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ABSTRACTS

Dysphagia Research Society 26th Anniversary Annual Meeting March 15–17, 2018 Renaissance Baltimore Harborplace Hotel, Baltimore, Maryland

President's Message

Dear DRS Colleagues:

Abstracts from the 26th Annual Meeting of the Dysphagia Research Society, held at the Renaissance Baltimore Harborplace Hotel in Baltimore, MD, are being published a bit later than usual; but better late than never, as there was a lot of great work to share. The meeting was a great success; and, as always, there are many people to thank for their contributions. Among these are the great staff at the Renaissance, the stellar program committee team we put together, the DRS Board of Directors and officers, and the amazing management team of Badger Bay. Without the over-the-top contributions of all of these people, this meeting would not have happened—much less been a success.

One of our goals for the year was to capitalize on the regional talent that exists in the Baltimore/D.C. area and within a few hours drive/train time and bring in some new, and hopefully permanent, members to DRS from the broader medical community in the region. We feel this was a great success and made efforts to build upon this methodology in San Diego and beyond.

But what really made the Baltimore conference a success was not the city, the management, the Board, or the invited guests. It was you…the scientists. The leadership of DRS has no ability to control the quality of scientific abstract submissions, and the 2017-2018 presentation quality—the scientific quality—was among the best we've ever had. This is not likely an artifact; but, rather, the result of a calculated effort on behalf of the exceptional scientists in our profession crafting the future by recruiting and mentoring great new researchers. I can't mention one lab without mentioning them all, but there are many building the future of our profession. Still, there were many other great presentations by individuals from labs around the world we'd known little about—until now, that is. Please keep doing the great work you are doing and pushing the science of deglutition forward. From labs big and small, from all parts of the world, the science of deglutition is gaining momentum. The future is as palpable as the larynx with four fingers and a cup of applesauce. We have many reasons to be optimistic about our future and the futures of the patients we aspire to help. Our science is strengthening, our collaborations are building, and our patients are improving from our efforts. Thank you for all that you do to improve the quality of our science and the quality of life.

Cheers!

Gary H. McCullough, Ph.D.
DRS Past President
(President 2017–2018)

Cross-Pathway Transfer Between the Ankle and Tongue

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Purpose: Many diseases and disorders that impact swallowing (corticobulbar pathway or CB) also impact the corticospinal pathway (CS) (i.e. reaching). There is evidence that motor skill transfer can occur within a pathway (i.e. CB-to-CB) however cross-pathway motor skill transfer is infrequently studied (i.e. CB-to-CS). The purpose of this study was to examine cross-pathway transfer because it could be important for understanding the benefit or harm when patients are involved in rehab across multiple disciplines (PT, OT, SLP).

Method(s): Healthy participants were recruited for this two-day study. Six participants performed a goal-directed task with their ankle on day 1 (ankle dorsiflexion), then tongue on day 2 (elevate tongue against IOPI). The other 6 participants performed the same task with their tongue on day 1, then ankle on day 2. Both the ankle and tongue tasks (50 trials each) required matching force and time to a visual target.

Result(s): The participants who underwent ankle training on day 1 exhibited decreased tongue force error on day 2 ($p = 0.022$) (i.e. greater accuracy). However, no cross-pathway transfer was found in the other group (tongue day 1, ankle day 2).
Conclusions (Including Clinical Relevance): Training in the CS (i.e. ankle, hand) might influence training of the CB (i.e. tongue, jaw). If training with the CS can lead to improved CB functioning, incorporating cross-pathway rehabilitation techniques might be valuable for clinicians across medical disciplines.
Relevant Financial Relationships: Alayna Ernster: Nothing to Disclose | Seoung Hoon Park: Nothing to Disclose | Basma Yacoubi: Nothing to Disclose | Evangelos Christou: Nothing to Disclose | Agostina Casamento- Moran: Nothing to Disclose | Michele Singer: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.
Relevant Non-financial Relationships: Alayna Ernster: Nothing to Disclose | Seoung Hoon Park: Nothing to Disclose | Basma Yacoubi: Nothing to Disclose | Evangelos Christou: Nothing to Disclose | Agostina Casamento- Moran: Nothing to Disclose | Michele Singer: Nothing to Disclose | Ianessa Humbert: Has a Non-Financial Disclosure Affliation; Dysphagia Research Society: Professional: Membership.

Bolus Airway Invasion in Healthy Community-Dwelling Adults: Prospective Investigation Using Videofluoroscopy

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Purpose: The purpose of this study was to investigate occurrence of penetration-aspiration among healthy adults.
Method(s): Eligible participants underwent a modified barium swallow study (MBSS) using a standardized approach (MBSImP). Each swallow was assessed using the Penetration-Aspiration Scale (PAS). Blinded consensus scoring was used to assign each swallowing task a PAS score. Descriptive measures were calculated and scatterplots were constructed (PAS vs. age category; PAS vs. sex). Differences in PAS score across age categories were analyzed using the Kruskal–Wallis test, and differences between sexes were analyzed using the Mann–Whitney U test. PAS scores were dichotomized as impaired (≥ 3) or not impaired (< 3), and Fisher's exact test was used to determine differences. 1936 swallows from 195 participants were analyzed.
Result(s): All possible PAS scores were observed, with 94% of swallows receiving a PAS score of 1. Impaired PAS scores were observed in 37 swallows (3%), with the greatest frequency observed as a score of 3 (1.2%). Five (0.1%) aspiration events were observed. Mean or worse PAS scores did not significantly differ across age categories ($p = 0.12$ and $p = 0.08$, respectively). Percent of impaired PAS scores did not significantly differ across age categories except for the three nectar-thickened swallowing tasks. Mean or worse PAS scores did not significantly differ between sexes ($p = 0.85$ and $p = 0.95$, respectively).
Conclusions (Including Clinical Relevance): Age-related changes to the swallowing mechanism in otherwise healthy individuals do not appear to affect occurrence of airway invasion observed during MBSSs.
Relevant Financial Relationships: Kendrea Garand: Has affiliations to disclose; USA: Salary/Stipend: Employment | Elizabeth Hill: Has affiliations to disclose; MUSC: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research) | Elaine Amella: Has affiliations to disclose; MUSC: Salary/Stipend: Employment | Bonnie Martin-Harris: Has affiliations to disclose; Northwestern University: Salary/Stipend: Employment; NIH: Grant: Other Activities; Northern Speech Services: Speaking fee: Teaching and speaking.
Relevant Non-financial Relationships: Kendrea Garand: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ASHA: Professional: Membership | Elizabeth Hill: Nothing to Disclose | Elaine Amella: Nothing to Disclose | Bonnie Martin-Harris: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ASHA: Professional: Membership.

Dysphagia Following Non-traumatic Subarachnoid Haemorrhage: A Retrospective Chart Review

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Purpose: Dysphagia following non-traumatic subarachnoid haemorrhage (SAH) can arise as a consequence of the injury or its management. The aim of this study is to investigate the incidence of dysphagia and establish risk factors which may reliably predict dysphagia risk in individuals presenting with non-traumatic SAH.
Method(s): A retrospective chart audit of 250 patients consecutively admitted over a three-year period (2013–2015) with non-traumatic SAH to a major, tertiary neurosurgery referral centre in Australia was conducted. Demographics, medical and surgical information, along with speech pathology assessment data were collected from medical charts.
Result(s): The incidence of dysphagia was 31.6% (n = 79). Speech pathology saw 29.2% (n = 73) of participants for clinical swallowing examination. Individuals with dysphagia had significantly ($p < 0.01$) higher WFNS grading scores, were more likely to have an aneurysmal cause, were more likely to have secondary complications such as vasospasm, hydrocephalus or new ischaemia, were older, and had longer intubation and ICU periods than those without dysphagia. Dysphagia risk was significantly associated ($p < 0.01$) with increasing age, ICU length of stay, and length of intubation.
Conclusions (Including Clinical Relevance): Dysphagia is highly prevalent following non-traumatic SAH, and significantly associated with a number of factors. Established risk factors will improve current knowledge, promote early identification of dysphagia, and inform speech pathology referral criteria and management of this patient cohort.
Relevant Financial Relationships: Katrina Dunn: Has affiliations to disclose; West Moreton 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.

The Economic Burden of Dysphagia in Geriatric Patients

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Purpose: To estimate the cost analysis of geriatric patients with dysphagia versus geriatric patients without dysphagia 1 year before hospitalization.

Method(s): Two hundred and fifty eight hospitalized patients, 60 years or older acute hospitalized in the geriatric department. Volume-viscosity swallow test and the Minimal Eating Observation Form-II were conducted for data collection. A Charlson Comorbidity Index Score measured comorbidity and functional status was measured by Barthel-100. To investigate the cost burden of dysphagia, patient specific data on health care consumption at the hospital and in the municipality (nursing, home care, and training) were collected from medical registers and records 1 year before hospitalization including the hospitalization for screening for dysphagia. Multiple linear regression analyses were conducted to determine the relationship between dysphagia and hospital and municipality costs, respectively, adjusting for age, gender, and comorbidity.
Result(s): Patients with dysphagia are significantly more costly than patients without dysphagia in both hospital ($p = 0.013$) and municipality costs ($p = 0.028$) compared to patients without dysphagia. Adjusted, annual hospital costs in patients with dysphagia were 4282 USD higher than patients without dysphagia at the hospital, and annual health care costs in the municipality were 7209 USD higher.
Conclusions (Including Clinical Relevance): Geriatric patients with dysphagia are significantly more costly for both hospital and municipality costs compared to geriatric patients without dysphagia.
Relevant Financial Relationships: Dorte Melgaard: Nothing to Disclose | Line Rethmeier: Nothing to Disclose | Signe Westmark: Nothing to Disclose | Maria Roer: Nothing to Disclose | Lars Ehlers: Nothing to Disclose.
Relevant Non-financial Relationships: Dorte Melgaard: Nothing to Disclose | Line Rethmeier: Nothing to Disclose | Signe Westmark: Nothing to Disclose | Maria Roer: Nothing to Disclose | Lars Ehlers: Nothing to Disclose.

Efficacy of Using a Manual Toothbrush with External Suction to Improve Oral Hygiene in Persons with Moderate to Profound Intellectual Disability in the Intermediate Care Setting

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Purpose: Pneumonia is a leading cause of morbidity and mortality in those with intellectual disability (ID) in the institutional setting. Those with ID also demonstrate higher rates of poor oral health with increased caries and periodontal disease. Given the strong relationship between poor oral health and increased pneumonia risk, this study sought to explore the benefit of using a manual toothbrush with external suction in improving oral hygiene in this population.
Method(s): Data were collected from 18 adults with ID (13 male and 5 female), aged 47–70 (mean 56.3) who required suction toothbrushing during their oral care. Participants were transitioned from using the Plak-Vac suction toothbrush to a standard toothbrush with an external suction (yankauer) handle. Oral hygiene (OH) ratings were collected at 1 month intervals for a period of 6 months using the Oral Hygiene Rating Scale. A repeated measures ANOVA was performed to identify change in OH over time with post hoc analyses of within subject differences.
Result(s): OH ratings were significantly improved ($p < 0.05$) with use of a standard toothbrush with an external suction handle.
Conclusions (Including Clinical Relevance): This study supports prior findings that the manual toothbrush is an effective tool in maintaining good oral health. Additionally, in adults with ID, the use of a manual toothbrush with external suction can produce oral health improvements that may help mitigate pneumonia risks.
Relevant Financial Relationships: Melissa Farrow: Nothing to Disclose.
Relevant Non-financial Relationships: Melissa Farrow: Nothing to Disclose.

Tongue Pressure Production During Plastic Bottle Drinking and Straw Drinking in Young Healthy Subjects

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Purpose: This study aimed at investigating the characteristics of tongue pressure production during sequential swallowing from a plastic bottle (PB) and a straw (ST).
Method(s): Forty healthy young subjects performed two sequential swallow tasks (PB and ST drinking of 100 ml water) with three 5 ml swallows from a spoon (SP) as one's base. Tongue-palate contact pressure (tongue pressure) was measured with five sensors: anterior = Ch1, median = Ch2, postero-median = Ch3, left = Ch4 and right = Ch5 postero-lateral positions. Total number of swallows (TNs) and total time of swallows (TTs) of the entire drinking were counted. Maximum magnitude (Max), duration (Dur), and integrated value (Intg) of pressure for multiple swallows at each recording channel were averaged.
Result(s): Statistically significant differences ($p < 0.05$) were found as follows:

(1) TNs and TTs were larger/longer during ST than PB, and larger/longer in females than in males.
(2) Max was higher at Chs1 and 2 during SP than PB/ST, but higher during ST than PB/SP at Chs4 and 5. Males showed higher values than females at Chs2 and 5.
(3) Dur was longer during SP than PB/ST at Chs1-3, while longer in males than females at Ch2.
(4) Intg was larger during SP than PB/ST at Chs1 and 2, whereas larger during ST than PB/SP at Chs4 and 5. Males showed larger value than females at Chs2 and 4. Interaction was found at Ch2.

Conclusions (Including Clinical Relevance): ST requires longer time and more frequent swallows than PB to drink 100 ml water. ST also requires stronger lingual contact than PB at postero-lateral parts of the palate. Male/female differences in some parameters may be influenced by their physical features.
Relevant Financial Relationships: Yoshiaki Ogawa: Nothing to Disclose | Masako Fujiu-Kurachi: Nothing to Disclose | Kazuhiro Hori: Nothing to Disclose | Shigehiro Fujiwara: Nothing to Disclose | Takahiro Ono: Nothing to Disclose.
Relevant Non-financial Relationships: Yoshiaki Ogawa: Nothing to Disclose | Masako Fujiu-Kurachi: Nothing to Disclose | Kazuhiro Hori: Nothing to Disclose | Shigehiro Fujiwara: Nothing to Disclose | Takahiro Ono: Nothing to Disclose.

Quarter-Turn Method and Guide for Selecting Expiratory Muscle Stength Training Target Values for Treatment

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Purpose: Expiratory muscle strength training (EMST) has been used for effective treatment of airway protection and swallowing. Limited access to precise calibration settings for EMST devices may limit a clinician's ability to develop specific goals and measurable treatment targets for various clinical populations. Our goal was to map how adjustments on an EMST device related to measurable pressure loads provided by the device.
Method(s): We measured the load pressure required to open the resistive valve on 6 separate EMST 150 devices at 24 different load settings. The smallest load (setting 1) was with the setting knob turned counterclockwise as far as possible. To increase the load setting for each device between trials, we turned the setting knob clockwise by a quarter turn (90°). We measured the opening pressure twice on each device, resulting in 288 separate measurements. We tabulated and plotted each quarter turn by the measured valve opening pressure (cm H_2O).
Result(s): We found a positive linear relationship between the number of quarter turns and the load pressure required to open the EMST valve. The minimum load pressure (setting 1) was between 22 and 32 cm H_2O. The maximum load pressure (setting 24) was between 149 and 161 cm H_2O. At each setting, the load pressures varied between devices by as much as 10 cm H_2O.
Conclusions (Including Clinical Relevance): This work resulted in a calibration reference guide that provides the load pressures at 24 different settings for clinical use of the EMST 150. Similar procedures could be applied to other EMST devices to enable clinicians to develop more specific goals and measurable treatment targets.
Relevant Financial Relationships: Michael Hammer: Nothing to Disclose | Katherine Hutcheson: Nothing to Disclose.
Relevant Non-financial Relationships: Michael Hammer: Nothing to Disclose | Katherine Hutcheson: Nothing to Disclose.

The Relationship Between Tongue and Lip Strength and Sarcopenic Dysphagia

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Purpose: Dysphagia due to sarcopenia (sarcopenic dysphagia) is related to low tongue strength. However, whether tongue strength is a useful factor for diagnosing sarcopenic dysphagia is unknown. In addition, the relationship between lip strength and sarcopenic dysphagia is unknown. The objective of this study was to investigate the relationship between tongue and lip strength and sarcopenic dysphagia, and the diagnostic accuracy of these relationships.
Method(s): This study included 205 consecutive inpatients aged $\geq$ 65 years who were hospitalized for post-acute rehabilitation. We assessed sarcopenia, dysphagia, and tongue and lip strength. Other factors assessed were age, sex, comorbidity, physical function, nutritional status, functional oral intake scale, and occlusion status. Logistic regression analysis and receiver operating characteristic curve analysis were undertaken.
Result(s): The prevalence of sarcopenic dysphagia was 61/220 (27.7%). In the multivariable logistic regression analysis, sarcopenic dysphagia was significantly related to tongue and lip strength. The area under the receiver operating characteristic curve scores for tongue and lip strength for sarcopenic dysphagia were 0.74 and 0.89 in men, and 0.76 and 0.84 in women. The cut-off value for tongue strength was 24.25 kpa for men and 23.85 kpa for women, while that for lip strength was 10.40 N for men and 8.45 N for women.
Conclusions (Including Clinical Relevance): Tongue and lip strength may be useful factors in the prevention, treatment and diagnosis of sarcopenic dysphagia in older adults.
Relevant Financial Relationships: Kotomi Sakai: Has affiliations to disclose; Setagaya Memorial Hospital: Salary/Stipend: Employment; Nihon University: Scholarship: Other Activities | Enri Nakayama: Has affiliations to disclose; Nihon University: Salary/Stipend: Employment | Haruka Tohara: Has affiliations to disclose; Tokyo Medical and Dental University: Salary/Stipend: Employment | Osamu Takahashi: Has affiliations to disclose; St. Luke's International University: Salary/Stipend: Employment | Sayako Ohnishi: Nothing to Disclose | Hidetaka Tsuzuki: Nothing to Disclose | Mayumi Hayata: Nothing to Disclose | Takahiro Takehisa: Has affiliations to disclose; Setagaya Memorial Hospital: Salary/Stipend: Employment | Yozo Takehisa: Has affiliations to disclose; Hakuai Memorial Hospital: Salary/Stipend: Management position | Koichiro Ueda: Has affiliations to disclose; Nihon University: Salary/Stipend: Employment.
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Determining the Sensitivity and Reliability of Barium, Blue, and Green Colorants for the Assessment of Airway Invasion During Flexible Endoscopic Evaluations of Swallowing (FEES)

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Purpose: To assess the effects of colorants (barium, blue dye, and green dye) on the sensitivity and reliability of airway invasion observations of liquids during flexible endoscopic evaluations of swallowing (FEES).
Method(s): A heterogeneous neurodegenerative population (N = 30) undergoing FEES were included in this study. Participants were presented with 10 cc of water with (i) blue dye, (ii) green dye, and (iii) barium in a randomized order within the same FEES exam. Penetration-Aspiration Scale (PAS) scores and the presence/absence of residue on four airway structures (i.e., epiglottis, laryngeal

vestibule, vocal folds, and subglottis) were blindly rated by a panel of expert raters. Statistical analyses were performed to determine differences in PAS scores, frequency of the detection of airway invasion residue, and reliability.
Result(s): ANOVA revealed the colorant significantly affected PAS scores and airway residue detection ($p < .05$). Barium was associated with more severe PAS scores and more instances of airway residue detection when compared to blue or green dye ($p < .05$). PAS reliability was good for barium ($k = 0.667$), moderate for green dye ($k = 0.500$), and fair for blue dye ($k = 0.333$). Residue reliability was very good for barium ($k = 0.83$) and green dye ($k = 1.00$), and moderate for blue dye ($k = 0.47$).
Conclusions (Including Clinical Relevance): Barium resulted in good-to-very good reliability and superior sensitivity in detecting airway invasion during FEES compared to blue and green dye, supporting its standardized use during endoscopic swallowing examinations.
Relevant Financial Relationships: James Curtis: Nothing to Disclose | Sarah Perry: Nothing to Disclose | Michelle Troche: Nothing to Disclose.
Relevant Non-financial Relationships: James Curtis: Nothing to Disclose | Sarah Perry: Nothing to Disclose | Michelle Troche: Nothing to Disclose.

The Effect of Body Position on Esophageal Reflexes in Cats: A Possible Mechanism of SIDS?

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Purpose: It has been hypothesized that life threatening events are caused by supra-esophageal reflux (SER) of gastric contents which activates laryngeal chemoreflex-stimulated apnea, and it has been found that placing infants supine decreases the risk of sudden infant death syndrome (SIDS). The purpose of this study was to determine whether body position affects esophageal reflexes that control SER.
Method(s): We instrumented the pharyngeal and esophageal muscles of decerebrate cats ($N = 14$) to record EMG or manometry, and investigated the effects of body position on the esophago-UES contractile reflex (EUCR), esophago-UES relaxation reflex (EURR), esophagus-stimulated pharyngeal swallow response (EPSR), secondary peristalsis (SP), and the pharyngeal swallow (PS). EPSR, EUCR, and SP were activated by balloon distension, EURR by air pulse, and PS by nasopharyngeal water injection. The esophagus was stimulated in the cervical, proximal thoracic, and distal thoracic regions. The threshold stimulus for activation of EUCR, EURR and PS, and the chance of activation of EPSR and SP were quantified and statistically compared using repeated measures two-way ANOVA and Cochran-Mantel–Haenszel test with the continuity correction respectively.
Result(s): We found that all of the reflexes investigated only EPSR was significantly ($P < 0.05$) more sensitive in the supine vs. prone position regardless of the stimulus or the position of the stimulus in the esophagus.
Conclusions (Including Clinical Relevance): We conclude that the EPSR may contribute to the protection of infants from SIDS by placement in the supine position.
Relevant Financial Relationships: Ivan Lang: Nothing to Disclose | Bidyut Medda: Nothing to Disclose | Reza Shaker: Nothing to Disclose | Sudarshan Jadcherla: Nothing to Disclose.
Relevant Non-financial Relationships: Ivan Lang: Nothing to Disclose | Bidyut Medda: Nothing to Disclose | Reza Shaker: Nothing to Disclose | Sudarshan Jadcherla: Nothing to Disclose.

Superior and Anterior Hyoid Displacement During Swallowing in Non-Dysphagic Individuals

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Purpose: The Dynamic Swallow Study (DSS) is a measurement methodology used to assess swallowing kinematics during Videofluoroscopic Swallow Studies (VFSS). However, no normative DSS data exists detailing superior (H_{sup}) and anterior (H_{ant}) hyoid movements, nor the ratio between the two (SA_{ratio}). The aims of this study were to: (1) establish normative data for H_{sup}, H_{ant}, and SA_{ratio} and (2) assess the effects of age, sex, and bolus size on these measures.
Method(s): H_{sup}, H_{ant}, and SA_{ratio} were analyzed for 1-, 3-, and 20-cc swallows for consecutive elderly ($\geq$ 65 years) and non-elderly ($<$ 65 years) male and female non-dysphagic subjects ($N = 161$). Statistical analyses were performed to establish normal patterns of H_{sup}, H_{ant}, and SA_{ratio}, and to determine the effects of age, sex, and bolus size on hyoid kinematics.
Result(s): H_{sup} was significantly larger for males and for increasing bolus sizes. ANOVA revealed a significant three-way interaction between age, sex, & bolus size, and a significant simple two-way interaction between sex and age for 20 cc bolus size, but not for 1 cc or 3 cc bolus sizes. H_{ant} was larger for increasing bolus sizes and for non-elderly subjects. ANOVA did not reveal any significant interactions between age, sex, & bolus size. SA_{ratio} was not significantly different between bolus sizes, age, or sex.
Conclusions (Including Clinical Relevance): H_{sup}, H_{ant}, and SA_{ratio} norms are established, differing significantly by bolus size, age, and sex. Using these measurement methodologies and normative data, one can more thoroughly identify areas of specific swallowing impairment and abnormal hyoid movements within the context of DSS.
Relevant Financial Relationships: James Curtis: Nothing to Disclose | Jonelyn Langenstein: Nothing to Disclose | Sarah Schneider: Nothing to Disclose.
Relevant Non-financial Relationships: James Curtis: Nothing to Disclose | Jonelyn Langenstein: Nothing to Disclose | Sarah Schneider: Nothing to Disclose.

