah Perry: Nothing to Disclose | Jordanna Sevitz: Nothing to Disclose | James Curtis: Nothing to Disclose | Nora Vanegas: Has affiliations to disclose; Michael J. Fox Foundation: Salary/Stipend: Other Activities; CurePSP Foundation: Salary/Stipend: Other Activities | Zeina Seikaly: Nothing to Disclose | Michelle Troche: Has affiliations to disclose; Michael J. Fox Foundation: Salary/Stipend: Other Activities; CurePSP Foundation: Salary/Stipend: Other Activities.
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Comparison of Voluntary Cough Effectiveness Between Aspirators and Non-Aspirators in Progressive Supranuclear Palsy

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Purpose: Progressive Supranuclear Palsy (PSP) is a degenerative neurologic disease in which aspiration pneumonia is a leading cause of death; however, little is known about the effects of PSP on cough and swallowing dysfunction. In related diseases (e.g., Parkinson's Disease), cough and swallowing have been found to degrade in a parallel fashion, with the presence of cough impairment frequently predicting deficits in swallowing safety. Therefore, the aims of this study were to (1) characterize the frequency of swallowing safety impairments in PSP; and (2) determine if differences in voluntary cough airflow measures were present between aspirators and non-aspirators in people with PSP. **Method(s):** Individuals with PSP were consecutively recruited and underwent voluntary cough testing and flexible endoscopic evaluations of swallowing (FEES). Cough peak expiratory flow rate (PEFR), cough volume acceleration (CVA), and cough expired volume (CVE) were recorded. FEES included a 90 cc water swallow test from which presence or absence of airway invasion was determined (Penetration–Aspiration scale; PAS score). ANOVA was used to determine if differences in PEFR, CVA, and CEV were present between aspirators (PAS 6–8) and non-aspirators (PAS 1–5).
Result(s): Eighteen individuals with PSP, with an average age of 71.7 years and disease duration of 4.6 years, were recruited. Ninety-four percent of participants demonstrated airway invasion during FEES: eight demonstrated silent aspiration (PAS 8), nine demonstrated penetration (PAS 2–5), and only one demonstrated no swallowing safety impairments (PAS 1). PEFR was significantly higher for the non-aspirators when compared to the aspirators ($p = .004$). While CVA was not significantly different between aspirator and non-aspirators ($p = .509$), CEV was found to be significantly larger in the non-aspirators when compared to the aspirators ($p = .045$).
Conclusions (Including Clinical Relevance): This study demonstrated that swallowing safety impairments are highly prevalent in PSP. Furthermore, voluntary cough effectiveness was significantly worse for aspirators when compared to non-aspirators. This suggests that clinical swallowing evaluations may benefit from the incorporation of voluntary cough testing to (1) assist in identifying individuals at risk of aspiration, and (2) examining cough effectiveness for airway protective function in people at risk of dysphagia.
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Sensate Versus Asensate Flap Reconstruction of the Oral Cavity with Objective Measurements of Tongue Strength and Function in a Rat Model

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Purpose: Surgical treatment of oral cavity cancer may compromise lingual and/or hypoglossal nerves, resulting in reduced tongue function. The impact of a lingual nerve deficit, which compromises transmission of sensory information from the tongue, on tongue function is not known. Our purpose was to simulate sensate and asensate oral cavity flap reconstructions in a rat model to objectively measure the impact of sensory and/or motor deficits on tongue function.
Method(s): Age matched male Sprague Dawley rats ($n = 24$) were randomized into 4 groups: (1) unilateral hypoglossal and lingual ablation (HL); (2) unilateral hypoglossal ablation (H); (3) unilateral lingual ablation (L); and (4) sham surgery with no nerve ablation (C). Maximum tongue force and press rate were quantified using a transducer. Measurements were made at four different time points: (1) pre-ablation baseline; (2) post-ablation day 4–6; 3) post-ablation day 11–13; and (4) post-ablation day 21–23. Repeated measures 4×4 ANOVAs were performed.
Result(s): Prior to nerve ablation, there were no significant differences across groups for maximum tongue force or tongue press rate. There were no significant tongue force differences within group L at any time post nerve ablation. However, Group L had a significant reduction in tongue press rate at all time points following lingual nerve ablation ($F_{[3,92]} = 13.29$, $p < .001$). Groups H and HL had substantial difficulty pressing the transducer post-ablation, resulting in a significant reduction in maximum tongue forces at all post-surgical time points relative to the C and L groups ($p < 0.001$). Tongue press rates were also significantly reduced in the H and HL groups at all time points post nerve ablation ($p < 0.001$).
Conclusions (Including Clinical Relevance): Ablation of lingual and/or hypoglossal nerves resulted in deficits in sensorimotor function of the tongue. As expected, ablation of hypoglossal nerves alone or in combination with the lingual nerve ablation caused severe impairments in force generating capacity within the tongue. However, and less expected, were the significant motor impairments observed with sensory ablation alone. The implication of these findings is that the lingual nerve contributes to normal sensorimotor function of the tongue. These data suggest efforts to spare or restore lingual nerve function during head and neck resection and reconstruction could result in improved oral cavity function.
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Wisconsin-Madison: Salary/Stipend: Employment; National Institutes of Health: Grant: Other Activities; Massachusetts Eye and Ear Infirmary: Grant: Independent contractor (Including contracted research) | Mark Varvares: Has affiliations to disclose; Massachusetts Eye and Ear Infirmary: Salary/Stipend: Employment.
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The Effect of Focus of Attention and Knowledge of Expectancies in Learning a Novel Swallow Motor Plan in Healthy Normals

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Purpose: There is limited evidence to support the most effective oropharyngeal dysphagia motor learning intervention despite years of exploration. Traditionally, swallow treatments target disordered swallows by repeating and shaping the swallow based on subjective observations. In therapy, it is necessary for clinicians and patients to know if motor patterns are being performed correctly or at all. It is known that a learner's focus of attention and knowledge of expectancies play a significant role in motor learning, but it is not known whether focus of attention and knowledge of expectancies enhance motor learning relative to swallow treatment.
Method(s): A sEMG trace of a motor plan and instructions like the Mendelsohn Maneuver were generated apriori (KG and EB). Participant received the same instructions, a picture of the motor plan, used saliva, and given 15 min to learn the motor plan in a treatment condition. The motor plan was "learned" upon three consecutive correct attempts. Levels of focus and expectancy were delivered to each group. Time was recorded. One hundred Nineteen (N = 119) healthy participants were assigned at random to one of three groups. Group 1 (external) Participants watched the sEMG traces and performed the motor plan. If acceptable, clinician gave positive feedback. If not acceptable, the participant was given negative feedback, directed to the non-acceptable portion of the trace, verbally shaped and asked to repeat the plan. Group 2 (expectancies) Participants were blind to the sEMG traces but the clinician was not. Clinician shaped the participant's behavior based on her sEMG feedback. Group 3 (internal) participants and clinician were blind to sEMG feedback.
Result(s): A Kaplan-Meier survival analysis revealed Group 1 (EFG): 97.4% of the group met the learn criteria and learned the motor plan; the median time was 3.52 min [95% CI 2.75–4.26; SE 0.54]. Group 2 (CSG): 75% of the group met the learn criteria; the median time was 8.23 min [95% CI 6.8–9.65; SE 0.96] min. Group 3 (NFG): 17% of the group met the learn criteria; the median time was 13.75 min [95% CI 12.8–14.7; SE 1.15] min.
Conclusions (Including Clinical Relevance): External focus of attention resulted in a shorter learning time. Manipulating the learner's performance expectancy was effective in training a new swallow motor plan. Internal focus without feedback was least effective in training a new swallow motor plan.
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Development of a Tongue-Strength Fatigue-Test: Proof of Concept of a Fatigue Paradigm in Post-stroke Oropharyngeal Dysphagia (PSOD) Versus Healthy Controls

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Purpose: Insufficient tongue strength increases risks of dysphagia, prolonged mealtimes and/or premature ending of meals. Healthy controls (HC) in previous research showed no tongue fatigue using a specific fatigue paradigm (FP). We aimed to compare tongue fatigability in PSOD with HC.
Method(s): 6 recent PSOD patients (50–75 yo, 4 males) were recruited in a rehabilitation center. Presence of PSOD was based on EAT-10-score > 3 and FOIS-level of 3–5. All patients indicated subjective fatigue when consuming a standard main meal.
Baseline assessment (BL) comprised of maximum isometric tongue pressure (MIP)–anterior (MIPA) and posterior (MIPP)—defined as the highest value of 3 motivated trials.