Clinical Utility of Palpation for Assessing Hyolaryngeal Movement

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Purpose: Hyolaryngeal excursion (HE) is typically assessed via palpation during clinical swallowing exams (CSE) and visually during videofluoroscopy (VF). However, minimal evidence exists to support

the use of these perceptual methods for judging HE. We investigated whether binary judgment of HE differentiates quantitative measures of hyoid movement on VF.
Method(s): Medical records of 87 inpatients (56 male, μ age = 61 SD = 19) were retrospectively reviewed. All patients received a CSE and VF within a 24-h period. Binary clinician ratings of HE ('reduced' or 'functional') were collected from CSE and VF reports. Single 5 ml swallows of barium pudding were extracted from each VF for blinded analysis. Maximum hyoid position from C4 was captured 3 ways (peak anterior, superior and hypotenuse positions), expressed relative to C2-4 length. Independent-sample t-tests, with Bonferroni correction, compared hyoid positions between patients judged to have reduced vs. functional HE on palpation and VF.
Result(s): Significant differences in peak anterior hyoid position was observed between patients judged to have reduced (μ = 89.2% C2–4) and functional (μ = 110.6% C2–4) HE on palpation (p = .001). No differences between groups were seen in superior or hypotenuse positions, or across any measures when compared to VF ratings.
Conclusions (Including Clinical Relevance): Clinicians differentiated peak anterior position but not superior or hypotenuse position on palpation. They did not detect hyoid movement differences during VF. While perceptual methods contribute to clinical decision-making, clinicians should remain cautious when making judgments about HE using these methods.
Relevant Financial Relationships: Danielle Brates: Nothing to Disclose | Sonja Molfenter: Has affiliations to disclose; NYU: Salary/Stipend: Employment; NIH/NIDCD: Grant: Independent contractor (Including contracted research) | Susan Thibeault: Has affiliations to disclose; UW-Madison: Salary/Stipend: Employment.
Relevant Non-financial Relationships: Danielle Brates: Nothing to Disclose | Sonja Molfenter: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership | Susan Thibeault: Nothing to Disclose.

Reliability of the SafeStraw™ for Limiting Liquid Volume

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Purpose: SafeStraw™ (Bionix Medical Technologies) is intended to limit volume delivered through a straw to 6.2 mL. The purpose of this study was to determine the reliability of the SafeStraw at limiting bolus volume.
Method(s): Materials: Six thin liquids (water, apple juice, skim milk, whole milk, hot coffee, thin liquid barium) were tested. All were confirmed as IDDSI Level 0 drinks using the IDDSI Flow Test. Eight white SafeStraws designed for use with thin liquids were tested. Procedures: 25 mL of test liquid was poured into a cup. The SafeStraw was first primed with liquid, then the examiner took a sip. Liquid remaining in the cup as well as any in the SafeStraw was emptied into a graduated cylinder to determine the exact amount that was drawn during the sip. This was repeated 10 times for each liquid.
Result(s): Effect of Device: Water and whole milk volume differed significantly by white SafeStraw device. Skim milk and liquid barium could not be drawn by the white SafeStraw. Difference from 6.2 mL: Only volume of water delivered by the SafeStraw did not differ significantly from 6.2 mL. SafeStraw delivered significantly smaller volumes of apple juice, whole milk and hot coffee.
Conclusions (Including Clinical Relevance): Although all liquids were IDDSI Level 0, they yielded different results with use of the Safe Straw. The white Safe Straw is meant for all thin liquids, yet it did not work with skim milk or thin barium. For some liquids, SafeStraw was inconsistent by device and for others, volume differed significantly from 6.2 mL. This inconsistency introduces a degree of unpredictability to performance of SafeStraw in real world applications.
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Mapping Acute Lesion Locations to Physiological Swallow Impairments After Stroke

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Purpose: While much has been accomplished to understand which brain lesion locations are related to dysphagia in general, it remains unknown which locations affect specific aspects of swallow physiology. We sought to investigate the statistical association between lesion locations and physiological swallow impairments in acute stroke patients.
Method(s): We retrospectively recruited 68 acute, first-ever ischemic stroke patients. Lesion locations were determined on diffusion weighted MRI scans and 17 physiological swallow impairments with the Modified Barium Swallow Study Impairment Profile (MBSImP©™). Intra- and interrater reliability was established. We performed voxel- and region-based lesion symptom mapping using multivariate modeling corrected for multiple comparisons by permutation thresholding.
Result(s): We found significant associations between supratentorial lesioned voxels or regions and impaired laryngeal elevation, anterior hyoid excursion, laryngeal vestibular closure, and pharyngeal residue. These swallow impairments showed overlapping and distinct lesion locations including the inferior frontal, pre- and postcentral, supramarginal, angular, superior temporal gyrus, insula, thalamus, amygdala, and corresponding white matter.
Conclusions (Including Clinical Relevance): Our results suggest that different physiological swallow impairments are related to

distinct lesion locations. Locations primarily comprised grey and white matter in sensory-motor integration areas. Future research is warranted to confirm our findings, support the development of a neuroanatomical model, and improve treatments targeting swallow physiology after stroke.

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Swallowing Mechanics Underlying UES Pressure Wave Suggest Pharyngeal Chamber Formation

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Purpose: To better understand the swallowing mechanics that underlie upper esophageal sphincter (UES) function during pharyngeal swallowing.

Method(s): Simultaneous high resolution pharyngeal manometry and videofluoroscopy (VFS) videos for 36 swallows from 18 non-dysphagic subjects were evaluated for this study. Thirteen anatomic landmarks were tracked in each frame of VFS imaging mapping the function of muscles underlying elements of pharyngeal swallowing. UES pressure readings were segmented into six pressure phases including a previously undescribed pre-relaxation contraction. These data were evaluated morphometrically using computational analysis of swallowing mechanics to determine the movement of key swallowing structures within each UES pressure phase.

Result(s): Canonical variate analysis and post hoc discriminant function analysis indicate significant differences in pharyngeal mechanics by UES pressure stage (range of D-values = 1.7–2.2, $p < .0001$). Procrustes superimposition and eigenvectors define the relative positions and movements of swallowing structures within each pressure phase. The soft palate maximally elevates during the pre-relaxation contraction of the UES. Early during UES relaxation, the hyolaryngeal complex and pharyngeal structures maximally elevate, and pharyngeal structures constrict around the bolus.

Conclusions (Including Clinical Relevance): The mechanics underlying the UES pressure wave suggest a central-pattern-generated signal that closes the pharynx at all orifices to generate a sealed pharyngeal cavity, possibly integral to pharyngeal pressure generation and bolus propulsion into the esophagus.

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Improvement of laryngeal closure after the traditional intervention in poststroke patients

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Purpose: This study examined whether the traditional swallowing intervention improves initiation or duration of laryngeal closure in stroke patients.

Method(s): Initial and follow-up videofluoroscopic swallowing examinations (VFSE) were recorded on 15 acute or subacute stage patients. These patients completed one month of traditional swallowing interventions that focused on compensatory or rehabilitative strategies. Means and standard deviations of initiation of laryngeal closure (ILC) and laryngeal closure duration (LCD) were analyzed using a 100-ms timer for 2 mL thin liquids and both 5 mL thin liquids and puree. Statistical comparisons were used by pairs *t* test. Significance level was set at $p < 0.05$.

Result(s): The initiation of laryngeal closure in stroke patients was significantly shorter after one month of swallowing intervention. However, the duration of laryngeal closure in these patients did not differ after the intervention. In addition, the stroke patients showed reduced occurrences of penetration or aspiration after the intervention.

Conclusions (Including Clinical Relevance): The shorter initiation of laryngeal closure after swallowing intervention may indicate that there is improvement of sensory receptor responses in the oropharynx after intervention. The traditional swallowing intervention at the acute stage of stroke may help stroke patients protect the airway effectively. Three possible explanations for improvement in initiation of laryngeal closure in stroke patients will be discussed: spontaneous recovery, neuroplasticity, and effects of swallowing intervention.

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Speech-Language Pathologists' Perceptions of Their Graduate Preparation to Provide Dysphagia Services

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Purpose: The purpose of this study was to examine the perceptions of speech-language pathologists (SLPs) regarding their graduate preparation and current confidence for providing dysphagia services, factors associated with perceptions of preparation, and the relationship between perceptions of preparation and confidence levels.
Method(s): Using an anonymous online survey, data were collected from 343 US-based SLPs who currently provide dysphagia services in their work settings.
Result(s): Respondents perceived that they were prepared in three of 11 knowledge/skill areas related to dysphagia. Perceptions of preparation following graduate school were positively correlated with comprehensiveness of dysphagia coursework, externship supervision ratings, number of externships involving dysphagia, and graduation year. There was a statistically significant difference between mean perceptions of preparation and current confidence levels ($p = .00$), although perceptions of preparation following graduate school were not strongly correlated with current confidence levels.
Conclusions (Including Clinical Relevance): There is great variation in the amount and quality of training SLPs have received in dysphagia at the graduate level. Many practicing clinicians may be insufficiently prepared to provide the dysphagia services that they are providing, which may have implications for patient care and the integrity of speech- language pathology as a profession.
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Clinical Swallowing Ability to Reach Full Oral Intake and the Feature of the Swallowing Movement of Patients with Wallenberg Syndrome

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Purpose: This study aimed to identify with videofluorography the kinematic feature to reach full oral intake in patients with Wallenberg syndrome.
Method(s): In this retrospective case series, 25 Wallenberg cases (22 men and 3 women; median [range] age, 59 years [42–81 years]) were divided into the FOIS $\leqq$ 3 (n = 13) and FOIS $\geqq$ 4 groups (n = 12). Sixteen timing events, including velopharyngeal closure, hyoid elevation burst, onset of laryngeal elevation, laryngeal vestibule closure, and upper esophageal sphincter (UES) opening, were extracted and given sequential numbers. Fourteen variables were measured. The head magnetic resonance image of each case was saved. The medulla was divided vertically into three parts. Bivariate and multivariate analyses were performed with SPSS ver. 24.
Result(s): All the cases were at the verified diet status with adequate swallowing ability (FOIS 2 to 7) on the examination date. The cases infarcted more than 2 parts were 8 times likely to be in the FOIS $\leqq$ 3 group ($p = 0.04$). In the bivariate analysis, a significant difference in UES opening duration (median [range]: FOIS $\leqq$ 3 group, 0.17 s [0.15–0.80 s] and FOIS $\geqq$ 4 group, 0.90 s [0.80–0.95 s], $p = .04$) was found, but not in sequential order. From the multivariate analysis, the vertical infarction range showed an independent significance ($p = .047$).
Conclusions (Including Clinical Relevance): The present study did not show a specific feature of movement or sequence associated with the clinical ability of patients with Wallenberg syndrome. A comparative study between Wallenberg syndrome and stroke without damage on the medulla should be performed.
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Measuring Structures on Flexible Endoscopic Evaluation of Swallowing to Calculate Vallecular Volume

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Purpose: How do we measure structures on Flexible Endoscopic Evaluation of Swallowing (FEES)? Simultaneous Modified Barium Swallows (MBS) and FEES were used to develop a method to measure depth on FEES. In this proof of concept study, we measured vallecular cavity volume and residue.
Method(s): Simultaneous MBS/FEES were collected. All 3 axises of movement (x,y,z) were calculated: the X axis was defined as width (anterior/posterior in MBS), Y axis as height (inferior/superior in MBS), and Z axis as length (horizontal axis in FEES, orthogonal to MBS). A penny was used as a scalar on MBS and the epiglottis as a common reference point on MBS and FEES. A tracking tool was used to measure distances on the MBS while endoscopic specifications were used to find distances on FEES. This combination of ratio measurements allowed for measurement on both the MBS and FEES. Vallecular capacity (mm^3) was determined by multiplying epiglottic width on FEES by the area of valleculae on MBS. A tracking tool was used to convert the pixels within the outlined valleculae to cm^2 with a free hand tool. The volume of vallecular residue was determined similarly.
Result(s): In n = 15 videos, mean epiglottis width = 22.92 mm; mean vallecular volume = 362.75 mm^3, and range of residue filling vallecular cavity = 0%–100%.
Conclusions (Including Clinical Relevance): While this method requires further development, advantages include the unprecedented ability to measure structures and volume on FEES from a single frame. With further development this method may provide the ability to quantify important swallowing outcomes and measure shapes/sizes/targets at different time points on the FEES.

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Dysphagia Presentation and Swallowing Rehabilitation Following Esophagectomy: A Systematic Review

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Purpose: No systematic review exists on dysphagia presentation and swallowing rehabilitation following esophagectomy. We performed a systematic review to synthesize the evidence on (1) swallowing abnormalities identified by instrumental evaluations, (2) health-related outcomes in relation to swallowing abnormalities, and (3) therapeutic interventions for post-esophagectomy patients.
Method(s): Five electronic databases were searched. A blind review was performed for studies that reported swallowing biomechanics and/or dysphagia by instrumental evaluations, and/or health-related outcomes in relation to swallowing abnormalities, and/or therapeutic interventions for dysphagia following esophagectomy.
Result(s): Twelve studies out of 2193 studies met the inclusion criteria. Reduced hyolaryngeal elevation, delayed onset of swallowing, and reduced opening of the upper esophageal sphincter were common abnormalities following esophagectomy. Vocal fold immobility (13–76%), aspiration (0–81%), and pharyngeal residue (22–100%) were prevalent. Pneumonia presented in 5–25% of the study patients. One quasi-experimental study examined the effectiveness of a set of swallowing exercises; three case series reported a benefit of the chin-tuck maneuver in reducing aspiration and residue.
Conclusions (Including Clinical Relevance): This review revealed distinct swallowing impairments and increased aspiration pneumonia risks following esophagectomy. Evidence on the efficacy of therapeutic interventions was limited; thus future studies are warranted to develop effective interventions for post-esophagectomy patients with dysphagia.
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Reduced Tongue Force and Altered Muscle Fiber Type Composition in a Rat Model of Post Stroke Dysphagia

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Purpose: Therapeutic interventions for post stroke dysphagia target the lingual muscles. While stroke has been shown to alter limb muscle fiber type, size, and number, the impact of stroke on lingual muscles is not known. Understanding what changes occur in lingual muscles after stroke may help guide clinical research on therapeutic interventions.
Method(s): Middle cerebral artery occlusion (MCAO) in the rat is a widely used model of unilateral ischemic stroke. Maximum voluntary tongue pressing forces were determined in 6-week old male Sprague–Dawley rats prior to receiving either a left MCAO (N = 6) or sham (N = 5) surgery. Tongue pressing forces were reassessed at one and two weeks post-surgery. Fluorescent immunohistochemistry was used to assess myosin heavy chain (MyHC) muscle fiber types.
Result(s): Post-MCAO tongue forces were significantly reduced from baseline at 1 and 2 weeks post-surgery ($p = 0.001$, $p = 0.021$). The contralateral genioglossus muscles (right) of the MCAO rats had significantly higher percentages of MyHC IIb than both the left genioglossus ($p = 0.025$) and the sham animal group ($p = 0.003$). The reduction in tongue force was correlated with both the infarct volume (Pearson's $r = 0.91$) and the percent of right genioglossus muscle fibers positive for MyHC IIb ($r = 0.45$).
Conclusions (Including Clinical Relevance): The MCAO rat model of post stroke dysphagia develops tongue weakness and altered muscle biochemistry of contralateral lingual muscles. Future studies will determine the neural, muscular, and functional swallowing changes that occur due to the interactions of age, stroke, and therapeutic interventions.
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Changes in the Relationship Between Muscle Activation and Airway Protection in Swallowing After RLN Lesion in Infants

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Purpose: Recurrent laryngeal nerve (RLN) lesion, a complication of cardiac surgery in preterm infants, results in dysphagia and aspiration. RLN lesion changes the relationship between oro-pharyngeal kinematics and airway protection outcomes. Whether oro-pharyngeal motor patterns change in a similar way is unknown. We tested the hypothesis that muscle activation and airway protection outcomes changed after RLN lesion in our validated infant pig model.

Method(s): We surgically implanted chronic indwelling bipolar electrodes in hyoid muscles of 4 infant pigs, permitting precise measurement of individual muscle activation, with a subsequent, separate surgical right RLN transection. We recorded the same pigs using high-speed VFSS with simultaneous EMG before and after RLN lesion. The outcome variables were (1) score on the Infant Mammalian Penetration Aspiration Scale (IMPAS) and (2) duration and timing of muscle activation for 8 muscles for a total of 473 swallows. Our hypothesis was tested using a complete two factor (treatment, IMPAS score) linear model.
Result(s): For duration of thyrohyoid activation, as well as timing of activation of geniohyoid, genioglossus and left cricothyroid, the IMPAS score-treatment interaction was significant ($p < 0.05$) indicating a pre-post lesion change in the relationship between those variables and IMPAS score.
Conclusions (Including Clinical Relevance): The change in the relationship between kinematics and airway protection are the result of changes in the relative timing of the muscles of swallowing, suggesting a reorganization of motor outputs from the central nervous system following RLN lesion.
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Effects of Recording Rate, Screen Calibration, and Room Ambient Lighting on Videofluoroscopic Swallow Study Outcomes

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Purpose: The purpose of this study was to assess whether frame rate, screen calibration, and ambient lighting levels affect clinical judgments of swallowing impairment.
Method(s): We selected 20 videofluoroscopic swallow studies (VFSS) recorded in the lateral plane at 30 frames per s. (f/s) from a clinical database and replicated them to simulate a 15 f/s recording rate. Each VFSS was viewed at 2 frame rates, 2 screen calibration conditions, and 2 room ambient lighting conditions creating 8 viewing combinations. A trained rater recorded penetration-aspiration scale scores (PAS) per swallow per VFSS. Krippendorff's alpha was used to measure reliability within each combination of the three viewing conditions. Percentage of differences greater than zero between ratings was calculated by condition. The Wilcoxon signed-rank test was used to evaluate differences in PAS scores.
Result(s): Reliability of PAS ratings ranged from 0.801 to 0.819 across eight combinations of viewing conditions. Twenty-two, 21, and 21 percent of ratings differed between frame rates ($p = .25$), room ambient lighting levels ($p = .49$) and between screen conditions ($p < .001$), respectively. Significantly higher average PAS ratings were measured under the max luminance screen condition.
Conclusions (Including Clinical Relevance): Regardless of viewing condition, ratings remained consistent with acceptable reliability (above .80). However, when calibration of the screen was completed, the clinician perceived higher PAS scores. Findings suggest that future studies should consider screen calibration as a factor influencing accurate scoring of VFS studies.
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Association Between Pharyngeal Pooling and Aspiration Using Fiberoptic Endoscopic Evaluation of Swallowing in Head and Neck Cancer Patients With Dysphagia

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Purpose: This study investigates the relationship between pharyngeal pooling and aspiration in head and neck cancer (HNC) patients with oropharyngeal dysphagia (OD), and the effect of tumor stage, tumor location, and cancer treatment on this relationship.
Method(s): Ninety dysphagic HNC patients underwent a standardized fiberoptic endoscopic evaluation of swallowing (FEES). For each swallow three ordinal variables were scored: vallecular pooling, pyriform sinus pooling, and aspiration. To explore the association between pooling and aspiration, logistic regression analysis was performed. Correction for the location of pooling, tumor stage, tumor location, and cancer treatment was performed.
Result(s): No significant association was found between vallecular pooling and aspiration. Pyriform sinus pooling was significantly associated with aspiration. An increasing amount of pharyngeal pooling did not significantly increase the odds of aspiration. Similar results were found after correction for pooling location, tumor stage, tumor location, or type of cancer treatment. Odds (risk) of aspiration was significantly higher for patients who underwent only radiotherapy, compared to patients who received multimodality treatment.
Conclusions (Including Clinical Relevance): This study showed an association between pyriform sinus pooling and aspiration in HNC patients, independent of amount of pooling, presence of vallecular

pooling, tumor stage, tumor location, or cancer treatment. These findings emphasize the importance of swallowing evaluation in HNC patients with specific attention to the presence of pyriform sinus pooling and its associated risk of aspiration.
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Tongue Strength in Multiple Sclerosis

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Purpose: Dysphagia is a common but insufficiently investigated comorbidity in Multiple Sclerosis (MS). Data on tongue strength in this population are also lacking. Therefore, this research aims to increase knowledge on maximum isometric tongue pressures (MIP) and saliva swallowing pressures (MSP) in MS.
Method(s): 145 MS patients (56 men, 89 women; age: 20–70 years old; mean age: 51.4 years old), with varying severity (EDSS-score: 0–9; mean: 5.2), participated in this study. MIP and (regular and effortful) MSP were measured anteriorly and posteriorly by means of the IOPI and compared with healthy controls (n = 300). Swallowing function and swallowing related quality of life were assessed using FOIS, Yale Swallow Protocol, EAT-10 and DHI. Unpaired sample t-test, Pearson's correlation coefficient, one-way ANOVA and Mann–Whitney U test were used for statistical analysis by means of R.
Result(s): Mean MIP was significantly lower in MS compared to healthy controls (MIPa: 44.7 kPa; p: .002; MIPp: 38.8 kPa; $p < .001$). No significant differences were found for MSP. Type of MS, disease severity and disease duration showed no significant effect on MIP and MSP. MIPa and MIPp values however, differed significantly between the categories of FOIS, EAT-10 and DHI, indicating presence or absence of dysphagia.
Conclusions (Including Clinical Relevance): This study reveals the first data on MIP and MSP in MS. MIP values are significantly lower in MS compared to healthy controls. No changes in MSP were found, indicating a decrease in functional reserve. This research advocates for inclusion of tongue strength measures in the assessment of dysphagia in MS.
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Role of ENaC in the Initiation of Mechanically Evoked Swallows in Anesthetized

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Purpose: Swallowing reflex evoked by the stimulation applied to pharyngolaryngeal regions plays a critical role in airway protection. Because impaired laryngeal sensation is related to an occurrence of laryngeal penetration and aspiration of bolus, it is important to know how laryngeal sensory system regulates swallowing initiation. The aim of this study was to clarify the neural mechanism of mechanically evoked swallows.
Method(s): Urethane-anesthetized male Sprague–Dawley rats were used. Swallows were identified by supra- and infrahyoid electromyographic bursts. Amiloride analogues (amiloride, benzamil, dimethylamirolide), ASIC inhibitors (mambalgine-1, diminazene) and gadolinium were applied topically (0.3–30 nmol, 3 μl) to the vocal folds. Swallowing threshold was measured for von Frey filament or electrical stimulation to vocal folds (n = 4–6 in each group). The number of swallows by capsaicin application (0.03 nmol, 3 μl) to vocal folds or upper airway (UA) distension were also measured (n = 5 and 6, respectively).
Result(s): The mechanical threshold of swallowing was increased in a dose-dependent manner of amiloride analogues and gadolinium, but not ASIC inhibitors. The increased swallowing threshold by amiloride analogues and gadolinium was recovered after saline (10 μl) washout. The number of swallows by UA distention was significantly decreased following benzamil application. On the other hand, benzamil did not affect the initiation of swallows evoked by capsaicin and electrical stimulation.
Conclusions (Including Clinical Relevance): We speculate that ENaC is involved in initiation of mechanically evoked swallows in larynx.
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An Examination of the Effectiveness of a Dysphagia Screening Tool Training Program for Registered Dietitians Working with Stroke Patients

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Purpose: A researcher-developed dysphagia screening tool training program effectiveness for registered dietitians, as indicated by implementation of the researcher-developed screening tool in a simulated environment, knowledge of dysphagia, and their disposition towards the researcher-developed screening tool after training.
Method(s): 1. Three Registered Dietitians participated. 2. Phase 1 included two 1 h sessions pre-tests administered in group. Phase 2–4 included 6 30-min sessions and introduction and modification for training program as warranted. Also, implementation of dysphagia screening tool in simulated environment.