Each patient performed in random order 3 FP with target-levels of resistance (TLR) of 60, 80 or 100% of BL MIPA, with 48 hours between FPs to avoid residual fatigue. 1 set of exercises was defined as 5 reps of the TLR followed by 1 MIPA; a successful rep required achieving and maintaining 3 s of TLR. Sets were repeated until task failure operationalized as (1) MIPA during FP $< 50\%$ of BL MIPA, (2) outspoken tongue discomfort, pain or cramping, or (3) FP-completion meaning 40 sets.

Recovery measures mirrored BL and were assessed directly after FP (Post0), 5 (Post5) and 15 min (Post15). All testing and measurements used the IOPI.

Results were analyzed using RM-ANOVA and Kaplan–Meier survival analysis.
Result(s):

(1) No MIPA decrease occurred during any FP with POST15 MIPA values higher than BL. MIPP was similar but showed a trend of lower Post0 measures to BL.
(2) At no time-point across FPs, significant differences between MIPAs were noted. To note a large effect size between 1st and 3rd FP for MIPA BL and Post0 (+10 and +6 kPa). Similar MIPP-results for BL versus Post0 (+8 and +5 kPa).
(3) A significant difference in successful reps per LR for MIPA 60 and 100% TLR ($p = .02$). Means and SD are 60% 118 ± 72, 80% 92 ± 68, 100% 19 ± 27.
(4) Significant different numbers of MIPA-repeats between PSOD (m = 16, 95% CI 1–31) and 40 HC (m = 66, 95% CI 63–67) at different time-points of the FP ($p < .000$ for chi2 log rank, breslow and tarone-ware.

Conclusions (Including Clinical Relevance): This FP discriminates between PSOD and HC when assessing the number of MIP-repeats.

This finding indicates cut-off values that can serve as a future screening tool to indicate abnormal fatigability, but further validation is needed in more patients and different dysphagia-etiologies.
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Relevant Non-financial Relationships: Jan Vanderwegen: Nothing to Disclose | Gwen Van Nuffelen: Nothing to Disclose.

Training and Visual Feedback Increase the Intensity of Effortful Swallows in Healthy Normals

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Purpose: Intensity of training is known to positively affect neural plasticity. The Effortful swallow is an intensive rehabilitative swallow technique used to treat dysphagia. Ng suggested that the effortful swallow is produced with 1.55% more microvolt amplitude than the typical swallow on sEMG. It is not known if feedback increases the ratio between an effortful swallow and typical swallow at different volumes. It is not known if feedback impacts the likelihood that the 1.55% ratio be reached at different volumes.
Method(s): One hundred Twenty (N = 120) healthy participants were assigned at random to one of three groups. Each participant was asked to swallow three volumes of liquid three times (5 mL, 10 mL and 15 mL) with maximum effort and again with typical effort. Each Swallow was measured in microvolts. Effort ratios were calculated for each participant in each group at each volume. The ratio was calculated as suggested by Ng et al. (2017). Group 1 (VTG) participants received training with adjunctive sEMG feedback. Group 2 (NTVG) received sEMG feedback only. Group 3 (NTNVG) received no training and no feedback.
Result(s): A one-way ANOVA revealed for 5 mL trials 85% of Group 1 (VTG) ratios were above 1.55% with a mean ratio of 2.43 (SD .97) and a range of 1.22–4.81 μV. Group 2 (NTVG) revealed 59% of ratios were above 1.55% with a mean effort ratio of 1.73 (SD .61) and a range of 0.87–3.93 μV. Group 3 (NTNVG) revealed 51% of ratios were above 1.55% ratio with a mean effort ratio of 1.71 (SD .46) and a range of 1.08–2.70 μV. The 10 mL and 15 mL. trials revealed similar results. A main effect for each volume revealed that Group 1 ratios were significantly different than Group 2 and 3 ($F = 12.6$; df (2) $P < .001$). A logistic regression revealed that at 5 mL volume group 1 (TVG) was 5 times more likely to achieve the 1.55% relative to group 3 at 10 mL group 1 (TVG) was 6.8 times more likely to achieve the 1.55% relative to group 3, and 15 mL group 1 (TVG) was 3.4 times more likely to achieve the 1.55% relative to group 3 (odds ratio [OR] $p = .001$).
Conclusions (Including Clinical Relevance): A combination of training and visual feedback are more effective in increasing the ratio between the effortful and typical swallow at different volumes than visual feedback alone or no feedback at all. Individuals work at a higher intensity with training and visual feedback.
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Experimental and Computational Modeling of Bolus Fragmentation

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Purpose: Loss of liquid bolus control during swallowing, and the resulting split of the bolus into multiple fragments, provides a significant risk for bolus misdirection and aspiration. To date, computational and experimental models of oropharyngeal fluid mechanics have generally considered the transport of a cohesive bolus. The purpose of this work was to develop an experimental apparatus to promote bolus splitting and to model this device using computational fluid mechanics. We study the tendency of a bolus to fragment as well as the predictive accuracy of a numerical model of bolus control.
Method(s): A representative planar oropharyngeal geometry, including a cupped lingual surface, was designed based on anatomical references and fabricated using 3-D printing. This oropharyngeal chamber was mounted on a rail system equipped with a rigid stop. A weight attached with a cable and pulley was used to propel the device. After traveling along the rail, the device hit the stop, causing a portion of the fluid to abruptly spill into the fluid well. The volume of fluid that spilled was measured and the sequence recorded on video for analysis. The position along the rail as a function of time was extracted and used to estimate the impact speed. A computer model of this process was developed using the incompressible flow solver in the LS-Dyna finite element software (Livermore Scientific Technology Corporation; Livermore, CA). The liquid was modeled as a Newtonian fluid and the motion of the device along the rail used as input to the model.
Result(s): Repeat studies indicate consistent emulation of impaired oropharyngeal bolus handling in both the speed at impact as well as volume spilled. Preliminary qualitative comparison indicates that the computational fluid mechanics model reproduces the physical conditions that predict bolus splitting and incohesion.
Conclusions (Including Clinical Relevance): An experimental and computational model is demonstrated that depicts oropharyngeal bolus incohesion. Future studies will consider varied bolus rheology and impact speeds, and quantitative comparison between experiment and simulation. These studies may provide insight into the physics of bolus splitting during pathological oropharyngeal transport, and thereby aid in the understanding of aspiration risk.
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Worsening Trismus After Radiation Therapy -Time to Intervene?

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Purpose: Purpose: With the rise of curable HPV-driven oropharynx cancers, treatment related sequlae, such as trismus, are becoming more common. The prevalence of trismus after radiation therapy ranges from 5 to 38% and there is currently no standard management or prevention approach. In order to consider future strategies for managing trismus, we aimed to first establish the rate of trismus after radiation therapy at our institution.

Method(s): Methods: We retrospectively evaluated the medical records of patients treated for oropharyngeal carcinoma with chemoradiation therapy with or without initial surgery at our institution from 2007 to 2018. Patients receiving radiation alone were excluded. Trismus measurements were obtained by experienced speech language pathologists by measuring the intra-incisoral distance. Measurements were also taken at 6 months post-treatment when possible. Jaw opening of 40 mm or more was considered to be normal jaw opening and < 40 mm was defined as trismus.
Descriptive statistics and unpaired t-tests were used to analyze the data.