Result(s): The data showed an increasing trend of data amongst the three participants pertaining to the skill of implementing the dysphagia screening tool from Phase 1 to 4. These indicated that there was an increase in the percentage of correctness of implementing the dysphagia screening tool from the baseline period or before they had undergone the training program to the post-test period or after they had they had undergone the training program.
Conclusions (Including Clinical Relevance): The study's findings bridge the gap in the development and implementation of a dysphagia screening tool training program specifically designed for the involvement of RDs in the dysphagia screening process. The findings highlights the importance of dysphagia screen tool training programs for RDs as healthcare professionals in the direct service with stroke patients. As the research has been largely dominated by the use of tools by nurses and speech-language pathologists, this study posits that further training is needed for RDs.
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Relevant Non-financial Relationships: Toupazer Jordan: Nothing to Disclose | Kenneth Simpson: Nothing to Disclose | Leslee Ortiz: Nothing to Disclose.

Continuous Laryngeal TRPV1 Activation Impairs Initiation of Swallowing in Anesthetized Rats

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Purpose: Patients with suffering from chronic gastroesophageal reflux disease have difficulty in swallowing. We hypothesized that those symptoms may be caused by impaired pharyngolaryngeal sensation following the long-term stimulation by gastric acid. The aim of this study was to investigate the modulation of swallowing initiation by continuous laryngeal TRPV1 activation.
Method(s): Experiments were carried out on Sprague–Dawley male rats anesthetized with urethane. To identify a swallow, electromyographic burst was recorded from the suprahyoid and thyrohyoid muscles. We examined time- dependent changes in swallowing initiation during continuous chemical stimulation. Capsaicin (10^{-5} M), hydrochloric acid (HCl, 0.1 N) or ethanol (vehicle of capsaicin) was continuously applied to the laryngeal mucosa at a rate of 0.5 μl/sec and the number of swallows was counted over 60 min. Immediately after the drug application, we counted the number of swallows evoked by mechanical airflow stimulation (40 ml/sec) to the larynx and compared it among the conditions.
Result(s): The number of swallows during capsaicin or HCl stimulation were decreased in a time dependent manner. The number of airflow evoked swallows was significantly decreased following continuous capsaicin or HCl stimulation compared with that following vehicle stimulation.
Conclusions (Including Clinical Relevance): These results suggest that long-lasting TRPV1 activation causes impairment of swallowing initiation.
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Effects of Neuromuscular Electrical Stimulation (NMES) Perturbation Paradigms on the Sequence of Swallowing Events in Healthy Adults

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Purpose: The goal of this study was to investigate the effects of different neuromuscular electrical stimulation (NMES) perturbation paradigms on the sequence of swallowing events in healthy adults.
Method(s): Swallowing was perturbed with NMES that opposes hyolaryngeal elevation in 25 healthy adults. Using videofluoroscopy, thirty 5-ml water swallows were assessed across 3 phases: 10 pre-perturbation, 10 perturbation (pert) and 10 post-perturbation. The 4 study conditions were: gradual NMES (gradually increasing amplitude during pert phase), abrupt NMES (sudden high amplitude throughout pert phase), masked NMES (low amplitude during pre- and post-pert phases to mask pert onset/offset) and unmasked NMES (no perturbation during pre- and post-pert phases). 5 swallowing kinematic events measured were: hyoid burst, hyoid at max elevation, upper esophageal sphincter (UES) opening, laryngeal vestibule closure (LVC) and laryngeal vestibule opening (LVO).
Result(s): The abrupt-masked NMES paradigm had the greatest effect; changing the sequence of every swallowing event ($p < 0.001$). Hyoid burst, LVC and LVO had less preferable sequences during pert and post-pert compared to pre-pert phase (later hyoid burst, later LVC, earlier LVO). All other events had more preferable sequences during pert and post-pert phases.
Conclusions (Including Clinical Relevance): Results suggest that NMES can be applied in dysphagia rehabilitation to manipulate specific swallowing events, depending upon the perturbation paradigm used. Clinicians using NMES must have a clear understanding of which physiological events they are altering and how these changes impact functional outcomes.
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Characterization of Speech-Language Pathology Care in a Particular Hospital Emergency in São Luís-Ma, Brazil

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Purpose: The purpose of this study was to describe the speech-language pathology care routine in the emergency department of a private hospital, in the city of São Luís - MA, Brazil.
Method(s): A retrospective, qualitative and descriptive study. Statistics data from the speech-language pathology and nursing team of the emergency sector were collected, comprising the period from January to July 2016. The inclusion criteria considered were:

hospitalized patients in the emergency unit and with speech-language pathology evaluation performed at the hospital emergency area. Patients who returned from emergency and were not hospitalized were excluded. The data were divided into: age, gender, reason for hospitalization and speech-language pathology, and tabulated. The results were presented in tables.
Result(s): There was a predominance of female patients in the sample, 54.4%, the elderly 65.2% in the majority. In the entry symptomatology were highlighted: the level lowering of the consciousness with 39.13%, followed by respiratory symptoms 34.7%. 100% patients at dysphagia risk were identified within 3 h of admission in the emergency, no patient developed aspiration pneumonia.
Conclusions (Including Clinical Relevance): This study cooperates to highlight the importance of the speech-language pathology approach in hospital emergencies, since there are a significant number of patients at dysphagia risk, besides it contributes to the patient safety process from the beginning of hospitalization to hospital discharge, minimizing the risk of bronchoaspiration.
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The Effects of Normal Aging on Temporal Sequence of Events in Swallowing: Comparative Study of Young Adults and Non-dysphagic Community-Dwelling Older Adults

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Purpose: Age-related changes in swallowing physiology are found in the context of a functional swallow. The aim of this study was to identify changes in the temporal characteristics of swallowing and on the sequence of swallowing events in non-dysphagic community-dwelling older adults as compared to younger adults. Greater understanding of age-related changes in swallowing is important to identify the targets for prehabilitation strategies that could prevent the development of oropharyngeal dysphagia in at-risk older adults.
Method(s): 31 community-dwelling older adults without history of dysphagia (mean age = 76.2, range = 62–91) underwent VFSS and were compared to 33 healthy younger adults (range = 18–28 years). Frame by frame analysis of temporal measures was performed for each swallow. The sequence of events was standardized to zero at onset of rapid hyoid movement. Wilcoxon rank-sum tests were used to compare the median duration of events in younger and older subjects.
Result(s): Older adults took longer to reach maximum anterior hyoid excursion and opening of the upper esophageal sphincter (UES) relative to hyoid onset ($p = 0.0045$, $p < 0.0001$ respectively). Duration of laryngeal vestibular closure (LVC) was longer in older (median (IQR) 495 ms (363–994)) than younger adults (median = 396 ms (330–495), $p = 0.003$).
Conclusions (Including Clinical Relevance): UES opening occurred later in older adults relative to the initiation of the swallow. Longer LVC in older adults may be a compensatory mechanism to prevent airway invasion in the presence of age-related swallowing changes.
Relevant Financial Relationships: Alba Azola: Nothing to Disclose | Rachel Mulheren: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose | Jeffrey Palmer: Nothing to Disclose | Marlis Gonzalez-Fernandez: Has affiliations to disclose; NIDCD: Grant: Other Activities.
Relevant Non-financial Relationships: Alba Azola: Nothing to Disclose | Rachel Mulheren: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose | Jeffrey Palmer: Nothing to Disclose | Marlis Gonzalez-Fernandez: Nothing to Disclose.

Comparing Swallow Screen and MBSIMP Results in Stroke Patients

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Purpose: Early and accurate detection of aspiration risk may reduce morbidity and mortality associated with dysphagia. We present the predictive capacity of a screening tool on MBSImP ratings in a stroke unit.
Method(s): The swallow screen was implemented by trained nursing staff and consisted of 3 steps; if any step is failed, the screen is stopped and the patient is made NPO. VFSS was conducted within 72 h of diagnostic neuroimaging and initial swallow screen. Predictive values and logistic regression (LR) modeling were used to assess the association between swallow screen and MBSImP results.
Result(s): 48 acute ischemic stroke patients were evaluated; 13 failed the swallow screen. Of 35 who passed, 15 were recommended for dysphagia therapy, and only 2 were recommended for diet modification. The swallow screen had sensitivity of 46% and specificity of 100% for dysphagia on VFSS. PPV was 100% and NPV was 57%, with a likelihood ratio of negative screen result of 0.54 and dysphagia prevalence of 58% on VFSS. Pass/fail of the swallow screen was not a significant predictor of presence/absence of dysphagia on VFSS; however, a model including MBSImP components of Laryngeal Elevation, Laryngeal Vestibule Closure, and Anterior Hyoid Excursion, and gender was statistically significant for swallow screen outcome.
Conclusions (Including Clinical Relevance): The results of this study suggest that this aspiration risk screen can discriminate patients with no/mild dysphagia from those with moderate/severe dysphagia on VFSS. Additionally, the results of the screen were associated with MBSImP airway protection components.
Relevant Financial Relationships: Rachel Mulheren: Nothing to Disclose | Marlis Gonzalez-Fernandez: Has affiliations to disclose; NIDCD: Grant: Other Activities.
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The Risk Feeding Model of Care: Impact on Length of Stay and Readmissions

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Purpose: The average length of stay of a patient with dementia in the acute setting is 11 days. The purpose of this study was to investigate the length of stay and aspiration pneumonia related readmissions in patients with dementia, following the introduction of a multidisciplinary risk feeding model of care to guide feeding decisions in the acute setting.
Method(s): All patients who are continuing to eat and drink despite the risk of aspiration are placed on a risk feeding register for audit and quality purposes. A review was conducted on patients placed on risk feeding with a diagnosis of dementia, who were admitted as a result of aspiration pneumonia. There were 20 patients in this cohort over the period September 2016 to August 2017. The electronic patient record system was used to track readmissions.
Result(s): Patients referred for a swallow assessment within a day of admission (75%) had risk feeding in place within an average of 2 days. The average length of stay for these patients was 5 days (0-9).Within this, 13% avoided admission by being discharged from Accident & Emergency with a plan for risk feeding in the community. Although 15% were readmitted over the year; none of the readmissions were as a result of chest infections.
Conclusions (Including Clinical Relevance): By having a risk feeding model of care in place, this study evidences that the average length of stay can be reduced, potentially resulting in significant cost savings. The process facilitates a reduction in aspiration pneumonia re- admissions in the frail elderly, leading to a better quality of life for these individuals for a meaningful length of time.
Relevant Financial Relationships: Dharinee Hansjee: Nothing to Disclose | David Smithard: Nothing to Disclose.
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Hyoid Kinematics In Patients With Amyotrophic Lateral Sclerosis (ALS): A Pilot Analysis

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Purpose: Several parameters of hyoid movement have been shown to vary as a function of bolus volume and consistency in healthy adults. Such modulation of hyoid kinematics has not yet been explored in patients with ALS. The purpose of this study was to (1) characterize hyoid kinematics in a sample of patients with ALS and (2) explore differences in hyoid movement related to bolus properties.
Method(s): Videofluoroscopy was collected from 26 adults diagnosed with ALS, aged 30–75. Blinded raters tracked hyoid position frame-by-frame, relative to an anatomical scalar, to yield measures of hyoid speed and range of movement in three directional planes. Mixed model repeated measures ANOVAs were performed to explore effects of bolus volume (1 mL/3 mL/20 mL) and consistency (thin/extremely thick) on hyoid kinematics, with an additional factor of ALS-onset type (bulbar/spinal).
Result(s): A main effect of volume was observed for average superior hyoid velocity and peak speed along the anterosuperior axis. Pairwise comparisons revealed that 20 mL boluses evoked faster hyoid movement compared to 1 mL boluses. No statistically significant differences in maximum hyoid position were identified, and hyoid kinematics did not vary by liquid consistency. Non-significant trends were identified with respect to ALS-onset type.
Conclusions (Including Clinical Relevance): Bolus volume, but not consistency, modulates hyoid movement in patients with ALS. Compared to previous data with healthy individuals, our results suggest differences in motor accommodation of hyoid movement in individuals with ALS. Further work is needed to explore the clinical implications of these results.
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Chemosensory Testing in Swallowing Management: A Survey of Speech-Language Pathologists

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Purpose: Although textbooks and research articles report that flavored stimuli can enhance swallowing function, the exact methods and frequency of implementation in swallowing evaluation and treatment are unknown. This survey describes how speech-language pathologists use taste and smell in dysphagia management.
Method(s): This survey queried the use of taste and smell in dysphagia evaluation and treatment. The survey was posted on a private communication board for dysphagia specialists.
Result(s): Almost twice as many responders (77/115, 67%) reported using taste in treatment than the number who reported evaluating taste (45/116, 39%), whereas a similar percentage reportage using smell in evaluation (22/116, 19%) and in treatment (21/116, 18%). The most frequent reason for not using taste or smell in swallowing management was lack of familiarity with the underlying science. The results indicate varying methods for taste and smell stimulation, with almost all responders (116/118, 98%) reporting an interest in learning more about taste and smell.
Conclusions (Including Clinical Relevance): Taste and smell are used by less than half of responding clinicians in swallowing evaluation, though taste is reportedly a common component of treatment. Stimuli and justification for chemosensory stimulation are variable. Additional clinical research is necessary to define standards of chemosensory application in dysphagia management.
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Prevalence of Severe Dysphagia in Patients up to 5 Years following Completion of Curative Radiotherapy for Head and Neck Cancer

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Purpose: The long-term prevalence of dysphagia post radiotherapy (RT) for head and neck cancer (HNC) is unknown. Our purpose was to compare the yearly prevalence and build a predictive model for severe dysphagia in these patients, marked by PEG, up to 5 years after RT.
Method(s): Using a cross-sectional design, we identified HNC patients treated with RT from September 2011–July 2016 at Princess Margaret Cancer Centre, which inserts prophylactic PEGs. Excluded patients had: oral cancer, surgery/previous RT for HNC; HNC recurrence; or, dysphagia unrelated to HNC. Included patients were stratified by year post RT. We conducted descriptive, Chi squared and logistic regression analyses to compare patients with vs. without PEG.
Result(s): Overall, 757 patients were included, mean age was 62.8 + 11.4 years. Patients were: male 622 (82.2%); HPV+ 458 (60.5%); stage IV 577 (76.2%); and, 484 (63.9%) had chemotherapy (CT). Tumour sites were: 482 (63.7%) oropharynx; 110 (14.5%) nasopharynx; 26 (3.4%) hypopharynx; 76 (10.0%) larynx; and, 63 (8.3%) unknown primary. There were no baseline demographic, cancer or treatment differences between strata. Yearly PEG prevalence post RT from available patients, 670 (88.5%), was: Year 1–5 (7.6%); Year 2–4 (2.5%); Year 3–9 (5.9%); Year 4–10 (7.1%); and, Year 5–7 (4.6%). Across the years, we identified no significant relation between PEG in situ and primary cancer site, HPV status, age, CT or time since RT.
Conclusions (Including Clinical Relevance): Our findings are the first to show that severe dysphagia persists up to 5 years after RT, peaking in years 1 and 4. These estimates are critical to design future therapeutic clinical trials.
Relevant Financial Relationships: Elissa Greco: Nothing to Disclose | Jolie Ringash: Nothing to Disclose | George Tomlinson: Nothing to Disclose | Rosemary Martino: Has affiliations to disclose; University of Toronto: Salary/Stipend: Employment; CCSRI #020190: Grant: Employment; Canada Research Chair in Swallowing Disorders: Grant: Employment.
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Swallow Function and Airway Protection in Patients with Non-tuberculous Mycobacteria

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Purpose: Non-tuberculous mycobacteria (NTM) can cause clinically significant lung disease and frequent pneumonias. It is unknown whether impaired swallowing contributes to the pathophysiology of NTM. Patients with NTM may exhibit decreased airway protection. Our aim is to determine airway protection and bolus clearance in patients with NTM.
Method(s): Videofluoroscopy (VF) was prospectively collected from 98 patients with NTM (67 female; ages 33–88). Two boluses of 3,5,10 ml thin liquid, two 5 cc puree Varibar, cracker were analyzed per subject (N = 980 swallows).Outcome measures included Penetration/Aspiration Scale (PAS) and ordinal ratings of residue in the valleculae and pyriform sinuses. Worst PAS scores categorized subject as unsafe ($\geq$ 3) or safe ($\leq$ 2). The correlation between clinical information and the present of penetration/aspiration and pharyngeal residue structures was analyzed.
Result(s): Inter- and intra-rater reliability of PAS ratings were assessed using two-way mixed intraclass correlation coefficients (ICC) on 20% of the data with excellent results (intra-rater: ICC 0.98, 95% CI 0.95–0.98 and inter-rater: ICC 0.85, 95% CI 0.69–0.92). The proportion of impaired swallows in the whole dataset was 12.9% (127/980 swallows with PAS scores $\geq$ 3). There was no correlation between presence of penetration/aspiration and pharyngeal residue with productive cough, pneumonia, smoking history and presence of acid reflux.
Conclusions (Including Clinical Relevance): Patients with NTM appear to have impaired swallow function as represented by impaired airway protection. Future work should explore swallowing physiology compared to a control group.
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Swallow Strength Training Exercise for Elderly: A Health Maintenance Need

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Purpose: Recent studies have shown high prevalence of oropharyngeal dysphagia associated with frailty and age-related muscle weakness. Strength training exercises have been advocated for locomotive health maintenance in the elderly and have shown positive outcomes. Since muscles involved in oropharyngeal phase of swallowing are also comprised of striated muscles, the aim of this study was to determine the biomechanical effect of a novel resistance exercise program, Swallowing Against Laryngeal Restriction (SALR), on pharyngeal phase swallowing in the healthy elderly.
Method(s): A total of 28 volunteers (75 + 7 years; 17 females) without dysphagia were studied using video fluoroscopy before and after six weeks of the swallow strength training exercise. Eighteen of these volunteers also underwent high- resolution pharyngeal manometry. Ten additional volunteers (81 + 6 years; 9 females) were studied by videofluoroscopy before and after 6 weeks of a sham exercise.
Result(s): Swallow resistance exercise but not the sham exercise resulted in a significant increase in maximum upper esophageal sphincter opening ($p < 0.01$), superior and anterior laryngeal excursion ($p < 0.01$) as well as posterior pharyngeal wall thickness ($p < 0.01$). Resistance exercise also resulted in a significant increase in pharyngeal contractile integral ($p < 0.01$).
Conclusions (Including Clinical Relevance): Strength training of pharyngeal phase swallowing musculature using the SALR technique significantly improves key physiologic features of the pharyngeal phase of swallowing. These findings provide the basis for developing an exercise-based swallow health maintenance program for the elderly.
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Relevant Non-financial Relationships: Dilpesh Agrawal: Nothing to Disclose | Mark Kern: Nothing to Disclose | Francis Edeani: Nothing to Disclose | Patrick Sanvanson: Nothing to Disclose | Reza Shaker: Nothing to Disclose.

Rehabilitation of a Heterogeneous Group of Dysphagic Patients by a Novel Exercise Technique of Swallowing Against Laryngeal Restriction

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Purpose: Deglutition disorders involving the oropharyngeal phase of swallowing constitute a significant clinical problem worldwide with limited therapeutic options. We have recently shown that the suprahyoid and pharyngeal muscles can be strengthened in the elderly using a novel technique of Swallowing Against Laryngeal Restriction (SALR). Since muscle weakness is a prevalent cause of dysphagia, the aim of this study was to test the effect of SALR-enabled exercise program on the deglutitive biomechanics and function of a non-selected group of oropharyngeal dysphagia (OPD) patients.
Method(s): We studied 29 dysphagic patients (65 + 10 year, 14F) with variable severity, duration and diverse etiology (chemoradiation, CVA, cervical spine surgery, aging, proximal esophageal hypomotility, post esophagectomy, pharyngeal stab injury) who had failed conventional deglutitive rehabilitation. All patients underwent videofluoroscopic evaluation of swallowing before and after completion of 6-weeks of exercise. Exercise period was extended if no effect was seen.
Result(s): Maximum UES opening and anterior hyolaryngeal excursion increased significantly ($p < 0.05$) after exercise. 17 patients showed aspiration at baseline and 9 of these demonstrated no aspiration on study termination ($p < 0.01$). Functional measures of swallowing i.e. EAT-10 and FOAMS improved significantly ($p < 0.01$).
Conclusions (Including Clinical Relevance): SALR-enabled swallow exercise program improves oropharyngeal swallowing function, UES opening, and deglutitive biomechanics as well as reduces aspiration in a heterogenous group of OPD patients. This improvement may take up to 18 weeks to achieve.
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Novel Method to Treat Stricture in Unsedated Patients Following Head and Neck Cancer Treatment

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Purpose: Pharyngoesophageal Junction (PEJ) stricture contributes to dysphagia following head and neck cancer treatment. Endoscopic dilatation is effective (70% response rate) but labor intensive and expensive (50% relapse at 10 months). The extent to which forceful dilatation, per se, exacerbates further fibrogenesis is unknown. The Fox Tissue Modification Device (FTMD) delivers a very slow, graded radial force adapted to the unsedated patient that should minimize tissue injury.
Method(s): Each patient (n = 5) underwent 4 unsedated dilatations with CRE wire-guided balloon (15–18 mm, Boston Scientific). In each session, the balloon was slowly inflated by the FTMD device to reach a target pressure which was increased each session (20, 30, 50, 60 PSI). Balloon position and stricture diameter were confirmed fluoroscopically. Pain scores were collected on a VAS and dysphagia severity assessed pre/post each dilatation session using Sydney Swallow Questionnaire (SSQ).
Result(s): All patients completed dilatation without sedation and with no adverse events. The average maximum pain score during dilatation was 6.5 95% CI [5.3 7.7] however it resolved immediately on extubation. The average increment in PEJ diameter per dilatation session was 0.58 mm 95% CI [0.08 to 1.08] ($p = 0.02$). SSQ scores improved by − 244 95% CI 6.5 95% CI [− 642 to 161] (NS, $p = 0.15$) but this was not significant.

Conclusions (Including Clinical Relevance): In this small pilot study, FTMD dilatation in unsedated patients is safe and feasible. PEJ diameter increased modestly and this method may provide clinicians with a safe and economic choice to standard endoscopic management of recalcitrant strictures.
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The Burden of Dysphagia on Family Caregivers of the Elderly: A Systematic Review

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Purpose: With the rapid increase in the elderly population, there has been a simultaneous increased need for care provided by informal caregivers. Research in head and neck cancer has indicated that caring for patients with dysphagia can impact a carer's quality of life. Given that many elderly people present with dysphagia, one can assume that carers of the elderly are equally affected. The purpose of this review was to examine all relevant literature regarding caregiver burden in carers of community-dwelling elderly with dysphagia.
Method(s): Seven databases were systematically searched by 2 reviewers from inception to April 2017 to identify relevant studies that discussed caregiver burden in family carers of the community-dwelling elderly with dysphagia. Full-text reviews of abstracts that met inclusion criteria were completed, and relevant data were extracted.
Result(s): The search yielded 2331 unique abstracts. Of the 176 abstracts that underwent full review, four were accepted. All 4 studies reported that caregiver burden increased due to presence of dysphagia in care recipients. In two studies, burden related to feeding tubes was discussed, and two studies discussed swallowing difficulties in terms of oral phase impairments. Only two studies used an objective outcome measure for caregiver burden.
Conclusions (Including Clinical Relevance): Although aspects of dysphagia likely play a critical role in caregiver burden, there is a paucity of data supporting this concept. The impact of dysphagia as a potential confounder for caregiver burden is unknown and future dysphagia-related studies should aim to include caregiver burden measures in their designs.
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Feeding and Swallowing Impairment Following Stroke and Cerebral Palsy in Children: A Systematic Review

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Purpose: Children with stroke and cerebral palsy often have feeding and swallowing problems; however, little is known about their incidence. A systematic review was conducted to determine the reported frequency of feeding and swallowing impairments in children diagnosed with stroke and/or cerebral palsy.
Method(s): Six electronic databases were searched to May 2017. Two blinded raters assessed abstracts and full articles for eligibility. Discrepancies were resolved by consensus. Reasons for exclusion included pre-term infants (< 37 weeks) and case series design (n < 10). Accepted articles were evaluated for quality using Cochrane's risk of bias, data was extracted and analyzed descriptively.
Result(s): Of 1289 abstracts, 8 studies met inclusion criteria. Across studies, etiology type and severity along with operational definitions of feeding and swallowing varied. Insufficient details were provided on assessment methods and timing. Reported frequency of any feeding and/or swallowing impairment ranged from 19 to 99%. One study included patients with only stroke and reported a frequency of feeding and/or swallowing impairment of 48.8%. There were higher frequencies noted with more severe cerebral palsy. Frequency of impairment did not vary based on caregiver report or clinician assessment.
Conclusions (Including Clinical Relevance): These results suggest that feeding and swallowing impairments are common consequences in pediatric patients with stroke and cerebral palsy; however, accurate estimates of incidence remain unknown. There is a need for more high-level evidence of these impairments, especially following stroke in children.
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Coordination Between Respiration and Swallowing in Infant Pigs With and Without a Recurrent Laryngeal Nerve Lesion

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Purpose: Recurrent laryngeal nerve (RLN) lesions, a complication of cardiac surgery, are known to be associated with compromised airway protection in preterm infants. Coordination between thoracic respiratory cycles and swallowing is changed following RLN lesion. We wish to understand the role of the larynx in regulating airflow during swallowing and changes that occur in this role because of an RLN lesion.
Method(s): We randomly selected 5 of 9 cesarean section delivered infant pigs for a surgical RLN lesion at 4 days of age. We recorded all subjects while drinking milk mixed with barium from a bottle with video fluoroscopy at 7 days old. We measured nasal airflow with a thermocouple and thoracic movement with a plethysmograph at the same time.
Result(s): There was a tight coordination between onset of inspiration and swallowing in the thoracic data in all cases. Airflow at the nostrils, as measured by range of temperature, was greater in lesioned infants than in control infants ($p < 0.001$), indicating that swallow apnea was less pronounced in lesioned pigs.
Conclusions (Including Clinical Relevance): The larynx serves as a valve to trap air as a food bolus travels over it, with this valving function of the larynx being compromised more frequently in RLN lesioned pigs. Airway protection in swallowing is achieved by coordination of different components (larynx, thorax) of the respiratory and swallowing system. Understanding the variable sources of pathophysiology of airway protection failure will help inform the development of effective interventions.
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VFSS Measurement Tool for Swallowing Impairment in Bottle-Fed Babies (BaByVFSS^{Imp}): Establishing a Standard

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Purpose: Despite the trends in increased pediatric dysphagia and related videofluoroscopic swallow studies (VFSS), standardized VFSS metrics for interpreting impairment are lacking. This study established the construct validity of a novel tool for assessing physiologic swallowing impairment in bottle-fed babies.
Method(s): Seven liked-trained speech language pathologists (SLPs), who met reliability criterion, scored 23 components of swallowing impairment organized into a tool on 300 prospective and randomly assigned VFSS from bottle-fed babies. Confirmatory factor analyses (CFA) tested for 5 hypothesized factors. Minimal threshold for factor loading was $\geq .5$.
Result(s): CFA resulted in 21 components loading onto the five functional domains: (1) Lingual Motion/Pharyngeal Swallow Initiation; (2) Pharyngeal Transport and Clearance; (3) Palatal Pharyngeal Approximation; (4) Airway Invasion/Laryngeal Closure; (5) Aspiration. Component 1 (Lip Closure) and Component 5 (Oral Residue) did not load onto any factor with highest loadings of .36 and .41, respectively. Spearman correlations between 13 components and feeding levels post-VFSS were significant.
Conclusions (Including Clinical Relevance): This project establishes the construct validity of a new standardized and objective tool (BaByVFSS^{Imp}) for quantification of swallowing impairment from VFSS exams in bottle-fed babies. Clinical translation and research implications will be addressed.
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Effects of Device-Facilitated Lingual Strengthening Therapy on Swallowing-Related Outcomes Post-stroke: A Pilot Study

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Purpose: The purpose of this pilot study was to characterize the effects of device-facilitated lingual strengthening therapy on swallowing-related outcomes in a group of patients with post-stroke dysphagia.
Method(s): 29 dysphagic patients within six months of stroke were recruited (8 females, 21 males; mean age = 71 years). 13 were randomized to usual care (UC) and 16 to lingual strengthening (LS) facilitated by the SwallowStrong® device. The LS group performed 10 press repetitions at front and back tongue locations against sensors embedded in a custom-fit mouthpiece 3 times/day, 3 days/week for 8 weeks. Data collected included maximum lingual pressures, Functional Oral Intake Scale (FOIS) scores, and swallowing quality of life (SWAL-QOL) scores. Mixed-design analyses of variance were used to determine change in outcomes over 8 weeks.
Result(s): While change was non-significant, max lingual pressures at both sensors increased from baseline in the LS group (mean change: front = 66 hectopascals (hP); back = 89hP) and decreased in the UC group (mean change: front = − 57hP; back = − 60hP). Across both groups, FOIS ($p < .01$) and SWAL-QOL total scores ($p < .001$) improved from baseline to 8 weeks.
Conclusions (Including Clinical Relevance): Patients post-stroke who received lingual strengthening facilitated by the SwallowStrong® device were able to build lingual strength over 8 weeks while those in the usual care group experienced decreased strength over time. Regardless, level of oral intake and quality of life improved for both groups. The impact of lingual strengthening on swallowing outcomes, including safety and efficiency, requires further study.
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Post-swallow Pharyngeal Residue: How Much is Normal?

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Purpose: (1) To determine how much post-swallow pharyngeal residue is typical in healthy young adults; (2) To determine how factors of bolus consistency and sip volume impact residue severity; (3) To compare residue between starch and gum-thickened liquids matched for gravity flow.
Method(s): Videofluoroscopy data were collected at 30 fps from 39 healthy adults (19 male), aged 21–55 (mean 34). Each participant swallowed 3 naturally sized boluses of thin liquid barium (20% w/v) and 6 boluses of slightly-, mildly-, moderately- and extremely-thick barium (20% w/v). For thick stimuli, 3 boluses were prepared with starch and 3 with xanthan-gum. Sip volume was measured using pre- and post-sip cup weights. Recordings were rated in duplicate by blinded raters to obtain pixel-based, anatomically normalized measures of residue in the valleculae, pyriform sinuses, and other pharyngeal locations at the end of the initial swallow for each bolus.
Result(s): Residue was significantly more likely to be present ($p < 0.01$) and significantly more severe on mildly, moderately and extremely thick compared to slightly-thick and thin stimuli ($p < 0.01$). Residue was also significantly more severe with larger sip volumes ($p < 0.001$) and with starch thickened liquids ($p < 0.05$).
Conclusions (Including Clinical Relevance): Small amounts of pharyngeal residue are normal for swallows of low-concentration barium stimuli (20% w/v). Residue is more likely to occur with thicker liquids, particularly when starch- based thickeners are used. This study provides reference data for residue seen in healthy young adults, to which data from patients with dysphagia can be compared.
Relevant Financial Relationships: Catriona Steele: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment;

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Changes in Aspiration Levels Over Development in Infants with and Without RLN Lesions

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Purpose: Recurrent laryngeal nerve (RLN) damage causes increased aspiration in 48 h in infant pigs, but its longitudinal effects on airway protection are unknown.
Method(s): Fifteen infant pigs were delivered via C-section; six had surgical RLN lesions at age 4 days. VFSS was used at days seven and 17 to record each pig drinking milk mixed with barium. One researcher scored all swallows using the Infant Mammalian Penetration-Aspiration Scale (IMPAS). We calculated percent of swallows with aspiration, percent of safe swallow, and average IMPAS score for each feeding sequence. The effect of time and lesion were tested using a repeated measures analysis.
Result(s): Both control (6 out of 9) and lesion (4 out of 6) pigs aspirated on days seven and seventeen. None of the factors (time, treatment, or the interaction) were significant for any of the measures of airway protection failure. Variation in frequency, distribution, and occurrence of aspiration was high within and between individuals, possibly obscuring differences between populations at small sample size.
Conclusions (Including Clinical Relevance): Despite finding no statistical significance between treatment and swallow safety, the high levels of silent aspiration in controls challenge the current model of pathological swallowing, which assumes zero to few aspiration events in healthy individuals. This finding reinforces the need for further research on the level of aspiration that infants can tolerate without adverse health outcomes, using surgery and imaging only possible in animal models.
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Reflex Cough Characteristics of Total Laryngectomy

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Purpose: Patients who are status post total laryngectomy are vulnerable to accumulation of endogenously produced, and occasionally aspirate material (from malfunctioning TEP) in the lower airways. With intact larynges, laryngeal afferents, in combination with glottal and supraglottal valving mechanisms, are critical for production of reflexive cough to clear material from the lower airways. To date, very little is known about the ability of laryngectomees to effectively clear their lower airway.
Method(s): Data were collected from 20 adults (14 male), aged 46–80 (mean 60) status post total laryngectomy (5 months–30 years; average 5 years) and 18 age and sex-matched healthy control participants. Reflex cough was induced using different concentrations of capsaicin, and cough airflow was recorded, along with the perceived urge to cough. A multivariate ANOVA was conducted with group and concentration as fixed factors, in order to test for differences between the groups.
Result(s): There were significant main effects for concentration ($F(19, 1) = 4.119$, $p = .000$) and group ($F(4, 1) = 14.678$, $p = .000$) but not a significant interaction effect ($F(14, 1) = .789$, $p > .05$). Specifically, the TL group had significantly lower UtC ($p = .05$) and CVA ($p = .000$) as compared to the control group.
Conclusions (Including Clinical Relevance): Effective cough as a function of airway clearance is imperative to the laryngectomized population. Reduced CVA and UtC results in ineffective and diminished detection of mucous plugging, or the inability to clear the airway of endogenous material, which is a leading cause of death during the acute postoperative phase.
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Mechanisms Contributing to Post-swallow Pharyngeal Residue in Healthy Swallowing

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Purpose: To determine which of the following are associated with pharyngeal residue in healthy swallowing: bolus consistency (IDDSI levels 0 to 4); sip volume; tongue pressure amplitude, rise- and decay-slope; pharyngeal constriction; UES opening width and duration.
Method(s): A sample of 39 healthy adults (19 male), aged 21–55 (mean 34), completed a videofluoroscopy protocol including 27 boluses of 20% w/v barium: 3 × thin and 6 each of IDDSI levels 1–4 (with half of each level thickened with starch and half with xanthan gum). Tongue pressures were collected simultaneously. Sip volume was calculated from pre- and post-sip cup weights.The videofluoroscopies were rated in duplicate to obtain anatomically normalized pixel- based measures of vallecular, pyriform and other pharyngeal residue; width of UES opening; pharyngeal area at maximum constriction; and duration of UES opening. Stepwise linear regression was used to determine factors predictive of residue severity.
Result(s): Vallecular residue was explained by a 2-factor model including pharyngeal constriction and sip volume ($R^2 = 0.37$). These factors were also explanatory of pyriform sinus residue, together with bolus consistency and tongue- pressure decay-slope ($R^2 = 0.2$). Residue in other pharyngeal locations was best explained by pharyngeal constriction and sip volume ($R^2 = 0.25$). Total pharyngeal residue was explained by pharyngeal constriction, sip volume and bolus consistency ($R^2 = 0.49$).
Conclusions (Including Clinical Relevance): Post-swallow residue in healthy young adults is explained by larger sip volumes, poorer pharyngeal constriction, thicker bolus consistency and tongue-pressure decay slope.
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Complexities of Managing the Elderly Burn Patient: Burn Location is Irrelevant to Risk for Dysphagia and its Complications in Patients Over 75 Years

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Purpose: Management of the elderly burn patient is complex with advanced age known to be associated with elevated risk for morbidity and mortality. The presence of dysphagia and its sequelae may further increase this risk. We aimed to determine the prevalence and identify a set of risk factors for dysphagia in patients admitted with severe burn injury over the age of 75 years.
Method(s): All patients over 75 years admitted to Concord Repatriation General Hospital with severe burn injury (2013–2017), were assessed for dysphagia on admission and continually throughout their stay. Key data points captured included: burn size and location, premorbid medical history and cognitive function, presence and severity of dysphagia, nutrition assessment and indication for nutrition support, number of surgical procedures requiring general anaesthetic, mechanical ventilation, medical complications during admission and discharge destination.
Result(s): A total of 66 patients (31 male; 31 female) aged 75–96 years (median 82 years) were recruited over the study period. 46.97% were identified as dysphagic during their hospital admission. Presence of dysphagia was associated with pre-existing cognitive impairment, need for mechanical ventilation, increased days of enteral feeding, increased hospital length of stay, in-hospital complications and mortality. There was no association identified between burn location, burn mechanism and presence of dysphagia.
Conclusions (Including Clinical Relevance): The findings of this study suggest that regardless of burn location, burn patients with advanced age are at risk for dysphagia and dysphagia related complications.
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Evaluation of the Implementation of Telepractice Services for the Clinical Assessment of Adult Swallowing Disorders

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Purpose: Recent research has validated the use of telepractice to conduct clinical swallow assessments (CSEs). However the clinical implementation of this service model has not been examined. Using a health service evaluation methodology, the current study examined factors that influenced the implementation of telepractice services for clinical dysphagia assessment within 5 health services.
Method(s): The Consolidated Framework for Implementation Research (CFIR) framework was used to analyze the experiences of 5 public health services, 1-year post implementation of telepractice services for dysphagia assessment. Semi-structured interviews were conducted with key staff from each service (n = 10) to examine experiences. Information obtained was coded across the constructs and domains of the CFIR framework, and then rated for Strength (2 = strong, 1 = weak, 0 = neutral) and Direction of Influence (+ive/−ive), using set coding conventions.
Result(s): All services were successfully established, with plans for ongoing sustainability. Positive implementation drivers were: Innovation Characteristics; Outer Setting; Inner Setting, and Process, with the constructs: Relative Advantage; Design Quality & Packaging; Innovation Participants; and External Change Agent perceived as vital. Constructs that challenged implementation were: Structural Characteristics and Available Resources.
Conclusions (Including Clinical Relevance): The study revealed key factors influencing implementation and sustainability of dysphagia telepractice services. Findings will inform implementation and expansion of telepractice models in other services.
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Understanding the Impact of Head and Neck Lymphedema on Swallow Function: Insights from Patients Experiences

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Purpose: Head and neck lymphoedema (HNL) is prevalent following head and neck cancer (HNC) management, and can contribute to a range of physical, functional and psychological deficits. Quantitative studies have recently correlated the presence of HNL with impaired swallow function. However, currently there is limited information from the patient perspective of exactly how HNL impacts oral intake in daily life. As part of a larger program of research, a qualitative methodology was used to explore patient perceptions of the impact of HNL on swallow function.
Method(s): Twelve participants who were > 3 months post HNC treatment and experiencing external, internal or combined HNL participated in individual, semi-structured interviews; analysed with deductive open-ended coding and verified by participant checking.
Result(s): Most (n = 11) felt that HNL impacted their swallowing. Specific to this, 3 themes emerged: (1) "It feels tight" –reflecting issues with tightness in the throat causing obstruction to bolus flow; (2) "It changes throughout the day"—highlighting fluctuation and temporal changes within their swallow function; and (3) "It requires daily self-monitoring and management"—providing insight into how patients managed and optimised their swallow function around their HNL symptoms.
Conclusions (Including Clinical Relevance): Clinicians need to monitor for the effects of HNL and ensure that patients with HNL understand the potential impacts to swallowing, and to how to manage these in times of increased difficulty. The multidisciplinary team need to remain aware that swallowing may be a component of the widespread impacts of HNL.
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Relationships Between Radiation Dose (DAP) and Radiation Exposure Time and Projection

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Purpose: This study sought to understand the relationship of Dose Area Product (DAP) in Modified Barium Swallow Studies (MBSSs) with radiation exposure time and projection used (lateral vs. posterior-anterior (PA)).
Method(s): DAP, radiation exposure time, and projection were recorded in 200 adults undergoing clinically indicated MBSSs conducted in accordance with the MBSImP guidelines. Data were analyzed using related sample Wilcoxon test and Spearman correlation. The data were also used to create a model which allocates the percentage of DAP in the various projections (lateral, PA, etc.).
Result(s): DAP was statistically correlated with radiation exposure time for the middle and lower GI PA projections only ($r = 0.46$, $r = 0.57$, $p < 0.01$). DAP was significantly higher in the PA (total) compared to lateral projections ($p < 0.01$), however, time was longer in lateral vs. PA (total) ($p < 0.01$). Based on our results, the estimated allocation of DAP during MBSSs is: 40% lateral, 20% PA upper GI, 10% PA middle GI and 30% PA lower GI.
Conclusions (Including Clinical Relevance): Clinicians should be aware that the relationship between exposure time and radiation dose (DAP) is dependent on the exam projection. A model of DAP allocation in MBSSs indicates that approximately 40% of DAP is from the lateral projection and 60% of DAP is from the PA projection.
Relevant Financial Relationships: Heather Bonilha: Has affiliations to disclose; Medical University of South Carolina: Salary/Stipend: Employment; NIH: Grant: Other Activities; NIH: Salary/Stipend: Membership on advisory committee or review panels; ASHA: Salary/Stipend: Membership on advisory committee or review panels | Sameer Tipnis: Has affiliations to disclose; Medical University of South Carolina: Salary/Stipend: Employment | Janina Wilmskoetter: Has affiliations to disclose; Medical University of South Carolina: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research) | Janet Cucciare: Has affiliations to disclose; Medical University of South Carolina: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research) | Bonnie Martin-Harris: Has affiliations to disclose; Northwestern University: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research); VA: Grant: Independent contractor (Including contracted research); Medical University of South Carolina: Salary/Stipend: Employment; Bracco Diagnostics: Grant: Independent contractor (Including contracted research); Northern Speech Services: Royalty: Teaching and speaking | Walter Huda: Has affiliations to disclose; Dartmouth-Hitchcock Medical Center: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research).
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Estimating Thyroid Doses in Modified Barium Swallow Studies

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Purpose: Entrance air kerma into thyroid doses conversion factors were obtained for patients undergoing Modified Barium Swallow Studies (MBSSs).
Method(s): A commercial software package (PCXMC 2.0.1) was used to to yield $f_{thyroid}$ ratios obtained by dividing the patient thyroid doses in MBSSs by the corresponding entrance air kerma. Conversion factors were computed for lateral and posterior-anterior (PA) projections where the thyroid gland is in the x-ray beam field of view and therefore directly irradiated. Calculation of $f_{thyroid}$ ratios were obtained for adult patients as well as children ranging from birth to 10-years-old for a range of x-ray beam qualities from 60 kV (3 mm Al filtration) to 110 kV (3 mm Al + 0.2 mm Cu filtration).
Result(s): In a normal sized adult, the average value of $f_{thyroid}$ was 0.63 ± 0.11 for a lateral projection and 0.18 ± 0.06 for an upper GI PA projection. Increasing the beam quality nearly doubled the value of $f_{thyroid}$ in lateral projection and quadrupled the value of $f_{thyroid}$ in upper GI PA projection. Average values of $f_{thyroid}$ in 10-year olds were similar to those of adults, but increased as the age of the exposed child was reduced. The average $f_{thyroid}$ for newborns was 0.84, nearly one-third higher than the corresponding ratio for normal sized adults.
Conclusions (Including Clinical Relevance): Clinicians can use the conversion factors from this study, along with readily available information from fluoroscopy units, to determine patient thyroid dose. The focus on radiation protection endeavors in MBSSs should be on infant and young females, where the risks are much higher than in adults.
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NIH: Grant: Independent contractor (Including contracted research); Northern Speech Services: Royalty: Teaching and speaking; Bracco Diagnostics: Grant: Independent contractor (Including contracted research); Mark and Evelyn Trammell Trust: Gift: Other Activities | Walter Huda: Has affiliations to disclose; Dartmouth-Hitchcock Medical Center: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research).
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Optimal Nipples for Efficient Barium Expression During the Videofluoroscopic Swallow Exam

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Purpose: The videofluoroscopic swallow study (VFSS) is a procedure used to identify deficits in swallow physiology and bolus flow among bottle-fed infants. During the procedure infants are fed thin and nectar barium from their home bottle nipple. While these nipples enable efficient expression of milk, their small orifice size limits the expression of the more viscous barium. Nipples with larger orifices capable of expressing more viscous liquids are clinically available. However, it is unknown which of these nipples enables infants to express barium with the same efficient rate of flow as they achieve when drinking milk in their typical feeding environment.
Method(s): Flow rates of four bottle nipples (Dr. Brown's L1, L2, L3, L4) were calculated during the expression of formula, thin barium, and nectar barium using a pulsated pressure pump. Differences in flow rates across conditions were tested using ANOVA with post hoc Dunnett's testing to identify the nipple that enabled thin and nectar barium contrast to flow at the same rates as formula with L1.
Result(s): Average flow rate for formula on a L1 was 10.57 ± 0.12 mL/minute. Although L1 nipples yielded similar flow rates when expressing thin barium (9.77 ± 0.13 mL/min, $p = 0.45$), a L3 nipple was required to achieve similar rates with nectar barium (9.87 ± 0.09 mL/min, $p = 0.59$).
Conclusions (Including Clinical Relevance): Nipples with larger orifice sizes are necessary to facilitate efficient expression of nectar barium during the VFSS. Future investigations that develop standardized methods of conducting the VFSS among bottle-fed children are necessary to improve reliability and validity of the exam.
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Tongue and Palate Contact DURING Cup and Straw Drinking Observing with Electrophalatograpy

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Purpose: Because straw drinking is much less incident of aspiration compare to cup drinking, clinicians choose straw for liquid in clinical settings (Daniels, 2004). It may be related to differentiate of oral movement during two ways (Veiga, 2014). In this study, we focus on tongue and palate contact during cup and straw drinking using electroplategraphy (EPG).
Method(s): Eight healthy adults (age, 35 ± 9 years) participated in this study. We made palate floors with 124 tough sensors. Sampling rate was 100 Hz. All participants were asked to set palate floor and measured at 124 points if each point contacts during liquid swallow. Amount of liquid was 10 ml in both cup drinking and straw drinking. All participants swallowed 8 times, under 3 swallowing conditions: (1) Thin liquid with a straw, (2) Thickened liquid with a straw, (3) Thin liquid with a cup. The minimum contacted point (MCP) and the uncontacted time (UT) were calculated. The statistical analysis used Friedman test.
Result(s): Six participants were analyzed in this study. MCP ($P < 0.01$) and UT ($P < 0.05$) were significant difference in three conditions. Large area of side tongue were always contacted to the palate during straw drinking.
Conclusions (Including Clinical Relevance): This study indicated that oral movement during cup drinking and straw drinking were significantly different and it may be influenced to avoid aspiration. Also, we observed different contact pattern between thin and thickened liquid.
Relevant Financial Relationships: Aya Hirata: Nothing to Disclose | Isamu Shibamoto: Nothing to Disclose.
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Longitudinal Effects of RLN Lesion of Rates of Swallowing and Respiration in Infant Pigs

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Purpose: Recurrent laryngeal nerve (RLN) lesion, a complication of cardiac surgery in preterm infants, affects coordination between breathing and swallowing. However, the individual impacts of a nerve lesion on (1) quiet respiration, (2) respiration during feeding, and (3) rate of swallowing in a developing infant are unknown. Our aim was to determine the effect of RLN lesion on the maturational changes in swallowing and respiration in infants.
Method(s): 9 infant pigs, delivered by cesarean section, were lesioned at 3-4 days, or assigned to control groups. Using respiratory

inductance plethysmography, respiratory cycle length and inspiration phase lengths were measured at rest until age 11 days, and under anesthesia at 22, 24, and 26 days. Using simultaneous VFSS and plesthysmography, swallowing rates and respiration rates were measured at 7 and 17 days. We tested the effect of age and lesion status using complete linear models.
Result(s): Lesion did not have a significant effect on respiratory cycle length. Under anesthesia, variation in inspiration phase lengths is greater in lesioned pigs. From 7 to 11 days, the variation in respiratory cycle lengths decreased. RLN lesion had no effect on swallowing rates, inter-swallow intervals, or respiratory rates during feeding, though all became shorter and less variable with age. Overall patterns of swallowing and respiration are not affected by RLN lesion, though they change with age.
Conclusions (Including Clinical Relevance): These results help construct a baseline for how RLN lesion affects respiration separate from swallowing in both pigs and possibly human infants.
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Economic and Survival Burden of Dysphagia among Inpatients in the United States

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Purpose: This study was designed to assess how a dysphagia diagnosis affects length of hospital stay (LOS), costs, discharge disposition, and in-hospital mortality among adult US inpatients.
Method(s): Dysphagia prevalence, LOS, hospital charges, inpatient care costs, discharge disposition, and in-hospital mortality were measured using the AHRQ Healthcare Cost and Utilization Project National Inpatient Sample (2009–2013). Patients 45 + years with LOS $\leq$ 180 days with and without dysphagia were included. Multivariable regression methods with propensity weighting were used to assess associations.
Result(s): 2.7 of 88 million (3.0%) adult inpatients had a dysphagia diagnosis and prevalence increased from 408,035 (2.5%) in 2009 to 656,655 (3.3%) in 2013. Mean hospital LOS in patients with dysphagia was 8.8 days (CI 8.6–8.9) compared to 5.0 days (CI 4.9–5.1) in the non-dysphagia group ($p < 0.001$). Total inpatient costs were a mean $6243 higher for those with dysphagia ($p < 0.001$). Patients with dysphagia were 33.2% more likely to be transferred to post-acute care facility ($p < 0.001$) with an OR of 2.8 (CI 2.7–2.8, $p < 0.001$). Adult patients with dysphagia were 1.7 times more likely to die in the hospital (CI 1.7–1.7).
Conclusions (Including Clinical Relevance): Dysphagia is associated with a significantly longer hospital length of stay, higher inpatient costs, higher likelihood of discharge to post-acute care facility, and inpatient mortality when compared to patients without dysphagia. Dysphagia has a substantial health and cost burden on the US healthcare system.
Relevant Financial Relationships: Dyanesh Patel: Nothing to Disclose | Shanthi Krishnaswami: Nothing to Disclose | Edward Steger: Nothing to Disclose | Ellen Conover: Nothing to Disclose | Michael Vaezi: Nothing to Disclose | Michelle Ciucci: Nothing to Disclose | David Francis: Nothing to Disclose.
Relevant Non-financial Relationships: Dyanesh Patel: Nothing to Disclose | Shanthi Krishnaswami: Nothing to Disclose | Edward Steger: Nothing to Disclose | Ellen Conover: Nothing to Disclose | Michael Vaezi: Nothing to Disclose | Michelle Ciucci: Nothing to Disclose | David Francis: Nothing to Disclose.