Result(s): Results: Forty-three patients in our dataset had trismus measurement of which 34 patients had pre-treatment trismus measurements with a mean (SD) of 41.9 (11.6) mm. There were thirteen patients with a trismus measurement at 6 months demonstrating significantly worsened symptoms with a mean opening of 34.2 (12.3) mm ($p < 0.05$). Prior to treatment, 71% of patients had normal mouth opening. This number was reduced to 46% at 6 months post-treatment. Pre- and post-treatment data was available for 6 of the patients; interestingly, there were 2 patients with normal jaw opening pre-treatment who retained normal jaw opening post-treatment who had 6 and 12 therapy sessions, respectively, within 12 months of completing treatment. The remaining 4 either had trismus and continued to have it despite therapy, or did not receive therapy and therefore developed trismus over time.

Conclusions (Including Clinical Relevance): Conclusions: Patients with oropharyngeal cancer treated with radiation therapy remain at high-risk for the development of trismus within months of completion of therapy. Efforts should be made to document a pre-treatment baseline and follow each patient closely within the first year following radiotherapy. Prospective guidelines on how best to optimize therapy are warranted.

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Changes in Swallow Safety and Efficiency After Radiation in Patients with Oropharyngeal Carcinoma

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Purpose: Dysphagia is commonly experienced by individuals who have undergone radiation treatment (RT) for head and neck cancer (HNC). However, we lack understanding of the specific changes in swallowing physiology that lead to Penetration–Aspiration or residue in this population. We explored the pathophysiology of impaired swallowing safety and efficiency in patients following RT for oropharyngeal cancer using a case-control design. Specifically, we explored the relationships between: (1) measures of laryngeal vestibule closure and Penetration–Aspiration; and (2) measures of pharyngeal constriction and post-swallow residue.

Method(s): The participants were 12 men (age 49–78), 3–6 months post RT (Mdn = 70 Gray, range 52–70 Gy) for oropharyngeal cancer. Up to 4 swallows each of 20%w/v thin barium were collected under videofluoroscopy at 30 pulses/s. Comparison data were collected for 12 healthy, age-matched males. The videofluoroscopies were rated in duplicate using the Penetration–Aspiration Scale (PAS); measures of the integrity of laryngeal vestibule closure (LVC; complete/incomplete); LVC reaction time (LVCrt) and duration (LVCdur); and pixel-based measures of maximum pharyngeal constriction (MPC) and residue (%C2–C4[2]). ANOVAs were performed to identify differences in timing between HNC and healthy swallows. Spearman's correlations were run to assess the relationship between residue and MPC.

Result(s): Swallows with a PAS of ≥ 3 were seen in 9/12 patients in the HNC group. LVC was incomplete in 67% of these occurrences. LVCrt was significantly longer in the HNC group compared to the healthy controls ($p < 0.001$). A large effect size was found for unsafe swallows in the HNC patients compared to healthy controls (Cohen's $d = 2.16$). LVCdur did not differ between groups. In the HNC patients, 41% of swallows had residue above the healthy range. Residue was significantly associated with poor pharyngeal constriction $r(39) = 0.88$ ($p < 0.001$).

Conclusions (Including Clinical Relevance): These data provide evidence that incomplete or late LVC represents a primary mechanism behind Penetration–Aspiration following radiation therapy for oropharyngeal cancer. Poor pharyngeal constriction was a primary contributing factor to post-swallow residue. These findings highlight targets for dysphagia intervention in patients following radiation treatment for head and neck cancer.

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Underlying MBS Swallowing Mechanics of FEES Variables

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Purpose: We wondered if swallowing mechanics can be inferred from Fiberoptic Endoscopic Evaluation of Swallowing (FEES) tasks. The aim of this study was to determine if FEES variables are associated with any specific swallowing mechanics as seen on Modified Barium Swallow (MBS).
Method(s): In a mixed sample of 22 patients, FEES and MBS exams were performed simultaneously. The following FEES variables were rated: secretions, true vocal fold (TVF) ab/adduction, and pharyngeal squeeze speech task (rated on an effortful "eeek" sound). Computational Analysis of Swallowing Mechanics (CASM) was used to analyze the pharyngeal stage of swallowing mechanics on the MBS and the FEES variables were added into the analysis to determine any associations. Using CASM, twelve swallowing landmarks tracked each participant's swallow of 5 mL thin liquid using a MatLab tracking tool. These data were exported into MorphoJ where each pharyngeal stage of the swallow determined mean differences in shape changes between normal/abnormal classification of the 3 FEES variables. A canonical variate analysis was performed to determine if differences between groups existed. A Mahalanobis distance was used to determine results of comparisons in discriminant function analyses.
Result(s): There were n = 3/19 with pooled secretions, n = 5/20 with reduced TVF mobility, and n = 9/15 with reduced pharyngeal squeeze on the speech task. The canonical variate analysis revealed significant differences ($p < .0001$) between all test groups. Swallowing mechanics on the MBSes differed significantly for those with secretions than without on FEES ($D = 7.7$, $p < 0.0001$), and there was a moderate reduction in hyolaryngeal excursion, pharyngeal constriction/shortening, and tongue base retraction on the MBSes. There was an overall significant but milder difference in those with reduced/absent TVF mobility ($D = 6.9$, $p < 0.0001$). There was a moderate-profound global reduction in all swallowing mechanics for those with a reduced pharyngeal squeeze speech task ($D = 9.1$, $p < 0.0001$).
Conclusions (Including Clinical Relevance): The three FEES variables of pooling of secretions, TVF movement, and pharyngeal squeeze on speech tasks were related to overall worse swallowing mechanics on the MBS exam. For the first time, we associated FEES variables with specific swallowing shape changes on MBS exams.

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Impact of Lingual and Pharyngeal Strength on Swallowing Safety and Efficiency in Individuals with ALS

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Purpose: Although dysphagia occurs in the majority of individuals with ALS, it is unclear how the progressive weakening of lingual and pharyngeal muscles contribute to specific impairments in swallowing safety (aspiration) or efficiency (pharyngeal residue). This study sought to:

(1) Compare maximum lingual strength and pharyngeal constriction profiles across radiographically confirmed DIGEST swallowing severity levels in ALS.
(2) Determine relationships between swallowing efficiency and (a) maximum lingual pressure and (b) maximum pharyngeal constriction area normalized.
(3) Compare maximum lingual strength and pharyngeal constriction in non-aspirators versus aspirators.

Method(s): 68 individuals with ALS (El-Escorial Criteria Revised) attended a testing session and completed a standardized videofluoroscopic swallowing evaluation and maximum anterior isometric lingual pressure (MAIP) testing using the Iowa Oral Performance Instrument (IOPI; Woodinville, PA). Two independent and blinded raters assessed VFSE using the Dynamic Imaging Grade of Swallowing Toxicity (DIGEST; Hutcheson, 2017), normalized maximum pharyngeal constriction area and determined aspiration status (PAS ≥ 6) using PAS scores (Rosenbek, 1995).
Statistical analyses included: ANOVA (LSD post hoc), Spearman's rho correlations and independent samples t-tests.
Result(s):

(1) Lingual strength (MAIP) differed across DIGEST swallowing severity levels [$F(3,402) = 60.1$, $p < .001$]. Post hoc analyses revealed significant differences in MAIP between ALS individuals with normal swallowing (DIGEST = 0) versus persons with mild, moderate and severe swallowing impairment (DIGEST 1–3). Pharyngeal constriction also differed across global dysphagia levels, $F(3,402) = 32.6$, $p < .001$, with significant differences in MPCAn between normal versus mild, moderate and severe groups.
(2) Higher MAIP's were associated with lower DIGEST scores ($r = -.53$, $p < .001$) and higher (worse) MPCAn was associated with more severe global dysphagia ($r = .39$, $p < .001$).
(3) MAIP was lower in ALS aspirators (mean: 23 kPa) vs. non-aspirators (mean: 40 kPa), $t(90) = 9.5$, $p < .001$. On average, pharyngeal area during swallowing was three times larger for aspirators vs. non-aspirators, [0.09 vs. 0.03, $t(65) = -4.2$, $p < .001$].

Conclusions (Including Clinical Relevance): These data suggest that both lingual strength and pharyngeal constriction contribute to global swallowing function and the ability to swallow efficiency and safely in ALS.
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Relevant Non-financial Relationships: Raele Robison: Nothing to Disclose | May Smith-Sherry: Nothing to Disclose | Lauren Tabor-Gray: Nothing to Disclose | Jennifer Chapin: Nothing to Disclose | Kelby Magennis: Nothing to Disclose | Carol Smith: Nothing to Disclose | Amber Anderson: Nothing to Disclose | James Wymer: Nothing to Disclose | Emily Plowman: Nothing to Disclose.