Spontaneous Swallow Frequency in Healthy Children and Children with Cerebral Palsy

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Purpose: This study evaluated spontaneous swallow frequency in healthy children and children with cerebral palsy in reference to age, motor status, dysphagia, and drooling.
Method(s): 5 children with cerebral palsy and 22 healthy children particpated in this study. Spontaneous swallowing frequency was obtained at rest based on acoustic recordings from the lateral neck over the proximal trachea. Swallow frequency was calculated as swallows per minute (SPM). Age was recorded in months. Motor status was evaluated with the Gross Motor Function Classification System (GFMCS). Dysphagia was evaluated with the Dysphagia Management Staging Scale (DMSS) and drooling was assessed with the Drooling Quotient (both rest [DQr] and active [DQa]).
Result(s): SPM was significant lower in children with cerebral palsy (Mean: 1.12 vs. 0.58). In healthy children SPM demonstrated a trend toward significant correlation with age ($r = -0.38$; $p = 0.08$) but did not correlate with either DQ. Age did demonstrate a significant negative correlation with both DQs ($r = -0.57$; $p = 0.006$). In children with cerebral palsy SPM demonstrated a significant negative correlation with age ($r = -0.53$; $p = 0.05$). Age was not associated with drooling in this group.SPM also demonstrated significant correlations with DQr ($r = -0.49$; $p = 0.03$), GMFCS ($r = -0.46$; $p = 0.04$), and DMSS ($r = -0.42$; $p = 0.03$).
Conclusions (Including Clinical Relevance): Spontaneous swallowing frequency is sensitive to both dysphagia and drooling in children with cerebral palsy. This simple tool could be employed as a monitor of swallow and other oral function change in this population.
Relevant Financial Relationships: Michael Crary: Has affiliations to disclose; ACP: Consulting fee: Consulting; ProCourse: Speaking fee: Teaching and speaking; Elsevier: Royalty: Other Activities; Univ Central Florida: Salary/Stipend: Teaching and speaking | Nathalie Rommel: Has affiliations to disclose; Univ Leuven: Salary/Stipend: Teaching and speaking | Giselle Carnaby: Has affiliations to disclose; ACP: Consulting fee: Consulting; ProCourse: Speaking fee: Teaching and speaking; Univ Central Florida: Salary/Stipend: Teaching and speaking.
Relevant Non-financial Relationships: Michael Crary: Has a Non-Financial Disclosure Affliation; DRS : Professional: Membership | Nathalie Rommel: Has a Non-Financial Disclosure Affliation; DRS:

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Factors that Influence Radiation Exposure Time During Videofluoroscopic Swallow Studies of Bottle-fed Children

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Purpose: The Videofluoroscopic Swallow Study (VFSS) is the primary method for evaluating swallowing impairments across the age span. The associated exposure to ionizing radiation should be limited especially in young children who are more radiosensitive than adults. This study examined the influence of patient and exam factors on radiation exposure time for bottle-fed children during VFSSs.
Method(s): Three hundred bottle-fed children (corrected age: mean 4.22 months, range: − 1.61 to 39.6) underwent clinically indicated VFSSs. Radiation exposure time, age, oral intake status, 3 aspects of swallowing physiology (number of sucks to form a bolus, sucking rhythmicity, timing of pharyngeal swallow initiation), number of consistencies presented, feeder, speech-language pathologist (SLP) experience, and institution were recorded. The influence of each factor on radiation exposure time was evaluated with bivariate analyses.
Result(s): Median radiation exposure time was 1.57 min (range: 0.28–5.00). Radiation exposure time was below 3 min for 90% of children in our sample. Oral intake status ($p < 0.05$), number of sucks to form a bolus ($p < 0.01$), sucking rhythmicity ($p < 0.01$), number of consistencies presented ($p < 0.01$), feeder ($p < 0.01$), institution ($p < 0.01$), and SLP's experience ($r = -0.49$, $p < 0.01$) significantly influenced radiation exposure times.
Conclusions (Including Clinical Relevance): Radiation exposure times vary considerably for VFSS in bottle-fed children and are influenced by patient, clinician and exam factors. Careful consideration should be given to factors that may be modified to decrease radiation exposure without degrading diagnostic accuracy.
Relevant Financial Relationships: Heather Bonilha: Has affiliations to disclose; MUSC: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research) | Maureen Lefton-Greif: Has affiliations to disclose; The Johns Hopkins University School of Medicine: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research); The Ataxia Telangiectasia Children's Project: Grant: Independent contractor (Including contracted research); IEDAT (European Commission Center): Grant: Independent contractor (Including contracted research); Medbridge Education: Royalty: Teaching and speaking | Katlyn McGrattan: Has affiliations to disclose; Northwestern University: Salary/Stipend: Employment | Sameer Tipnis: Has affiliations to disclose; MUSC: Salary/Stipend: Employment | Walter Huda: Has affiliations to disclose; Dartmouth-Hitchcock Medical Center: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research) | Bonnie Martin-Harris: Has affiliations to disclose; Northwestern University: Salary/Stipend: Employment; MUSC: Salary/Stipend: Employment; NIH: Grant: Independent contractor (Including contracted research); VA: Grant: Independent contractor (Including contracted research); Bracco Diagnostics: Grant: Independent contractor (Including contracted research); Northern Speech Services: Royalty: Teaching and speaking.
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Intensity Modulated Radiation Therapy Dose to Glottis as Risk Factor for Dysphagia

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Purpose: The glottis is a known dysphagia/aspiration-related structure predictive for development of dysphagia following IMRT, less is known about epiglottis or subglottal trachea, which also receives radiation during therapy. The goal of this study was to determine the relationship between radiation dose to the glottis, epiglottis, and subglottal trachea, and swallowing.
Method(s): Retrospective data was collected from 33 subjects status post IMRT with contouring plans to determine dose specific to the subglottal trachea, glottis and epiglottis. We reviewed VFSS for documented penetration/aspiration with Dynamic Imaging Grade of Swallowing Toxicity (DIGEST) scores for both safety, defined as PA score 1 or 2, and efficiency of swallow.
Result(s): ROC analysis for swallow safety determined cut-points for dose to glottis as 29 Gy with 90% sensitivity (45% specificity), and for the epiglottis 63 Gy with 90% sensitivity (52% specificity); subglottal trachea dose was not significant in this model. These were

recoded into binary variables (dose groups) and a MANOVA was used to evaluate differences between dose groups on DIGEST scores. Significant differences exist for DIGEST scores between glottal dose groups ($F(3,1) = 13.471$, $p = .001$) but not epiglottal dose groups.
Conclusions (Including Clinical Relevance): Heretofore IMRT dose under 35 Gy to the glottis was considered safe. These results confirm dose to glottis as an independent risk factor for dysphagia, however suggest doses as low as 29 Gy may be associated with increased risk of dysphagia. Neither epiglottic or subglottic tracheal doses were significantly related to decreased swallow safety/efficiency.
Relevant Financial Relationships: Amy Fullerton: Nothing to Disclose | Kathryn Hitchcock: Nothing to Disclose | Karen Hegland: Nothing to Disclose.
Relevant Non-financial Relationships: Amy Fullerton: Nothing to Disclose | Kathryn Hitchcock: Nothing to Disclose | Karen Hegland: Nothing to Disclose.

Flow Tests of Barium Stimuli for Use in Videofluoroscopy

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Purpose: Barium is commonly used in videofluoroscopy. Recipes are needed to achieve matching flow of barium stimuli to the liquids they are intended to represent. The purpose of this study was to measure the flow of barium preparations using the International Dysphagia Diet Standardisation Initiative (IDDSI) Flow Test, which classifies thickness based on flow through a standard 10 ml slip tip syringe.
Method(s): We used the IDDSI Flow Test to measure different barium stimuli: a) Powdered barium (Varibar® thin; E-Z-HD®; E-Z-Paque®) in 20% w/v and 40% w/v concentrations and thickened with starch and gum thickeners to target IDDSI levels 1–4 (slightly to extremely thick); b) Barium suspensions: Bariogel® (20% w/v; 40% w/v); Varibar® nectar, thin-honey, honey-thick (40%w/v); Varibar® nectar diluted to 30% w/v; c) E-Z-HD® powder mixed into pre-thickened liquids (40%w/v). All stimuli were tested in triplicate at room temperature, 30 min after mixing.
Result(s): Stable flow (i.e., $\leq$ 1 ml variation across repeated tests) were achieved for all stimuli. Variations in flow were observed between starch and gum thickeners. Higher barium concentration resulted in thicker liquids. Pre-thickened liquids became thicker with the addition of barium.
Conclusions (Including Clinical Relevance): The IDDSI Flow Test can be used to confirm the thickness of barium stimuli and confirm matched flow to non-barium liquids. Clinicians should be aware that the addition of barium to pre-thickened liquids results in additional thickening. Results from this study will serve as references for clinicians who wish to use stimuli of different consistencies in videofluoroscopy.
Relevant Financial Relationships: Carly Barbon: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment; University of Toronto: Scholarship: Employment | Brittany Guida: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Catriona Steele: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment; National Institutes of Deafness and other Communication Disorders: Grant: Other Activities.
Relevant Non-financial Relationships: Carly Barbon: Nothing to Disclose | Brittany Guida: Nothing to Disclose | Catriona Steele: Has a Non-Financial Disclosure Affliation; International Dysphagia Diet Standardisation Initiative: Professional: Board membership.

An Evaluation of Service Outcomes, Costs, and Consumer Engagement Following Implementation of Telepractice Services for Clinical Assessment of Dysphagia

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Purpose: The delivery of dysphagia services is impacted by travel distance; a geographically disperse population; and access to a skilled local workforce. These issues may be alleviated with telepractice. This study examined the service outcomes, costs and consumer satisfaction of a telepractice service model for conducting clinical swallow examinations (CSEs) implemented across 5 public health services.
Method(s): Forty CSE sessions were conducted via videoconferencing, linking the assessing speech pathologists (n = 8) with 30 patients in distant health facilities. Telepractice sessions followed published methodology with patient- end support provided by a trained local health support worker (HSW). Data was collected on waiting times, clinical and session outcomes, service costs and consumer satisfaction. Outcomes were compared to existing standard care, which involved scheduled/on-demand clinician visits to remote services or patients travelling to face-to-face assessments.
Result(s): Telepractice services enabled a reduction in patient waiting times (mean = 2 days); saved clinical time through avoided clinician travel (mean = 2½ h); and cost savings (mean = $220/session). Swallow safety and oral intake was optimized for 62% of patients who required diet/fluid changes post assessment. The HSW role was vital in providing patient support. Despite some technical issues, all sessions were completed successfully. Patient and clinician satisfaction was high.
Conclusions (Including Clinical Relevance): Telepractice can enable remote facilities to access CSEs in a more efficient manner, optimizing patient safety, and enhancing service and cost efficiencies.
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The Strength of Masticatory Muscle Affects Tongue Pressure

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Purpose: Tongue movement is coordinated with jaw movement in mastication. Many researchers reported that tongue pressure (TP) declines with aging. However, other factors affecting the decline of tongue strength throughout a life span is still unknown. In this study, we investigated interaction of the strength of masticatory muscle and tongue pressure.
Method(s): 781 healthy subjects (men: 148, women: 633, aged 20s to 80s) were enrolled in this study. Hand grip strength (HGS), body mass index (BMI) and TP were measured. Regarding with masticatory muscle strength, occlusal force (OF) as strength of jaw closing muscle and jaw opening force (JOF) as that of jaw opening muscle were measured also. The subjects were divided into two groups (the adult group: aged 20–50s, mean age: 37.3 ± 10.7, n = 289, the elderly group: aged 60–80s, mean age: 70.6 ± 5.4, n = 492). To investigate which variables were significant independent variables on TP, a multivariate linear regression analysis was carried out in each group.
Result(s): In the adult group, HGS, OF, BMI and age were significant variables on TP, while in the elderly group, age and JOF were significant variables.
Conclusions (Including Clinical Relevance): Our results revealed that low OF affects the decline of TP in the ages prior to the elderly stage. On the other hand, JOF was a significant variable on TP in the elderly. It suggests decreased JOF might contribute to declining TP in elderly. We conclude that each of masticatory muscle strength affect TP, but it depends on age. The exercise for not only tongue muscle but also each of masticatory muscle might contribute to maintain TP in aging.
Relevant Financial Relationships: Koji Hara: Nothing to Disclose | Haruka Tohara: Nothing to Disclose | Kenichiro Kobayahi: Nothing to Disclose | Ayako Nakane: Nothing to Disclose | Kohei Yamaguchi: Nothing to Disclose | Kanako Yoshimi: Nothing to Disclose | Shunsuke Minakuchi: Nothing to Disclose.
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Possible Mechanisms of Swallowing Initiation Evoked by Mechanical and Chemical Stimulation in Anesthetized Rats

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Purpose: Capsaicin, an irritant component, is reported to facilitate swallowing initiation in mammals. However, precise mechanisms of swallowing initiation evoked by activation of capsaicin-sensitive nerves remain unclear. The aim of the present study was to investigate how the capsaicin-sensitive laryngeal nerves affected swallowing initiation evoked by mechanical and chemical stimulation.
Method(s): Experiments were carried out on urethane-anesthetized Sprague–Dawley rats. Swallowing reflex was identified by the electromyographic burst of suprahyoid and thyrohyoid muscles. Effect of topical application of capsaicin with QX-314 (QX-314/capsaicin) to the vocal folds on the following swallows evoked by capsaicin, carbonated water (CW), distilled water (DW) and von Frey mechanical stimulation was evaluated at 5 min. Effect of topical application of TRP channel blockers and ASIC channel blockers on initiation of capsaicin and CW-evoked swallows was also examined.
Result(s): The blockade of laryngeal capsaicin-sensitive nerves by application of QX-314/capsaicin strongly inhibited both capsaicin and CW-evoked swallows. This was not the case of those evoked by DW and mechanical stimulation. CW-evoked swallows were significantly inhibited following application of ASICs blockers (diminazene and amiloride) while it was not influenced by application of TRP channels blocker (Ruthenium red).
Conclusions (Including Clinical Relevance): We speculate that ASIC receptors expressed in capsaicin sensitive nerves is involved in the initiation of swallows evoked by CW application to the larynx.
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Effect of Effortful Swallow on Pharyngeal Cavity Volume with 10 ml Honey-Thick Boluses: Kinematic Analysis Using 3D Dynamic Computed Tomography

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Purpose: In our previous study, longer duration of minimum pharyngeal volume during effortful swallow (EF) of 4 ml nectar-thick boluses (460 mPA) suggested increased pharyngeal contraction. However, contrary to previous MRI studies, we did not find pre-

swallow reduction of pharyngeal cavity volume. This study examined the effect of EF on pharyngeal cavity volume with a larger, honey-thick bolus using 320-row area detector CT (ADCT).
Method(s): 6 healthy volunteers (22-34y) swallowed 10 ml honey-thick boluses (1700 mPa) with EF and with no maneuvers (control swallow) under ADCT. Upper and lower volumes (bordered by valleculae) of the pharyngeal air column and the bolus were measured at every frame. Upper and lower volumes at the onset of anterosuperior hyoid movement and the volume integral (sum of volumes 0.5 s before onset) of air and bolus were compared between EF and control swallows.
Result(s): During EF, the upper air volume at hyoid onset was significantly smaller (EF = 8.4 ± 4.9 $cm^{3,}$ control 12.1 ± 4.4 cm^3, $p < 0.028$), and the air volume integral tended to be smaller (EF = 49.1 ± 17.9 cm^3, control 60.0 ± 20.4 cm^3, p = 0.08). Meanwhile, pharyngeal air volume was similar between the two swallows. Pharyngeal bolus volumes did not differ before the swallow, but tended to peak earlier during EF than control swallows.
Conclusions (Including Clinical Relevance): During EF, reduced upper pharyngeal air volume and earlier bolus volume peak may enhance pharyngeal contraction. The lack of reduced pharyngeal volume in smaller and less viscous boluses suggests that a larger and more viscous bolus may be more effective during EF to strengthen pharyngeal contraction.
Relevant Financial Relationships: Yoko Inamoto: Nothing to Disclose | Eiichi Saitoh: Nothing to Disclose | Yuriko Itoh: Nothing to Disclose | Yoichiro Aoyagi: Nothing to Disclose | Seiko Shibata: Nothing to Disclose | Hitoshi Kagaya: Nothing to Disclose | Naoko Fujii: Nothing to Disclose | Rachel Mulheren: Nothing to Disclose | Jeffrey Palmer: Nothing to Disclose.
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Aspiration Pneumonia Rates Before and After Implementation of a 3-Ounce Water Screening Protocol at a Tertiary Care Cancer Hospital

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Purpose: A 3 oz water screening is a validated means of detecting aspiration risk. The aims of this study included: to determine if implementation of such a protocol reduced the rate of aspiration pneumonia in an acute care oncology hospital, and to describe the population who developed hospital-acquired aspiration pneumonia.
Method(s): A single-institution cohort study of patients admitted to a comprehensive cancer center over a 3-year period included adult patients with a diagnosis of "aspiration pneumonitis due to inhalation of food/vomit," not present on admission. Screening compliance, patient-specific demographics, and medical data were also collected.
Result(s): Prior to the intervention, the frequency of aspiration was .68% annually (68 pneumonias in 10,048 unique patients admitted over a 2-year period). Following implementation of the screening protocol, the frequency of aspiration pneumonia was .82% (43 patients out of 5266 patient admissions per year) (p-value = .336). Metastatic disease represented the most frequently associated diagnosis (50% of patients), followed by gastroesophageal reflux (30%), gastrointestinal obstruction (27%), palliative care encounter (25%), and dysphagia (25%). During the intervention period, nursing compliance with use of the screening tool was > 80%.
Conclusions (Including Clinical Relevance): Aspiration pneumonia in hospitalized cancer patients is rare. Aspiration pneumonia rates did not decrease following implementation of a 3 oz water protocol. Patients who were extremely ill and/or had GI-related conditions represented the largest proportion of patients who developed aspiration pneumonia in this setting.
Relevant Financial Relationships: Barbara Ebersole: Nothing to Disclose | Miriam Lango: Nothing to Disclose | Sarah Clark: Nothing to Disclose | Nausheen Jamal: Nothing to Disclose.
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Types of Brain Injury and Degree of Dysphagia in Children with Cerebral Palsy

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Purpose: To evaluate brain magnetic resonance imaging (MRI) in children with cerebral palsy (CP) and dysphagia.
Method(s): Brain MRIs were evaluated in 20 CP children aged from 9 months to 16 years with swallowing impairment detected by videofluoroscopy. Two patients were classified as Gross Motor Function Classification System (GMFCS) level III, 5 patients as level IV, and 13 as level V. According with DOSS, 9 patients were level I (severe), 1 patient was level II, 3 level III, 3 level IV and 4 level V (mild).
Result(s): MRI showed multicystic encephalomalacia (15%), leukomalacia (25%), anoxia typical of a full-term newborn (35%), and others (25%) (anoxia with severe brain atrophy, microcephaly and sequelae of kernicterus). Severe dysphagia as associated with neurological lesions characteristic of multicystic encephalomalacia (100% of patients). Among patients with leukomalacia or anoxia typical of a full-term newborn, 50.0% had severe dysphagia and 41.6% mild dysphagia.
Conclusions (Including Clinical Relevance): Severe dysphagia was related to multicystic encephalomalacia, and our results show the importance of early assessment of swallowing together with early medical diagnosis in these patients.We also highlight the importance of evaluating swallowing in the other types of lesions associated with mild/severe dysphagia.

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Videofluorographic Characteristics of Pharyngeal Stage of Swallowing Function in Very Elderly People

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Purpose: The purpose of this study is to clarify the fluorographic characteristics of pharyngeal swallowing function in Presbyphagia by comparing non-elderly and very-elderly people without dysphagia.
Method(s): The subjects were underwent videofluoroscopic swallowing study (VFSS) at our hospital due to suspected dysphagia in past 8 years, resulted in no obvious dysphagia or no aspiration. They were classified into two groups according age: the non-elderly group (34–64, median 44 years of age, n = 20), very elderly group (76–101, median 86 years of age, n = 36). VFSS videos (recorded at 30 frames per second) were analyzed frame-by-frame to quantify three times swallows (3 ml of bolus) of each subject. ImageJ was used to measure the distance on the fluorographic image. We compared pharyngeal delay time (PDT), laryngeal elevation delay time (LEDT), duration of base of tongue and posterior pharyngeal wall (BOT-PPW) contact, duration of upper esophageal sphincter (UES) opening, distance of laryngeal movement, and distance of UES opening (lateral view).
Result(s): Compared to non-elderly group, very elderly group had significantly delayed PDT ($p < 0.05$), prolonged duration of UES opening (0.42 ± 0.09 vs. 0.48 ± 0.10 s, $p < 0.05$), and increased distance of UES opening (6.9 ± 2.2 vs. 7.8 ± 1.9 mm, $p < 0.05$).
Conclusions (Including Clinical Relevance): In presbyphagia, reduced swallowing function with age is compensated. The delay of initiation of pharyngeal swallow may be compensated by the increase in the UES opening distance and the extension of the UES opening time.
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Correlations Among Upper Esophageal Sphincter Post-swallow and Pharyngeal Pressures in Healthy and Dysphagic Subjects

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Purpose: Manometric post-swallow pressures represent muscular contraction and caudal movement of the upper esophageal sphincter (UES) returning to its rest position. Little is understood about how these high-amplitude pressures relate to the pharynx. This study examined relationships among pharyngeal and UES post-swallow pressures generated during swallowing tasks in healthy and dysphagic subjects.
Method(s): High-resolution manometry data were extracted for 63 adult patients with dysphagia (mean age 66 ± 15 years) from the UW Madison Voice & Swallow Outcomes database. Age- and sex-matched healthy controls were also evaluated for comparison. For 10 ml swallow tasks, correlations were calculated among maximum nasopharyngeal, tongue base region, and UES post-swallow pressures in both the healthy and dysphagic groups.
Result(s): Post-swallow pressures were positively correlated with both nasopharyngeal ($r = 0.525$, $p < 0.001$) and tongue base regions ($r = 0.415$, $p = 0.001$) in healthy subjects. Nasopharyngeal and tongue base region pressures showed a significant correlation in both healthy ($r = 0.406$, $p = 0.001$) and dysphagic ($r = 0.377$, $p = 0.002$) subjects. In contrast, post swallow pressures generated in patients with dysphagia showed no significant correlation with nasopharyngeal or tongue base region pressures ($p > 0.05$).
Conclusions (Including Clinical Relevance): Pharyngeal and UES post-swallow pressures are correlated in healthy subjects. However, the loss of this relationship in patients with dysphagia indicates that UES post-swallow pressures may be influenced by factors independent of pharyngeal contractile force and bolus-related sensory feedback.
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Analysis of Objective Swallowing Measures to Distinguish Safe and Unsafe Swallowing After Stroke

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Purpose: Modified diets are the most commonly prescribed treatments to avoid pneumonia because they can prevent ingested material from entering the larynx (penetration) or the trachea (aspiration). However, it is unknown whether modified diets that reduce aspiration also modify swallowing airway protection kinematics. This is significant because it is unclear whether modified diets are simply (a) compensatory by facilitating existing impaired swallowing airway protection or (b) rehabilitative by modifying and improving swallowing airway protection. To address this unknown, we compared laryngeal vestibule closure kinematics between safe and unsafe swallows (with different bolus types) among individuals with post-stroke dysphagia.
Method(s): 11 patients with post-stroke dysphagia swallowed barium of various thicknesses, volumes, and modes of delivery to identify a

bolus that was swallowed safely and a different bolus type that was swallowed unsafely (aspiration or penetration to the vocal folds). Videofluoroscopy was used to image, record, and analyze swallowing kinematics. Swallowing kinematics included the reaction time and duration of laryngeal vestibule closure.
Result(s): The timing of swallowing airway protection is not different between safe and unsafe swallows ($p < 0.523$).
Conclusions (Including Clinical Relevance): While potentially helpful for preventing aspiration, diet modifications likely offer little to no physiological rehabilitation, because they do not modulate swallowing airway protection kinematics.
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Chinese Version of the Toronto Bedside Swallowing Screening Test for Stroke patients

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Purpose: The purpose of this study is to establish the reliability and validity of the Chinese Version of the Toronto Bedside Swallowing Screening Test.
Method(s): After the Toronto Bedside Swallowing Screening Test was translated into Chinese using the back- translation method, the screening test was administered to a total of 87 stroke survivors ranging in age from 46 to 74 in a variety of acute and rehabilitative settings in 2 hospitals. Afterward, the screening test data were used to assess the validity and reliability of the test according to criterion validity, interrater reliability and test-retest reliability. Criterion validity was assessed via the gold standard of videofluoroscopic assessment of swallowing by a radiologist.
Result(s): The test of criterion validity demonstrated sensitivity at 88.24%, specificity at 88.89% and negative predictive values at 93.75%. The kappa coefficient of interrater reliability was determined to be 0.78, and the kappa coefficient of test-retest reliability was 0.71.
Conclusions (Including Clinical Relevance): This study highlights the Chinese version of the Toronto Bedside Swallowing Screening Test as a simple, accurate and evidence-based tool to identify stroke patients at risk of dysphagia, suitable for use by Taiwanese nurses. Hospitals should explore the feasibility of introducing this test for use with all acute stroke patients upon admission.
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Nutritional Status of Patients with Cerebral Palsy and Dysphagia After the Implementation of the International Dysphagia Diet Standardization Initiative's (IDDSI) Modified Diets

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Purpose: To assess the nutritional status of patients with cerebral palsy and dysphagia in a home for the aged after the implementation of texture-modified foods proposed by the IDDSI.
Method(s): Fifty-six adults aged between 25 and 71 years participated in the study. Swallowing and nutritional status were assessed at two time points: December 2015 and December 2016. Nutritional status was evaluated by body mass index and classified according to the WHO recommendations for adults, and to Lipschitz for the elderly. The Dysphagia Risk Evaluation Protocol was used for assessment of swallowing, and functional level of oral intake was assessed using the FOIS. Statistical analysis was performed by the McNemar test.
Result(s): There were no significant changes in the degree of dysphagia ($p = 0.70$) or in the FOIS (0.08). However, the number of patients classified as level VII decreased from 12 in 2015 to 5 in 2016, and the number of patients at level IV increased from 3 in 2015 to 12 in 2016. Also, after implementation of the IDDSI system in 2016, no significant changes were detected in patients' nutritional status (0.22). Nevertheless, of patients receiving food at correct consistency, 17 (30.4%) and 11 (19.6%) were underweight in 2015 and 2016, respectively, whereas 26 (46.4%) and 32 (57.1%) of these patients were normal weight in 2015 and 2016, respectively.
Conclusions (Including Clinical Relevance): Although there were no significant changes in patients' nutritional status during the study period, there was evidence of improvement. A longer follow-up may be needed to make the results more clear.
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Validation of the Normalized Laryngeal Constriction Ratio in Normal and Disordered Swallowing

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Purpose: The timing of laryngeal vestibule closure (LVC) is important for airway protection during swallowing. However, it is unknown whether the amount of closure impacts airway protection. The goal of this study is to validate the amount of LVC via a measure called laryngeal constriction ratio (LCR).
Method(s): A retrospective analysis of videofluoroscopic swallows was conducted on 10 stroke participants and 10 healthy controls. The LCR was calculated by deriving a size-normalized area of airspace from a (1) maximum closed laryngeal vestibule and a (2) maximum open laryngeal airspace (at rest). Swallowing severity was derived via the Penetration-Aspiration scale score.
Result(s): 226 videofluoroscopic swallows were analyzed. A mixed model analysis revealed a statistically significant mean difference between the normalized laryngeal constriction ratios of healthy individuals (M = 0.005) versus dysphagic patients ($p < 0.000$)), quantifying less closure in patients. Additionally, swallows with airway compromise had a statistically worse LCR when compared to swallows without airway compromise ($p < 0.000$).
Conclusions (Including Clinical Relevance): The normalized LCR might be a valid measure of amount of LVC and, furthermore, airway compromise during swallowing. By investigating spatial measurements during safe and unsafe swallows, objective measurements can be made to allow for critical examination of the physiology in order to precisely detect and treat abnormalities in the swallowing mechanism.
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Association Between Laryngeal Sensation, Pre-swallow Secretions and Pharyngeal Residue on Fiberoptic Endoscopic Examination of Swallowing

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Purpose: Reduced laryngeal sensation and accumulated pharyngeal secretions are known predictors of aspiration. Yet, their association with residue has not been fully explored.
Method(s): 110 Fiberoptic Endoscopic Examinations of Swallowing (FEES) were analyzed. Murray's Secretion Scale (MSS) for secretion stasis and laryngeal sensation were tested for association with residue severity (Yale Pharyngeal Residue Severity Rating Scale, YPR-SRS) and the number of swallows required to clear the bolus. The worst bolus challenge for each consistency (liquid, purée and solid) was analyzed.
Result(s): Reduced laryngeal sensation was significantly associated with higher YPRSRS for all consistencies examined and for both vallecular and pyriform sinuses residue. P-values (liquid/purée/solid) for vallecular residue 0.026/0.001/0.028, and 0.0001/0.0001/0.001 for pyriform sinuses. Similarly, MSS was significantly associated with higher YPRSRS for all consistencies examined and for both vallecular and pyriform sinuses residue. P-values (liquid/purée/solid) for vallecular residue 0.044/0.002/0.016, and 0.03/0.05/0.022 for pyriform sinuses. For all consistencies examined, both reduced laryngeal sensation and MSS were significantly associated with increased number of swallows required to clear a bolus. P-values for normal vs. reduced laryngeal sensation (liquid/purée/solid) p = 0.0001/0.0001/0.042, and for MSS ≤ 1 vs. MSS > 1 p = 0.001/0.0001/0.049.
Conclusions (Including Clinical Relevance): Reduced laryngeal sensation and secretion stasis are associated with pharyngeal residue severity and reduced residue clearing on FEES.
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Tongue Strength in Parkinson's Disease (PD) Compared to Atypical Parkinsonism (AP)

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Purpose: Motor disorders in PD are caused by hypokinesia and rigidity rather than muscle weakness, in AP however strength may be decreased. This hypothesis was studied for tongue strength (TS) in people with PD and AP.
Method(s): We used the Iowa Oral Performance Instrument (IOPI) to assess TS in 46 community-dwelling people with PD (27 men) and 15 with AP (13 men). Anterior and posterior maximum isometric pressure MIP_A, MIP_P (kiloPascal) and endurance Endu_A, Endu_P (seconds) were measured following the protocol used to collect normal values in Belgium [Vanderwegen, Dysphagia 2013: 159-166]. In addition age, disease duration and Hoehn & Yahr stage were collected, as well as maximum swallowing speed (MSS, ml/s).
Result(s): Age was similar: PD 71 y (SD 7.3) vs. AP 75 year (SD 7.0). The mean TS values for AP vs. PD vs. controls were for MIP_A: 46.1, 42.6 and 38.6 kPa, p = .04; for MIP_P: 39.1, 37.4 and 36.6 kPA, p = .78; for Endu_A: 10.4, 15.8 and 25.1 s., p = .00; for Endu_P: 8.9, 11.21 and 16.5 s., p = .01. In the PD group TS and endurance were stable across age, disease duration and H& Y stage, but in the AP group TS decreased with H& Y stage (p = .03) and endurance with age (p = .02). Correlations with MSS were moderate for MIP_A in PD (r = .33) and strong for Endu_A and Endu_P in AP (r = .80/.68). Additionally, in PD MSS was significantly dependent from higher age and H& Y stage (p = .02) and in AP from H& Y stage (p = .02).
Conclusions (Including Clinical Relevance): TS appears equal or even higher in people with PD or AP when compared with age-matched controls, but endurance is lower. Clinical implications of TS in PD or AP are still unclear.
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Effects of Superior Laryngeal Nerve Lesion on the Timing Relationship Between Suck and Pharyngeal Swallow in an Infant Mammal Model

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Purpose: Pediatric patients with a delayed pharyngeal swallow tend to aspirate more often compared with patients of similar age without a delay in the swallow. Work in animals shows that stimulation of the superior laryngeal nerve (SLN) initiates a swallow, and an injury to this nerve results in un-safe swallows. We hypothesized that after surgical transection of the superior laryngeal nerve, the pharyngeal swallow will be delayed relative to the suck cycle.
Method(s): Therefore, we measured the timing of suck and swallow from the EMG signals of mylohyoid and thyrohyoid 48 swallows in 3 pre-weaning infant pigs, each serving as its own control, pre- and post-SLN lesion.
Result(s): During the suck in which the swallow occurs, we found no significant difference in suck-swallow timing between control and lesion. However, the amount of variation changed significantly post-lesion. The standard deviation of mylohyoid minus thyrohyoid contraction time was $\geq$ 53 ms pre-lesion, but was $\leq$ 34 ms after lesion. Furthermore, inter-individual variation was large, with each subject having very different timing, with almost no overlap among animals.
Conclusions (Including Clinical Relevance): This suggests that some of the variation in suck-swallow timing is a result of adjustments or fine-tuning that in turn results from the sensory feedback from the superior laryngeal nerve. When this sensory field is eliminated on one side, the suck-swallow timing becomes much more stereotyped, but in different ways among subjects. We will follow-up by determining if particular timing patterns after lesion are more correlated with increased penetration/aspiration.
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An Examination of Lingual Physiologic Reserve in Individuals with ALS

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Purpose:

(1) Profile lingual strength and physiologic reserve in individuals with ALS.
(2) Examine relationships between lingual reserve and (a) swallowing safety and (b) swallowing efficiency.
(3) Compare lingual strength and physiologic reserve profiles in safe versus unsafe swallowers.

Method(s): 51 individuals (26 male, mean age = 63) with a diagnosis of ALS participated. Individuals completed a standardized videofluoroscopic examination of swallowing and lingual pressure testing using the Iowa Oral Performance Instrument. Swallowing safety was analyzed using the Penetration Aspiration Scale and swallowing efficiency using the Dynamic Imaging Grade of Swallowing Toxicity E subscale. Descriptive statistics, t-tests and Spearman rho correlation analyses were generated to analyze the data.
Result(s): Mean maximum anterior lingual pressure (MAP) was 36 kPa (SD = 15.50), representing a 40% reduction in strength compared to established normative MAP data. Lingual Reserve (MAP—saliva swallow pressure) was 15 kPa representing a 67% reduction to norms. Negative correlations were noted between lingual reserve and a) swallowing efficiency ($r_s = -0.371, p < .05$) and swallowing safety ($r_s = -0.500$, $p < .05$). Unsafe swallowers demonstrated lower MAP's (25.1 ± 12.3 vs. 43.1 ± 12.2) and lingual reserve (7.38 ± 6.8 vs. 18.43 ± 11.8) than safe ALS swallowers.
Conclusions (Including Clinical Relevance): Reduced lingual strength and functional reserve were noted in this group of ALS patients and may provide a physiologic foundation for impairments in swallowing safety and efficiency. Further work is needed to validate these findings.
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Intralingual Cholera Toxin B-Saporin (CTB-SAP) Injections Mimic Aspects of Amyotrophic Lateral Sclerosis (ALS) Related to Dysphagia

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Purpose: ALS is a devastating neurodegenerative disease that results in dysphagia due to weakness of the tongue and other cranial muscles. We propose that swallowing function may be preserved in ALS by enhancing neuroplasticity, particularly in the hypoglossal (XII) motor nucleus that innervates the tongue. One spontaneous mechanism that we hypothesize enhances plasticity in ALS is motor neuron death. However, it is difficult to study XII plasticity in ALS models because the amount and rate at which motor neuron death occurs cannot be controlled, and degeneration is not limited to XII. Thus, we have developed a novel and inducible model of XII motor neuron death that mimics the behavioral phenotype of dysphagia observed in ALS models.

Method(s): Sprague–Dawley adult male rats received intralingual injections of conjugated CTB-SAP (25 μg; n = 11) or un-conjugated CTB-SAP (control; n = 11) into the genioglossal muscle. Swallowing function was assessed via videofluoroscopic swallow study (VFSS) at baseline and 8 days post-injection. At the study end-point (9 days post-injection), in vivo neurophysiology and immunohistochemistry assays were conducted for correlation with VFSS findings.
Result(s): Compared to controls, treated rats exhibited significant ($p < 0.05$) deficits in lick and swallow rates, XII motor output, and XII motor neuron survival.
Conclusions (Including Clinical Relevance): This novel model will allow us to study mechanisms that induce XII plasticity to preserve swallowing function. Our results will guide future translational studies in patients with ALS and other neurodegenerative diseases that result in dysphagia.
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Potential Factors That Influence the Echo Intensity of Masseter Muscle

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Purpose: Ultrasonography is safe, inexpensive, and allowed to use by several medical staff. And, not only muscle quantity but also muscle quality as echo intensity (EI) can be assessed by ultrasonography. Previous studies have reported the relationship between EI of limb muscle, muscle strength, and physical fitness. EI of sarcopenia's limb muscle were significantly higher than robust elderly. However when it comes to EI of perioral muscle, there were no reports about the relationship between EI and whole body skeletal muscle and oral condition in healthy subjects. Therefore, the aim of this research is to investigate the relationship between EI of masseter muscle and the other factors.
Method(s): Sex, age, tooth loss, EI of masseter muscle, masseter muscle thickness (MMT), skeletal muscle mass (SMI), grip strength, occlusal force, lean body mass, body mass index (BMI), arm circumference (AC), calf circumference (CC) were obtained in healthy community dwelling subjects $\geq$ 60 years (men: n = 71, women: n = 87). These data were analyzed to determine influential factor on EI of masseter muscle by multiple regression analysis both men and women.
Result(s): In outcome of the analysis, independent variable were grip strength, MMT both men and women. In addition to these results, EI of masseter muscle were related to both BMI and AC in men, in women, to age.
Conclusions (Including Clinical Relevance): The research showed the relationship between EI of masseter muscle and grip strength, MMT both men and women, especially in men, found association between EI and nutrition status.
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Asymmetrical Velopharyngeal Pressures During Swallowing and Phonation Tasks Evaluated Using Three-Dimensional High-Resolution Manometry

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Purpose: Velopharyngeal pressure evaluation using high-resolution manometry (HRM) can provide insight about nasopharyngeal closure competency and rostral pharyngeal activity during swallowing and non-swallowing tasks. However, standard HRM fails to adequately describe potential physiological asymmetry. We hypothesized that use of 3D-HRM would describe circumferential directional differences in velopharyngeal pressure generation during swallowing and phonation tasks in young healthy adults.
Method(s): Circumferential velopharyngeal pressures were assessed during swallowing and sustained phonation of the vowel/i/in eight healthy individuals using 3D-HRM. Repeated measures ANOVA was used to compare directional differences in maximum regional pressures between the two tasks.
Result(s): Significant main effects of task ($p < 0.01$) and circumferential direction ($p = 0.01$) on pressure were observed. Higher velopharyngeal pressures were produced during swallowing compared to phonation. Pressures were predominantly generated from the anterior direction in both tasks ($p < 0.05$), with more noticeable circumferential asymmetry observed during phonation.
Conclusions (Including Clinical Relevance): This study confirms velopharyngeal valving pressures are asymmetrically generated, with a distinctive regional pressure pattern resulting from significant anterior palatal activity. Evaluation of pressurization using 3D-HRM also exposes subtle task-dependent disparities in muscle group recruitment to achieve velopharyngeal port closure. Improvement in the understanding of pressure derivation may lead to improved evaluation of velopharyngeal dysfunction.
Relevant Financial Relationships: Sarah Rosen: Has affiliations to disclose; NIH: Grant: Employment | Corinne Jones: Has affiliations to disclose; NIH: Grant: Employment | Timothy McCulloch: Has affiliations to disclose; NIH: Grant: Employment.
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Changes in Swallowing Mechanics Before and After Lung Transplantation

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Purpose: Oropharyngeal swallowing impairments can follow lung transplantation, thereby increasing post-operative complications and mortality. However, prior research has failed to reveal the mechanism of dysphagia in this population. The aim of this study was to identify the differences in swallow function in patients before and after lung transplantation.
Method(s): A retrospective review of 15 consecutive lung transplant (LT) patients who underwent pre- and post-operative videofluoroscopic swallow studies was conducted. Age-matched healthy adult controls were included. Bolus flow, kinematic timing, and penetration-aspiration scale analyses were performed for all swallows. Mixed model ANOVAs were performed with post hoc analysis of compared group and pre- and post-op group differences.
Result(s): Healthy controls (382 ms) have longer laryngeal vestibule closure durations than LT patients (338 ms) ($p = .012$). Laryngeal vestibule closure reaction time for LT patients was longer after surgery (348.11 ms) than before surgery (288.42 ms) ($p = 0.47$). All 15 LT patients demonstrated safe swallows pre-operatively (PAS 1-2), while 2 demonstrated laryngeal penetration (PAS 3) and 2 demonstrated silent aspiration (PAS 8) post-operatively.
Conclusions (Including Clinical Relevance): LT patients demonstrated less preferred airway protection timing measures, albeit in the absence of aberrant bolus flow, when compared to healthy controls as well as when compared pre- and post-operatively. Further studies are needed to understand the relationship between kinematics and penetration-aspiration frequency in this extremely immunocompromised population.
Relevant Financial Relationships: Michele Singer: Nothing to Disclose | Margaret Fynes: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.
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Relationship Between Aspiration and Impaired Cough Reflex in Parkinsonian Syndrome

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Purpose: This study aimed to predict the risk of aspiration in patients with parkinsonian syndrome from their cough test.
Method(s): Of the patients with parkinsonism admitted to our hospital during the May 2012 to April 2016 period, 347 who were able to orally ingest daily food and gave informed consent were investigated. The patients consisted of 189 with Parkinson's disease without dementia (PD), 63 with Lewy body dementia (LBD), 55 with progressive supranuclear palsy (PSP), and 41 with multiple system atrophy (MSA). Videofluoroscopic examination of swallowing was performed on all of the patients. In addition, a cough test was performed on all of the patients. In this test, the patients were asked to inhale a mist of 1% citric acid in physiological saline, and if they did not cough within 30 s of inhalation, then, an impaired cough reflex was judged to be present. The frequencies of aspiration and impaired cough reflex, and their relationships were investigated.
Result(s): The frequency of aspiration was as follows: PD, 10%; LBD, 30%; PSP, 20%; and MSA, 15%. The frequency of impaired cough reflex was as follows: PD, 23%; LBD, 56%; PSP, 21%; and MSA, 37%. The frequencies of both aspiration and impaired cough reflex differed among diseases ($p < 0.01, < 0.01$). By the cough test, aspiration could be diagnosed with statistical significance only in patients with PD (sensitivity, 50%; specificity, 80%; Chi square test, $p < 0.01$).
Conclusions (Including Clinical Relevance): In parkinsonian syndrome, the frequencies of aspiration and impaired cough reflex differed among diseases. In PD, the cough test was useful for the screening of aspiration.
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Significance of Body Adiposity in Dysphagic Infants in the NICU: A Pilot Study

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Purpose: Convalescing NICU infants are often fed via gavage routes, owing to aero-digestive illness and delays in adaptation. Current nutritional practices in NICU are guided by weight gain trends, and may be associated with altered %body fat (PBF) and lower lean body mass (LBM). Desire to take orally is related to hunger, swallowing, and satiety. Objective: To determine the association between body adiposity and infant dysphagia.
Method(s): Prospective longitudinal observational study. Body composition was determined by air displacement plethysmography. In infant's $\geq$ 38 week post-menstrual age (PMA), body composition of infants on oral/tube-fed (dysphagic), were compared to infants on full oral fed (controls).
Result(s): Data from 30 infants were examined; 6 were dysphagic, and the rest 24 were oral-fed (controls). PMA and weight at the time of study in dysphagic infants and controls were 41.2 ± 1.7 and 40.4 ± 1.5 week, and 4044 ± 1332 and 3221 ± 499 g, respectively ($p > 0.05$). The enteral feeding volume, nutrient intake (calorie, protein), and duration of parenteral nutrition were similar in both groups. Dysphagic infants had significantly higher PBF (20.2 ± 6.9 vs. 11.7 ± 6.1, $p = 0.029$) and lower LBM (79.9 ± 6.9 vs. 88.1 ± 6.2, $p = 0.032$), compared to controls. 50% of dysphagic infants required G-tube at NICU discharge.
Conclusions (Including Clinical Relevance): These pilot data suggest that higher body adiposity is linked with infant dysphagia, and may be an important predictor of oral feeding success in infants. We speculate that higher adiposity may be associated with higher leptin (satiety hormone) levels and therefore, early satiety, reduced hunger, and swallowing.
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The Relationship Between Neck Circumference and Swallowing Function in the Elderly with Dysphagia