Hyolaryngeal Movement as Seen on MBS and Its Relationship with Epiglottic Inversion as Seen on FEES

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Purpose: The hyoid excursion is one part of the complex epiglottic inversion, which provides some of the necessary protection of the airway from the bolus. The aim of this study was to identify which, if any, swallowing mechanics as seen on Modified Barium Swallow exam (MBS) are associated with inadequate epiglottic inversion as seen on the flexible endoscopic evaluation of swallowing (FEES).
Method(s): Data were collected from 20 adult dysphagic patients swallowing 5 mL thin liquids during a simultaneous FEES/MBS exam. Epiglottic inversion was rated by three independent raters as seen on FEES for reliability. Using CASM, twelve swallowing landmarks tracked for each participant's swallow's shape change on the MBS video using a MatLab specific tracking tool. These data were then compiled and exported in a MorphoJ format. In MorphoJ, a Procrustean fit of the landmarks across all frames of each pharyngeal stage of the swallow determined the mean differences in shape changes between the swallows in the 3 groups: complete, reduced, and absent epiglottic inversion as seen on FEES. A graph correction method was used to account for the anatomical constraints of the swallowing apparatus when visualizing eigenvectors. This function allows a more accurate visualization of gestalt mechanics using the vertebrae as a point of reference. A Procrustes fit was applied to the vector results aligning 3 of the coordinates representing C1, C2, and C4 vertebrae. A Mahalanobis distance indicated how many standard deviations away each group's swallow was from another in a discriminant function analysis.
Result(s): Epiglottic inversion was rated as (n = 2 absent, n = 4 reduced, n = 14 complete). There were n = 351 in the complete group, n = 98 in the reduced group, and n = 20 in the absent group; 469 total frames. Discriminant function analyses showed significant differences ($p < .0001$) between all test groups with Mahalabonis distances ranging from 3.2 to 45.1. Eigenvectors demonstrated mechanical differences in the hyoid, tongue base retraction, pharyngeal shortening, and laryngeal elevation. Differences in the direction and magnitude of the hyoid appeared greatest between the complete and absent group.
Conclusions (Including Clinical Relevance): CASM revealed that absent epiglottic inversion on FEES the with a gestalt reduction in swallowing mechanics on MBS. Further, hyoid differences were most reduced in the absent epiglottis group.
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Relevant Non-financial Relationships: Amr Jijakli: Nothing to Disclose | Jessica Pisegna: Nothing to Disclose | Emily Ramirez: Nothing to Disclose | Joesph Murray: Nothing to Disclose | Rebecca Leonard: Nothing to Disclose | Susan Langmore: Nothing to Disclose.

Development of a Rat Model for Studying the Behavioral Assessment of Dysphagia

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Purpose: Dysphagia is reported to occur in more than 50% of stroke patients at acute phase. Symptoms of dysphagia caused by stroke are variable and therapeutic strategies should be arranged depending on the patients' condition. So far, no studies to precisely apprehend how chewing and swallowing muscle activities are affected by stroke has been reported. Thus, we attempted to develop a recording system using stroke animal model in freely behaving rats.
Method(s): We used seven weeks male Sprague-Dawley rats. They were divided into four groups; control, sham, external carotid artery ligation (ECAL), and middle cerebral artery occlusion (MCAO). At the first surgery, bipolar polyurethane-coated stainless steel wire electrodes (0.2 mm diameter, 1 mm interpolar distance) were placed in the bilateral masseter, right suprahyoid and right thyrohyoid muscles for EMG recording. Following 1-week recovery period, feeding behaviors were recorded.
Result(s): We have optimized surgical procedures and established the natural feeding model in freely behaving rats. Although no remarkable difference in chewing behaviors was found among control, sham and ECAL groups, chewing duration, rhythmicity of chewing as well as muscle activity were changed in the MCAO rats.
Conclusions (Including Clinical Relevance): We have successfully developed a series of surgical procedures and the protocol to obtain the natural feeding behavior in rats. We will do further research to analyze the effects on mastication and swallowing, such as oral environmental changes and cerebrovascular damage, using this model.
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DHI Responses Not Associated with PAS Score from MBS