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Purpose: Recent studies have shown that aging is associated with degenerative loss of muscle mass including muscles associated with swallowing. We studied whether neck circumference (NC) measurements can be used as a simple evaluation method to assess swallowing function.
Method(s): Data were collected from subjects with chronic dysphagia. The subjects were 127 adults (64 male and 63 female) aged 65 years or older (mean age 80.7 $\pm$ 8.7) whose swallowing function had been evaluated prior to this study. NC was measured on both above (superior NC) and below (inferior NC) the thyroid cartilage. The subjects were underwent video-endoscopically for pharyngeal residues and aspiration. A receiver operating characteristic (ROC) curve was created, and sensitivity and specificity values were calculated at the determined optimal cut-off points.
Result(s): The mean values for male superior NC, female superior NC, male inferior NC and female inferior NC were 36.5, 33.5, 36.3 and 33.3 respectively. Significant differences between male and female subjects were seen in both measurements ($p < 0.05$). For the pharyngeal residue analysis, we report a specificity value of 0.71 for female superior NC values. For the aspiration analysis, we report a specificity value of over 0.7 for male and female NC values, and a sensitivity value of over 0.7 in female NC values.
Conclusions (Including Clinical Relevance): The results of this study suggest that NC measurements may be useful to screen aspiration patients, and superior NC may be a better detector of dysphagia compared to inferior NC.
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Transition of Symptoms and Functions of Swallowing Related to Irradiation for Oropharyngeal and Hypopharyngeal Cancer

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Purpose: Our purposes were to clarify the transition of subjective symptoms and objective functions on swallowing related to (chemo)radio therapy for head and neck cancer, and to explore the causes of eating disorder.
Method(s): We retrospectively identified 44 oropharyngeal and hypopharyngeal cancer patients who had received definitive irradiation between October 1, 2013 and December 31, 2016. The patients received questionnaires and examinations about feeding and swallowing at six points: before irradiation, during irradiation (40 Gy), just after irradiation, after 1, 3, and 5 months after irradiation. The questionnaires included FOIS (Functional Oral Intake Scale), EAT-10 (Eating Assessment Tool-10), CTCAE grade of dryness and dysgeusia. The examination included PAS (Penetration Aspiration) scale AsR score on videofluoroscopy.
Result(s): There was significant decrease during irradiation and insufficient recovery after irradiation in FOIS score. Similarly, EAT-10 and dysgeusia grade got worsen during irradiation and recovered insufficiently after irradiation. Dryness grade got worsen during irradiation and didn't recover. Conversely, PAS scale and AsR score had little changes during irradiation but returned to the original state after the irradiation.
Conclusions (Including Clinical Relevance): After irradiation PAS scale and AsR score were not different from the state before the treatment, although subjective symptoms significantly got worsen. These results suggest eating disorder related to irradiation is not mainly derived from dysphagia in narrow sense but greatly affected by subjective symptoms such as dryness, dysgeusia, and mental status.
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The New Aspiration Prevention Surgical Method; Modified Central-Part Laryngectomy that Preserve the Posterior Plate of Cricoid Cartilage Makes Broad Pharynx and Tracheostoma

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Purpose: We developed central-part laryngectomy (CPL) for uncontrollable aspiration in 2010. In CPL, medial thyroid cartilage, whole cricoid cartilage, glottis and the origin of cricopharyngeal muscle are removed. CPL can not only prevent aspiration, but also make pharynx wide to be favorable for eating. But its tracheostoma is similar to total laryngectomy, and stenosis was seen in about 20% of cases. To overcome this drawback, we modified the CPL.
Method(s): In modified central-part laryngectomy (mCPL), we preserve posterior plate of the cricoid cartilage and use it as part of the tracheostoma. The cricopharyngeal muscle is cut from the cricoid. The preserved part of cricoid is tilted forward and pulled upward with the skin under the chin. By these procedures, the tracheostoma is composed of cricoid and tracheal cartilages, and mechanically strengthened. Tilted and towed posterior plate of cricoid makes pharynx wider and the cut cricopharyngeal muscle makes cervical esophagus relaxed.
Result(s): We conducted mCPL on five patients with severe dysphagia. Before the surgery, all of them had a tracheotomy with a tracheal cannula because of saliva aspiration. After mCPL, all patients were relieved from pulmonary inflammation. Two were eating all meals, and the remain could enjoy meal by mouth. One used a tracheal cannula for positive pressure ventilation, but all patients had a wide tracheostoma with no need of a cannula.

Conclusions (Including Clinical Relevance): The mCPL can not only prevent the patients with severe dyphagia from aspiration, but also enable them to eat by mouth and be released from a tracheal cannula. And it can improve their QOL.
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Pharyngeal Versus Esophageal Stasis: Accuracy of Localization

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Purpose: Patients with complaints of bolus stasis after swallowing are often referred to a speech pathologist for swallowing evaluation. Previous research has shown that patients with esophageal obstruction are more likely to localize stasis proximal to an obstruction on EGD, however, this has not been studied in patients with oropharyngeal stasis complaints. The purpose of this study was to determine if the location of patients' complaints of bolus stasis were accurate to physiologic location.
Method(s): Prospective analysis was completed using the University of Wisconsin Voice & Swallow Outcomes Database of patients that complained of bolus stasis on their intake form and completed a standard of care combined videoflouroscopic swallow study (VFSS) and esophagram (n = 387). Fisher's exact test was used to compare location of statsis complaint with patient's accuracy of localization.
Result(s): Only 34% of patients accurately localized bolus stasis. Accuracy was increased in patients that complained of stasis in esophagus (79%) versus pharynx (17–33%) ($p < 0.0001$). Forty-one percent of patients with complaints of stasis in pharynx had stasis in the esophagus. No patients with complaints of esophageal stasis had pharyngeal stasis.
Conclusions (Including Clinical Relevance): Patients that complain of bolus stasis in the pharynx are less likely to accurately localize their stasis than those that complain of bolus stasis in the esophagus. This highlights the importance of comprehensive evaluation of the esophagus in patients that complain of pharyngeal stasis that are referred for VFSS.
Relevant Financial Relationships: Stevie Marvin: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment | Susan Thibeault: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment.
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The Biomechanics of Tongue Base Retraction: Evidence for a Hyolingual Hydraulic Linkage

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Purpose: Understanding the mechanism of tongue base retraction is essential to designing effective rehabilitation for dysphagic patients with pathological lingual function. We tested three hypotheses for the mechanism of retraction: (1) shortening of extrinsic tongue muscles, (2) hydrostatic deformation by shortening of intrinsic tongue muscles, and (3) hydraulic displacement of tongue volume by hyoid protraction and mouth floor elevation.
Method(s): We measured muscle length, hyolingual kinematics, and tongue volume from retraction onset through maximum retraction in 69 swallows by 3 macaques using X-ray Reconstruction of Moving Morphology and Fluoromicrometry.
Result(s): Posterior tongue retraction during hyoid protraction and mouth floor elevation is accompanied by limited shortening of styloglossus (mean 0.6 mm) and palatoglossus (0.05 mm). Hyoglossus shortening (4.9 mm) and tongue retraction (7.0 mm) are similar, but hyoglossus shortening is associated with hyoid elevation and protraction; therefore, it does not retract the tongue during swallowing. Posterior tongue volume increased by 61%, and in 2 subjects posterior tongue dimensions increased in all three directions.
Conclusions (Including Clinical Relevance): The results falsify the extrinsic muscle and hydrostatic deformation hypotheses and support a hydraulic mechanism of tongue retraction wherein the posterior tongue is displaced posteriorly by hyoid protraction and floor of mouth elevation decreasing the volume of the oral cavity. We hypothesize that rehabilitation programs for weak tongue base retraction that target the suprahyoid muscles will be more effective than those that do not.
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The Day-to-Day Variability of Clinical Dysphagia and Mealtime Duration in Self-feeding Children with Cerebral Palsy

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Purpose: To examine the day-to-day variability of clinical signs of dysphagia and mealtime durations in spastic CP (SCP).
Method(s): 13 children (8 M) with SCP (5; 10–17; 6 yoa) participated. Children were divided into unilateral (n = 6; GMFCS I-II, MACS I-III) and bilateral (n = 7; GMFCS III-IV, MACS I-IV) SCP groups. Feeding/swallowing was assessed during lunches on 15 consecutive days via the Dysphagia Disorder Survey (DDS). Duration measures collected on all days were: mealtime duration, and sip/bite duration. Within (i.e., day-to-day) and between children variability on all variables was examined using Intraclass Coefficients (ICCs).
Result(s): The unilateral group exhibited significantly less signs of dysphagia than the bilateral group ($p = 0.035$). Regarding DDS Scores, for the unilateral group, variability was relatively low and 60% of it was attributed to the day-to-day or within children variability (ICC: 0.60; CI 34–100%). For the bilateral group, DDS scores'

variability was greater, but only 20% was attributed to the day-to-day variability (ICC: 0.20; CI 10–44%). For duration measures variability was high for both groups. 75–85% of the variability in mealtime durations was attributed to day-to-day variability.

Conclusions (Including Clinical Relevance): Clinical severity of dysphagia varies substantially across days especially in children with bilateral SCP and more severe dysphagia. Day-to-day mealtime duration also varies for both groups. These results emphasize the need to account for variability when evaluating and treating swallowing in children with CP and have direct implications for practice.

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Cortical Adaptation to Changing Need for Airway Protection During Swallowing

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Purpose: Swallowing physiology may adapt to different head positions to maintain swallow safety. It is unclear if neural activity also demonstrates adaptive changes when swallowing in different head positions.

Method(s): We used functional near-infrared spectroscopy in 20 healthy participants to record event-related changes in blood oxygenation in the bilateral sensory (S1), motor (M1), and premotor cortex (PMC) during 5 ml water swallows in head neutral, down and up positions. Cortical activation patterns were compared for the first and last swallows in each head position in the regions of interest using repeated measures ANOVA. Adaptation within position was defined as the pattern of decreasing cortical activation as the participant adjusted to each head position over several swallows.

Result(s): Planned contrasts showed cortical activation was greater in the head up position compared to the neutral position in M1 ($p = .045$) and the PMC ($p = .03$). Less cortical adaptation within position was demonstrated in the head up compared to the neutral position ($p = .02$), although S1 and PMC demonstrated no adaptation regardless of head position ($p < .02$).

Conclusions (Including Clinical Relevance): Swallowing in head up position was associated with greater cortical activation compared to neutral, which possibly represents the increased need for laryngeal closure in this position. Cortical activation did not decrease over time as the participants habituated to swallowing with their heads up. Swallow training in this posture may facilitate sensorimotor adaptation of swallow physiology while promoting greater cortical activation even with repeated trials.

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Relationship Between Dysphagia, Nutritional Status and Functional Oral Intake in Patients with Cerebral Palsy in a Home for the Aged

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Purpose: To investigate the relationship between dysphagia, nutritional status and functional oral intake in patients with cerebral palsy in a home for the aged.

Method(s): Fifty-six adults aged between 25 and 71 years participated in the study. Three patients were classified as level III in the Gross Motor Function Classification System, 28 as level IV and 25 as level V.Nutritional status was evaluated by body mass indexand classified according to the World Health Organization recommendations for adults, and to Lipschitz for the elderly. The dysphagia risk evaluation protocol was used for clinical assessment of swallowing, and the Functional Oral Intake Scale (FOIS) for the assessment of functional oral intake. Statistical analysis was performed by the Fisher's exact test.

Result(s): Ten patients had normal/functional swallowing, 29 mild-to-moderate dysphagia, 155 had moderate-to-severe dysphagia, and 2 had severe dysphagia. Seventeen patients were underweight, 26 normal weight, 6 overweight and 7 were obese. With respect to functional oral intake, 3 patients were at level IV, 33 at level V, 8 at level VI and 12 at level VII. Nutritionalstatus was related to dysphagia ($p = 0.03$); 88.2% of underweight patients had mildly to severely impaired swallowing. Functional level of oral intake was associated with nutritional status ($p < 0.01$). Ninety-four percent of underweight patients had some texture-related dietary restriction or required a specially prepared diet.

Conclusions (Including Clinical Relevance): Dysphagia led to worsening of nutritional status and hence limitation of functional oral intake.

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The Effects of Electrical Stimulation Pulse Duration on Lingual Palatal Pressure Measures During Swallowing in Healthy Older Adults

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Purpose: The most commonly used electrical stimulation (e-stim) protocol known as VitalStim utilizes long pulse duration (PD) (700 μs) for dysphagia rehabilitation. However, limited research in swallowing physiology has suggested that VitalStim may not penetrate deep enough to impact the extrinsic tongue muscles and subsequently modulate the tongue pressure measures during swallowing. The purpose of this study was to compare the effect of varying PDs on lingual-palatal pressure measures during swallowing in healthy older adults.
Method(s): Thirty healthy older adults (60–70 years of age) participated in this study. Lingual-palatal pressures were collected using a three-bulb tongue pressure array. Each subject swallowed three trials of 10 ml pudding under three e-stim conditions: no stimulation, short PD, and long PD. E-stim was delivered using two-channel surface electrodes on the submental area. Maximum Amplitude Tolerance (MAT) was identified separately for short and long pulse e-stim conditions. Tongue peak pressure and pressure duration were measured under each condition. Two-way repeated measures ANOVAs were conducted to identify within subject effects of e-stim condition and tongue bulb location.
Result(s): Tongue peak pressure was reduced in the short PD condition. MAT was higher in short PD than long PD condition. Furthermore, MAT was correlated with lingual-palatal peak pressure. Changing PD had no impact on tongue pressure duration.
Conclusions (Including Clinical Relevance): Overall, this lowering effect of e-stim on tongue pressure has the potential to be used during a resistive exercise paradigm for tongue elevation during swallowing.
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Oropharyngeal Functioning in Oculopharyngeal Muscular Dystrophy (OPMD)

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Purpose: Oculopharyngeal muscular dystrophy (OPMD) is a rare hereditary late onset progressive muscular dystrophy, with ptosis and dysphagia as prominent features, but clinically understudied. As part of an international research program we designed an intensive protocol (OPMD-Forte) for a cross-sectional longitudinal study with 50 people with (pre)symtomatic OPMD. Here we present the initial data of the clinical oropharyngeal measurements.
Method(s): Fifty people with OPMD and family members (all genetically tested for OPMD; 27 women; mean age 61 year; SD 8.5) agreed to participate and were measured with the following tasks: maximum swallowing speed (MSS), maximum swallowing volume (MSV), maximum isometric pressure of the tongue (MIP), maximum bite force (MBF) and maximum chewing time (TOMASS). In addition they completed the EAT-10. We identified severity groups based on range of symptoms: (1) no complaints; (2) ptosis and swallowing complaints; (3) ptosis, swallowing complaints and limb weakness.
Result(s): In groups 1, 2 and 3, mean age (years) was 53.7, 58.1 and 63.6 ($p = .009$), mean MSS (ml/s) was 16.2, 13.2 and 7.6 ($p = .003$), mean MSV (ml) 43.0, 31.8 and 22.6 ($p = .028$), mean MIP anterior tongue-to-palate (kPa) was 47.3, 34.6 and 27.4 ($p = .004$), mean MBF (kg) was 19.3, 16.7 and 13.1 ($p = .091$) and maximum chewing time (s) was 38.0, 68.2 and 75.0 ($p = .523$). When adjusting for age, only MMS significantly decreased across these groups.
Conclusions (Including Clinical Relevance): In OPMD, swallowing tasks and tongue force decrease more than chewing time and biting force, emphasizing the pharyngeal weakness, but not excluding oral weakness.
Relevant Financial Relationships: Hanneke Kalf: Nothing to Disclose | Rosemarie Kroon: Nothing to Disclose | Corinne Horlings: Nothing to Disclose | Bert de Swart: Nothing to Disclose | Baziel van Engelen: Nothing to Disclose.
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Evaluation of Different Fatigue-Inducing Paradigms on Maximum Isometric Pressures (MIP) of the Anterior Tongue in Healthy Adults and Elderly

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Purpose: Tongue strength is critical for bolus propulsion. MIP is commonly the highest of 3 repetitions. Meal consumption however requires many more swallows; failure to repeatedly produce adequate pressures can result in dysphagia, prolonged mealtimes and/or

premature ending of meals. We aimed to study tongue fatigability and influencing parameters.
Method(s): 40 healthy people with MIP within normative data were included: 20 adults (20–60 years old) and 20 elderly (70 +). All testing and measurements used the IOPI. 6 fatigue paradigms (FP)(2 × at 60, 80, or 100% of baseline (BL) MIP) were done in randomized order with intervals of 48-72 h. Reps were 3 s of specified tongue pressure production (confirmed by visual feedback), followed by 3 s of rest; MIP measurements were repeated every 5 reps. FP was aborted at discomfort, session duration exceeding 60 min (equaling a max of 470 reps and 94 MIPs), or when MIPs during FP were < 30% of BL MIP. Recovery (R) MIPs were performed 5 and 15 min after ending FP.
Result(s): 1. median/maximum MIPs across all FP were 65 and 80 respectively 2. No significant decay in MIP was noted between BL and R for any FP 3. increased BL MIP over 6 subsequent FP indicated a training effect 4. Kaplan- Meier (KM) analysis in similar FP showed no significant differences 5. KM showed no difference in performance between adults and elderly 6. KM indicated no difference in performance in function of % BL MIP.
Conclusions (Including Clinical Relevance): Different FP failed to induce significant fatigue within the time constraints. These data can serve to develop a potential assessment for tongue fatigue in dysphagic patients.
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Pharyngeal Electrical Stimulation for Early Decannulation in Tracheotomised Stroke Patients with Dysphagia (PHAST-TRAC): A Randomised, Single-Blind, Pivotal, Superiority Trial

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Purpose: Dysphagia after stroke is common, especially in ventilated patients. Pharyngeal electrical stimulation (PES) has been shown to reduce aspiration and dysphagia in pilot trials, including in ventilated stroke patients.
Method(s): Patients with recent stroke who required ventilation and tracheotomy were randomised in this phase III trial to receive 3 days of PES or sham. The primary outcome was readiness for decannulation at 24–72 h post treatment, assessed using a validated fibreoptic endoscopic evaluation of swallowing (FEES) protocol. Secondary outcomes included need for recannulation, and serious adverse events (SAE).
Result(s): The Data & Safety Monitoring Committee recommended that the trial should stop early for reason of efficacy. 69 (PES 35, sham 34) participants from 8 centres in Germany, Austria and Italy were randomised: age 64(12) years; haemorrhagic stroke 20 (29%); onset to randomisation 37 [11, 120] days. PES was associated with more patients who were ready for decannulation as compared to sham: 17 (48.6%) vs. 3 (8.8%), odds ratio (OR) 9.76 (95% confidence intervals, CI 2.5–37.9, P < 0.001). All patients who were ready in the PES group had decannulation performed, or their cuff deflated. No patients required recannulation. The number of patients with at least one SAE did not differ between the groups: 10 (28.6%) vs. 8 (22.9%), OR 1.3 (0.44–3.83), p = 0.79.
Conclusions (Including Clinical Relevance): Pharyngeal electrical stimulation increases the number of stroke patients who can be safely decannulated after mechanical ventilation, and appears safe and well tolerated.
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Changes in Cardiac Function During a Swallow Exercise Program in patients with Coronary Artery Disease

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Purpose: Research regarding risks of swallow treatment suggests that patients with stroke and coronary artery disease (CAD) experience changes in heart rate/rhythm when completing the supraglottic swallow and super supraglottic swallow. This study evaluates cardiac function during multiple swallowing exercises in patients with dysphagia and CAD.
Method(s): Eligible patients had CAD and confirmed dysphagia from VFS and sufficient cognitive ability to follow direction. The protocol included a priori concealed randomized order of 7 swallowing exercises (supraglottic swallow, super supraglottic swallow, Mendelsohn and Masako maneuvres, effortful swallow with and without breath hold, and jaw opening against resistance). Objective measures of heart rate/rhythm, oxygen saturation and blood pressure were compared before vs. after the overall session and each exercise using the Wilcoxon signed-rank test, with alpha at 0.05 and beta at 0.80.
Result(s): Participants were 20 adults (15 male), aged 28–88 (median 76.5 years). 75% were intubated (40% > 1 intubation) and 25% suffered post-op stroke. Severe dysphagia, marked by NPO status, occurred in 30% of patients. Sessions were 26 min long (mean). With few exceptions, objective measures were stable pre- vs. post overall and after each exercise. Heart rhythm worsened with effortful swallow alone (p = .04); but, improved with masako maneuvre (p = .04).
Conclusions (Including Clinical Relevance): Patients with CAD and dysphagia experience few changes in heart rate/rhythm, oxygen saturation and blood pressure when completing swallowing exercises, suggesting good tolerance. Telemetry can monitor for subtle changes.
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Swallowing-Related Quality of Life in Patients with Multiple Sclerosis

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Purpose: Several studies have confirmed decreased quality of life (QOL) in MS patients, however little is known about the impact of dysphagia in their overall quality of life. The aim of this study was to explore the association between dysphagia and decreased quality of life in MS.
Method(s): 85 MS patients filled out 2 self-report questionnaires, the SWAL-QOL and the MSQOL-54. The Kurtzke Expanded Disability Status Scale (EDSS) was used to monitor disability. Spearman's Rho correlation coefficient analyses were performed between SWAL-QOL, MSQOL-54, EDSS, and disease-type.
Result(s): Significant relationships were found between SWAL-QOL and MSQOL-54, EDSS and disease type ($p < 0.05$). Results indicated worse swallow-related QOL and worse overall QOL in more disabled patients.
Conclusions (Including Clinical Relevance): Current results suggest a significant impact of dysphagia on QOL of MS patients. Dysphagia management can potentially lead to improved QOL in these patients.
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Sensorimotor Behavioral Assays of Alexander Disease in a Rat Model

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Purpose: Alexander disease (AxD) is a fatal neurodegenerative condition caused by an autosomal dominant mutation in the glial fibrillary acidic protein (GFAP) gene. Individuals with AxD often have difficulty swallowing and speaking, poor coordination, and loss of motor control. Our purpose was to examine clinically-relevant oral-motor function in a translational rat model of AxD (Gfap +/R237H) versus age-matched controls (wildtype; WT).
Method(s): Male Sprague–Dawley rats (AxD, n = 10; WT, n = 9) were assessed for: mastication [biting; chewing], tongue force and press rates, functional swallowing via videofluoroscopy [bolus area, jaw motion rate, bolus velocity, head compensation, gag, aberrant bolus flow], and ultrasonic vocalization (USV) characteristics [number of calls, duration, max amplitude, mean frequency, type]. Dependent variables were analyzed with one-tailed t-tests ($\alpha < 0.05$).
Result(s): We found significantly reduced tongue force ($p < 0.001$) and tongue press rates ($p < 0.005$) in AxD rats compared to WT. AxD rats showed significantly fewer bites/sec ($p < 0.007$) and higher number of chewing events ($p < 0.001$). The AxD rats had a significantly greater number of USVs. ($p < 0.05$). No significant differences were found with videofluoroscopy.
Conclusions (Including Clinical Relevance): AxD rats showed oral motor deficits (tongue function and mastication) in the absence of USV or functional swallowing deficits. These data parallel clinical findings in children with AxD. Since the rat R237H is equivalent to the common R239H mutation in humans, this model may be useful for research examining underlying mechanisms and treatment for AxD.
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The Endoscopic Evaluation of the Interaction Between Effectiveness and Efficiency in pAtients with Pharyngeal Residue

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Purpose: Residue in the pharynx, as parameter of effectiveness, predisposes to episodes of penetration/aspiration, as parameter of efficiency. The correlation between residue and airway invasion and the residue detection time in affecting the amount of residue and the severity of dysphagia are considered.
Method(s): Two experienced raters blindly evaluated 70 short videoclips of bolus transit, recorded during endoscopic evaluations of 16 patients with dysphagia of differing etiologies. The pooling score (p-score) and the Penetration Aspiration Scale (PAS) were detected after swallowing (T1) and after the 5th dry swallow (T5). The correlation between the p-score (sub test 3 and 4 for 'site of residue') and the PAS (2-5 and 6-8) was performed (ROC curve analysis and Youden Index).
Result(s): The inter-rater agreement between the 2 raters in scoring the p-score was good (ICC > 0.800) for FEES for every consistency (T1vs.T1 & T1vs.T5) with exception of liquid (Spearman's Rho $>$ 0.70 - sing < 0.05). The p-score showed a good trade off between sensitivity and specificity when compared with the PAS penetration (score 3 to 5) and aspiration (6 to 8) scores with a p-score cut-off of 3 for penetration and 4 for aspiration respectively.