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Purpose: The Dysphagia Handicap Index (DHI) is a validated, patient-reported questionnaire used to quantitate the physical, emotional, and functional handicapping effects in patients with dysphagia. This study sought to assess the association between DHI items related to aspiration (1p and 7e) and the global rating, and Penetration–Aspiration Scale (PAS).

Method(s): Participants were part of an IRB-approved dysphagia evaluation protocol that included the DHI and a Modified Barium Swallow (MBS). Each participant had completed the DHI questions: "I cough when I drink liquids" (1p) and "I'm afraid that I'll choke and stop breathing because of my swallowing problem" (7e). Responses were categorized as normal ("ever") and abnormal ("sometimes" or "always"). PAS scores were rated for both 5 mL and 20 mL thin liquid boluses and were categorized as "aspirator" (PAS > 6) or "non-aspirator" (PAS < 6). Global ratings were categorized as "normal" (< 4) or "abnormal" (> 4). Statistical analyses included unadjusted bivariate analyses and a multiple logistic regression to adjust for confounding variables.

Result(s): A total of 57 individuals were included in this study. Question 1p had 17 (29.82%) normal responses and 40 (70.18%) abnormal responses. Of the normal responses, n = 1 (5.88%) aspirator and n = 16 (94.12%) non-aspirators. Of the abnormal responses, n = 5 (12.50%) aspirators and n = 35 (87.50%) non-aspirators. The adjusted model yielded an odds ratio of 0.71 (p = 0.81). Question 7e had n = 16 (28.07%) normal responses and n = 41 (71.93%) abnormal responses. Of the normal responses, n = 2 (12.50%) aspirators and n = 14 (87.50%) non-aspirators. The adjusted model yielded an odds ratio of 0.35 (p = 0.37). The global rating had n = 11 (19.30%) normal ratings (5 were aspirators and 41 were not) and n = 46 (80.70%) abnormal ratings (1 was an aspirator and 10 were not). The adjusted model yielded an odds ratio of 1.59 (p = 0.72).

Conclusions (Including Clinical Relevance): No statistically significant association was found between abnormal DHI questionnaire responses on 2 items and PAS scores. These results suggest that the DHI is not clinically indicative of PAS outcomes on thin liquid boluses on MBS exams, therefore highlighting limitations of patient-reported tools and the need for other indicators of aspiration aside from instrumental evaluations.

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An Outpatient Feeding Clinic Can Help Reduce Rehospitalization and Pulmonary Complications of Pediatric Patients with Dysphagia?

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Purpose: This study sought to compare the relationship between use of antibiotics, chest X-rays and hospitalization due to pulmonary complications of pediatric patients with dysphagia pre and post enrollment in a pediatric follow up outpatient feeding clinic of a tertiary public hospital.

Method(s): The variables analyzed were obtained from medical records, chart information and speech and language ambulatory consults. We used McNemar and Wilcoxon tests to explore the hypothesis that after enrollment in the outpatient feeding clinic infants and children attending this clinic would reduce use of antibiotics, number of chest X-rays performed and hospitalization due to pulmonary complications.

Result(s): 197 pediatric patients diagnosed with dysphagia were included in this study, mean age was 45.55 months, 65% male and 50.8% of the sample had a neurologic disease. After these patients started to attend the outpatient feeding clinic they presented fewer hospitalization due to pulmonary complications ($p < 0.001$) and the use of antibiotics was reduced significantly ($p < 0.001$). We also observed that referrel to chest X-ray to monitore pulmonary status or to rule out pulmonary complications was diminished ($p < 0.001$).

Conclusions (Including Clinical Relevance): The results of this study contributed to the idea that a follow up pediatric outpatient feeding/swallowing clinic can help reduce complications of swallowing disorders as well as hospital costs with medications, exams and rehospitalizations.

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