Conclusions (Including Clinical Relevance): The time of scoring residue (T1vs.T5) is relevant in detecting severity of dysphagia during an instrumental evaluation for different consistencies. The time of detection of a score (T1 or subsequent) should be disclosed, if not imposed by the score itself. The p-score correlates with the PAS score in detecting penetration/aspiration.

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Temporal Analysis of EAT-10 Scores in Outpatients with Oropharyngeal Dysphagia from a Tertiary Care Clinic

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Purpose: Self-perception of disease is increasingly recognized as a determinant of health. The Eating Assessment Tool-10 (EAT-10) is a functional health status questionnaire that measures the symptomatic severity of dysphagia from the patient's perspective. Our primary objective was to identify contributors (demographics, clinical variables, swallowing physiology) to longitudinal change in EAT-10 scores in outpatients with oropharyngeal dysphagia.

Method(s): All patients with swallowing concerns that were included in the UW Madison Voice and Swallowing Outcomes database from 12/2012 to 04/2015 were invited to complete EAT-10 and a general health survey (SF-12v2) at their initial evaluation and six months later. Forty-two patients were included in analysis (n = 42).

Result(s): Weaning from a gastrostomy tube was significantly associated with EAT-10 improvement. Approximately 70% of the sample had mild dysphagia, and floor effects were observed for EAT-10 items 1, 2, and 6. Significant, weak-moderate correlations were found between and EAT-10 and SF-12v2 scores for all comparisons except for Physical Health Composite at six months (rs = = 0.24 to − 0.43). Mean SF-12v2 Physical Component Summary score was substantially lower than that of the general population.

Conclusions (Including Clinical Relevance): Weaning from a feeding tube appears to meaningfully improve self-perceived symptoms of dysphagia. Given the floor effects observed, validity of EAT-10 for patients with mild dysphagia should be examined. Future research should address contributors to self-perceived symptom change across the range of dysphagia severity.

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Quality of Life Related to Swallowing in Patients with Advanced Laryngeal Cancer: Total Laryngectomy Versus Organ Preservation

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Purpose: To compare the quality of life related to swallow of patients with advanced laryngeal cancer who were submitted to total laryngectomy (TL) or to organ preservation (OP).

Method(s): It was a prospective and randomized study. Seventeen patients (16 male and 1 female) with 58,09 mean age (46-76 years) were included and answered the University of Washington Quality of Life Questionnaire (UW-QOL) at selected times: pretreatment, 1, 3, 6, 12, and 24 months post-treatment. Patients with associated neurological conditions, previous head and neck surgery or previous neoplasia in another part of the body were excluded. Statistical analysis was performed by the nonparametric Wilcoxon rank sum test. Score distributions were compared in the TL versus OP groups.

Result(s): UW QOL was completed by 15 surviving patients (7 TL and 8 OP). The topics related to swallowing presented significant statistical differences related to saliva ($p = 0.001$), chewing ($p = 0.027$), taste ($p = 0.039$) and difficult swallowing ($p = 0.018$). OP group presented worse scores mainly in the evaluations performed after 1, 3 and 6 months.

Conclusions (Including Clinical Relevance): The long-term follow-up of patients with advanced laryngeal cancer showed that the greatest impact on swallowing occurs after organ preservation treatment and especially in the months close to the end of treatment.

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Attentional Resource Allocation and Cough Reflex Sensitivity in Healthy Young Individuals

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Purpose: Reflex cough is an essential airway protective mechanism. Models of cough production emphasize the role of cortical modulation, yet no studies have examined the impact of cognitive demand on reflex cough function. We tested the effects of performing concurrent cognitive and coughing tasks on measures of reflex cough in healthy young adults.

Method(s): Volunteers (N = 22, age range 22–35 years) underwent four blocks of capsaicin-induced cough challenges. In each block, six concentrations of capsaicin were presented in a randomized order: 0, 10, 20, 50, 100, 200 μM. Two blocks consisted of cough testing only (single task). During the other two blocks, participants counted tones whilst undergoing cough testing (dual task). Cough motor response, self-reported 'urge to cough' (UTC), cough frequency and cough airflow were measured.

Result(s): Participants coughed more in the single task condition [x = 11, SE = 2.38] compared to the dual task [x = 7, SE = 1.61], p = .02. Participants' UTC ratings were lower in the dual task condition [x = 1 ("very slight")] compared to the single task [x = 2 ("slight")], p = .02. This represented a large effect, r = .48. There was a non-significant trend towards increased sensitivity thresholds in the dual task [p = .08]. Cough peak expiratory flow rates did not change [p = .82].

Conclusions (Including Clinical Relevance): Somatosensation of tussive stimuli changes in response to cognitive load. Abnormal cognitive resource allocation may be a mechanism involved in silent aspiration; therefore, cognitive rehabilitation should be considered as a therapeutic target in those at risk of aspiration during swallowing.
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The Influence of Tongue Strength on Oral Bolus Preparation, Swallowing Efficiency, and Airway Invasion in Parkinson's Disease

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Purpose: Reduced lingual strength and swallowing pressure have been correlated with increased mealtime duration and clinical signs of aspiration. Further, performance on the Timed Water Swallowing Test (TWST) and Test of Masticating And Swallowing Solids (TOMASS) has been correlated with the presence of dysphagia. We explored the influence of lingual strength measures on oral bolus preparation, swallowing efficiency, and penetration/aspiration in people with Parkinson's disease (PD) and dysphagia.
Method(s): Adults with PD (N = 34, 26 males, mean disease duration = 10 years) completed isometric tongue pressure tasks and saliva swallows using the Iowa Oral Performance Instrument (IOPI). Participants then completed the TOMASS, TWST, and an endoscopic swallowing evaluation. Measures of oral bolus preparation, swallowing efficiency, and bolus clearance (using the Penetration-Aspiration Scale; PAS) were completed.
Result(s): IOPI values accounted for 23–70% of the variation in swallowing efficiency, and 46–60% of the variation in oral bolus preparation parameters; however, did not significantly influence these outcomes ($p > .05$). IOPI values accounted for 81% of the variation in the PAS, and significantly influenced the PAS score ($p = .03$).
Conclusions (Including Clinical Relevance): Lingual strength is associated with penetration/aspiration in people with PD. This provides support for incorporating objective measures of lingual strength into clinical swallowing evaluations/dysphagia screenings. Factors other than lingual strength may be better predictors of oral bolus preparation and swallowing efficiency in people with PD, and warrant further investigation.
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The Recline and Head-Lift Exercises have Similar Biomechanical Swallowing Outcomes and Detraining Effects in Older Adults: A Randomized Clinical Trial

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Purpose: To compare kinematic and functional swallow outcomes and detraining effects of the novel Recline Exercise (RE) and the Head Lift Exercise (HLE) in healthy older adults.
Method(s): Twenty-two elders (10 males; mean = 67 years) were randomized to the RE or the HLE regimen for 6 weeks. The RE differs from the HLE in the amount of recline and type of isometric resistance used. Kinematic measures of superior and anterior hyoid excursion and UES opening (on 5 ml and 10 ml thin, pudding, and cookie) were collected using VFSSs at baseline, post-exercise, and 6 weeks post-detraining. Functional measures included penetration/aspiration scale (PAS) scores and perceived exertion ratings (Borg scale).
Result(s): Post-exercise, significant increases in superior hyoid excursion across boluses ($p \leq 0.01$), anterior excursion on 10 ml thin and pudding ($p = .01$), and UES opening on cookie ($p = .02$) were noted for both groups. PAS scores did not change, but both groups had a significant decrease in exertion levels ($p = < .01$). No differences were noted between groups for any measure with the exception of perceived exertion. Borg ratings were $\sim$ 20% lower for the RE group at all time points ($p = .01$). Subjects showing biomechanical gains maintained an average of 11-100% of those gains post-detraining. No differences in detraining effects were seen between groups.
Conclusions (Including Clinical Relevance): The RE has similar biomechanical swallow outcomes and detraining effects as the HLE in older adults, and requires less effort. The RE is a promising alternative to the HLE. Further validation of these results in dysphagia patients is needed.
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Swallow Event Sequencing: Comparing Healthy Older and Younger Adults

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Purpose: Previous research has established that a great deal of variation exists in the temporal sequence of swallowing events for

healthy adults (1, 2). Yet, the impact of aging on swallow event sequence is not well understood. Kendall and colleagues (2003) suggested there are 4 obligatory paired-event sequences in swallowing. We directly compared adherence to these sequences, and quantified the percentage of unique sequences in two samples of healthy adults: young (< 45) and old (> 65).
Method(s): The 8 swallowing events that contribute to the sequences were reliably identified from videofluoroscopy (3 × 5 ml thin, 3 × 20 ml thin, 3x5 ml nectar) in a sample of 23 healthy seniors (10 male, mean age 74.7) and 20 healthy young adults (10 male, mean age 31.5) with no evidence of penetration-aspiration or post-swallow residue. Chi- square analyses compared the proportions of obligatory pairs and unique sequences by age-group.
Result(s): Compared to the older subjects, younger subjects had significantly lower adherence to two obligatory sequences: UES open ≤ bolus at UES (13% young, 86% old, $\chi^2 = 193.2$, $p < 0.001$) and maximum UES opening < maximum pharyngeal constriction (83% young, 100% old, $\chi^2 = 35.1$, $p < 0.001$). Further, significantly fewer unique swallow sequences were observed in the older group (54%) compared with the young (82%) ($\chi^2 = 31.8$; $p < 0.001$).
Conclusions (Including Clinical Relevance): Our findings suggest that paired swallow event sequences may not be robust across the age-continuum and that variation in swallow sequences appears to decrease with aging. These findings provide normative references for comparisons to older individuals with dysphagia.
Relevant Financial Relationships: Erica Herzberg: Nothing to Disclose | Wendy Liang: Nothing to Disclose | Cathy Lazarus: Has affiliations to disclose; Mount Sinai Beth Israel: Salary/Stipend: Employment; PCORI (Patient Centered Outcomes Research Institute): Grant: Independent contractor (Including contracted research); Northern Speech Services: Royalty: Teaching and speaking | Catriona Steele: Has affiliations to disclose; University Health Network, Toronto: Salary/Stipend: Employment; National Institutes of Deafness and Other Communication Disorders: Grant: Independent contractor (Including contracted research) | Sonja Molfenter: Has affiliations to disclose; NYU: Salary/Stipend: Employment; NIH NIDCD: Grant: Independent contractor (Including contracted research).
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Detection of Swallow Kinematic Events from Acoustic High Resolution Cervical Auscultation Signals in Patients with Stroke

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Purpose: High resolution cervical auscultation (HRCA) is a combined hardware-software system that merges electronic transducers (e.g., a microphone and/or an accelerometer) with advanced data analysis methods. It has been proposed as a more objective dysphagia screening than stethoscope-based cervical auscultation (CA). However, similar to CA, there is no consensus on the kinematic source of the HRCA acoustic signals. In this study, we assessed the association between HRCA acoustic signals and swallow kinematic events.
Method(s): One hundred liquid wallows obtained through concurrent videofluoroscopy and HRCA from 35 patients with stroke (26 males + 9 females; mean age 65.8) were analyzed. Nine acoustic signal features were compared to the time onset of nine pharyngeal swallow kinematic events.
Result(s): Six HRCA acoustic signal feature (e.g., standard deviation, skewness, kurtosis, centroid frequency, bandwidth, and wave entropy) peak occurred within 0.1 s of nine kinematic events associated with hyoid elevation, laryngeal closure, upper esophageal sphincter opening, and tongue base to posterior pharyngeal wall contact ($p < .04$). Results indicate HRCA acoustic signals were associated with actual swallow kinematic events that are not detectable by CA.
Conclusions (Including Clinical Relevance): There were association between HRCA acoustic signal features and swallow kinematic events. HRCA may have advantages over CA. If implemented with the aid of advanced computer analysis, HRCA may potentially contribute to more objective dysphagia screening test by temporally localizing some swallow kinematic events that may produce aspiration/penetration.
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The Pitch Glide Speech Task Lacks Clinical Utility to Infer Dysphagia

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Purpose: Current literature debates if speech tasks are predictive of swallowing function. This study investigated the utility of the pitch glide speech task in relation to swallowing and whether was associated with dysphagia.
Method(s): Modified Barium Swallows (MBS) captured speech tasks and bolus trials at 30 frames per second. A rater scored each pitch glide as "adequate" or "not adequate" to indicate a subject's effort. Videos were excluded if rated "not adequate" or had no visualization on MBS. Using SwallowTail®, laryngeal elevation was measured by comparing posterior cricoid movement relative to C2-C4 alignment at a rest frame and at the height of the pitch glide as well as 20 mL thin liquid, 5 mL thin liquid, and 15 mL puree trials. Paired t-tests (with

Bonferroni correction) determined if there was a difference in laryngeal lift between the pitch glide and the bolus trials.
Result(s): Each subject's pitch glide (n = 41) was compared to their swallows of 20 mL thin liquid (n = 38), 5 mL thin liquid (n = 41), and 15 mL puree (n = 29). Laryngeal lift during the bolus swallow was greater than the lift during the pitch glide by an average of 1.14, 1.10, and 1.34 for 20 mL thin liquid, 5 mL thin liquid, and 15 mL puree, respectively. There was a significant difference in laryngeal lift between the pitch glide task and the 20 mL thin liquid ($p < 0.0001$), 5 mL thin liquid ($p < 0.0001$), and 15 mL puree ($p < 0.0001$) swallows.
Conclusions (Including Clinical Relevance): This study suggests that using a pitch glide to make assumptions about an individual's ability to swallow boluses may be misleading and might not indicate dysphagia.
Relevant Financial Relationships: Samantha Kennedy: Nothing to Disclose | Kaylee Kim: Nothing to Disclose | Linda Parker: Has affiliations to disclose; Boston Medical Center: Salary/Stipend: Employment | Susan Langmore: Has affiliations to disclose; NIDCD-NIH: Grant: Other Activities | Jessica Pisegna: Has affiliations to disclose; NIDCD-NIH: Grant: Other Activities; Boston Medical Center: Salary/Stipend: Employment.
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Surface Electromyography During Expiratory Muscle Exercise in Healthy Individuals Using Differents Devices

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Purpose: To compare the electromyography activity during expiratory muscle exercise with different devices.
Method(s): Prospective cross-sectional clinical study. Studied 10 healthy young adults, six females and four males, aged 20-39 years old (mean age 33 years old). All individuals performed the expiratory muscle exercise with three different devices (Respiron®, Straw and Expiratory Muscle Strength Training—EMST) by randomization sequence. The muscular activity of the suprahyoid muscles and orbicularis muscle of the mouth was evaluated by normalized root mean square (RMS) of electromyography signal during the expiratory muscle exercise and compared between the devices by ANOVA One Way test.
Result(s): There were no difference between the electromyography activities during the expiratory muscle exercise using different devices in suprahyoid muscle (Respiron: 0.28 ± 0.12; Straw: 0.35 ± 0.19; EMST 0.35 ± 0.13; $p = 0.54$) and from orbicularis of the mouth (Respiron: 2.71 ± 1.53; Straw: 3.03 ± 1.86; EMST: 3.40 ± 2.16; $p = 0.72$).
Conclusions (Including Clinical Relevance): The electromyography activity of the suprahyoid muscles and upper orbicularis muscle of the mouth was similar using different devices during expiratory muscle exercise in healthy individuals.
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Kinematic Visual Biofeedback Improves Accuracy of Swallowing Maneuver Training and Accuracy of Clinician Cues During Training in Post-stroke Patients with Dysphagia

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Purpose: Dysphagia is a common problem after stroke. Submental surface electromyography (ssEMG) visual feedback is a commonly used clinical tool to train novel swallowing maneuvers, even though its effectiveness has been questioned. This study compares the effect of ssEMG and videofluoroscopy (VF) visual biofeedback on hyolaryngeal accuracy when training the volitional laryngeal closure swallowing maneuver (vLVC) in post-stroke patients with dysphagia. The vLVC maneuver involves and prolonging LVC for at least 2 s. We also examined whether clinicians accurately judged vLVC performance.
Method(s): 14 stroke patients underwent 2 study phases. Phase 1: first demonstrated ability to perform the vLVC accurately. Phase 2: vLVC training. Participants were randomized into 3 biofeedback groups including the ssEMG Group (ssEMG biofeedback in both phases), the VF Group (VF biofeedback in both phases), and the Mixed Group (VF phase 1, ssEMG phase 2). To promote the best vLVC performance, a clinician provided real-time, verbal cueing using the only visual biofeedback type also seen by the patient.
Result(s): Both accuracy of vLVC training performance and clinician feedback were worse in the ssEMG group compared to the VF and Mixed Groups ($p < 0.001$).
Conclusions (Including Clinical Relevance): Swallowing airway protection requires precisely timed movements of small, hidden laryngeal and pharyngeal structures. Kinematic feedback may be required to ensure that target swallowing movements are being trained in rehab, rather than maladaptive movements.
Relevant Financial Relationships: Alicia Vose: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose | Arielle Marcus: Nothing to Disclose.
Relevant Non-financial Relationships: Alicia Vose: Nothing to Disclose | Ianessa Humbert: Has a Non- Financial Disclosure Affliation; DRS: Professional: Membership | Arielle Marcus: Nothing to Disclose.

Nature and Prevalence of Dysgeusia During and Post Head and Neck Cancer Management and Its Impact on Oral Intake

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Purpose: During and post head and neck cancer (HNC) management, dysgeusia is a common deficit. However, there has been limited systematic study of taste deficits and their impacts. This study examined physiological taste recognition and intensity during and after radiotherapy, and patients' perceptions of taste change and effect on eating.
Method(s): Fifteen patients with HNC were assessed at: baseline; week 2, 4 of treatment, and; 1, 3, 6 months post, using: (1) Liquid, whole mouth test of taste (salt/sweet/sour/bitter) recognition and intensity, (2) the Chemotherapy-Induced Taste Alteration Scale (CiTAS) a taste-related questionnaire, and, (3) "How often do you have taste issues" and "Has taste impacted eating" from the Head and Neck Patient Symptom Checklist (HNSC).
Result(s): Taste recognition and intensity were impaired as early as week 2, with most severe deficits by week 4. By 6 months, there was some resolution, though a degree of deficit persisted. Although taste recognition returned for most patients, taste intensity perception remained reduced in up to half (depending on tastant) at 6 months. Patient perceptions (CiTAS, HNSC) were highly consistent with objective measures. Most perceived taste deficits interfered (somewhat to a lot) with eating at week 4, with half noting, persisted issues at 6 months.
Conclusions (Including Clinical Relevance): Though impacts were greatest during treatment, many patients experienced long-term deficit. Taste was considered a factor impacting eating both during and post-treatment. This study highlights the need to monitor and manage taste issues to help patients optimize oral intake post-treatment.
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Neonatal Dysphagia: Does Difference in Nipple Flow and/or Formula Concentration Make any Changes in Swallowing Physiology?

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Purpose: As a strategy for infant grow and weight gain, preterm infant formula calories are frequently increased. Osmolality of feeds (concentration of formula) should not exceed 450 mOsm/l. The aim of this study was to investigate changes in swallowing physiology throughout the videofluoroscopic swallow study (VFSS) of premature neonates suspected of dysphagia comparing different concentration formulas and nipple flows.
Method(s): A cross-sectional design was used to analyze VFSS swallowing exams and compare to clinical findings. To describe the effect of formula concentration (thin formula and concentrated formula 16% and 20%) and nipple flow (slow and regular flow) in swallowing and airway protection Generalized Linear Model was used.
Result(s): The sample comprised of 53 VFSS exams of premature neonates. There was no significant statistical difference between thin formula and concentrated formula. The results showed significant difference for posterior spillage when comparing slow flow nipple to regular flow ($p = 0.028$). Penetration is significantly associated to posterior spillage, nasal regurgitation and swallowing initiation in valleculae or pyriform ($p = 0.037$, $p = 0.013$ e $p = 0.037$).
Conclusions (Including Clinical Relevance): The results suggest that changes in reduction of flow appear to be a strategy for safer swallowing in premature neonates presenting dysphagia. Future researches with larger samples are warranted to determine the effects of flow and consistency in the biomechanics of swallowing in this population.
Relevant Financial Relationships: Deborah Levy: Nothing to Disclose.
Relevant Non-financial Relationships: Deborah Levy: Nothing to Disclose.

Accounting for Taste: The Relationships Between Taste Profile, Genetic Taster Status, and Swallowing Biomechanics

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Purpose: As part of a larger study examining taste effects on brain activity and swallowing, we tested relationships between five taste profiles, taste enjoyment (hedonics), genetic taste status, and swallowing morphology.
Method(s): Videofluoroscopy captured images of healthy participants' relevant anatomy and physiology during swallows of five tastants (two trials each of an unflavored barium suspension plus sour, sweet-sour, lemon, and orange barium suspensions). Outcomes for this analysis included hedonic general labeled magnitude scale (H-gLMS) ratings, genetic taster status via N-propylthiouracil testing, and measures of swallowing morphology via the computational analysis of swallowing mechanics (CASM) tool.
Result(s): In the small preliminary cohort analyzed to date ($N = 7$, including 2 nontasters, 3 midtasters, and 2 supertasters), genetic taster status accounted for $\sim$ 75% of the variance in pharyngeal stage swallowing mechanics, whereas $\sim$ 22% of variance was related to tastant type. CASM revealed fundamental differences in pharyngeal stage mechanics across the three taster groups, and in group-specific responses to the various tastants.
Conclusions (Including Clinical Relevance): Taste-mediated differences in swallowing mechanics in healthy persons, especially when combined with neuroimaging data and other outcome measures using the same tastants, may help define optimal stimuli for adjuvant dysphagia therapies. Genetic taster status appears to contribute to baseline swallowing mechanics in healthy persons, and therefore may

be a relevant consideration in assessing dysphagia risk and management strategies.

Relevant Financial Relationships: Angela Dietsch: Has affiliations to disclose; University of Nebraska-Lincoln: Salary/Stipend: Employment | William Pearson: Has affiliations to disclose; Augusta University: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Angela Dietsch: Has a Non-Financial Disclosure Affliation; Dysphagia Research Society: Professional: Membership | William Pearson: Has a Non-Financial Disclosure Affliation; Dysphagia Research Society: Professional: Membership.

Dysphagia in a Pediatric Population and Its Association With Pulmonary Causes of Hospitalization

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Purpose: To report the main swallowing findings in a pediatric population that underwent videofluoroscopic swallowing study (VFSS) and to correlate these findings with clinical repercussions and with major pulmonary causes of hospitalization.

Method(s): A total of 187 of VFSS exams were included propectively. All pediatric patients aged 30 days to 5 years 11 months who were refferred to examination were included. The variables of interest were clinical data, data on hospital admissions due to pulmonary causes and main VFSS findings. The Person's Chi squared test and adjusted residuals test was perfomed from to identify the variables association, at significance level of 0.05.

Result(s): Mean age was 8.2 months; 60.4% of patients were aged 1 year or younger and 58.8% were male. The most prevalent underlying condition was preterm birth (50.3%). Of these patients, 49.7% were being fed orally, and the remaining 50.3% by alternative routes. The most prevalent reason for hospitalization was bronchopneumonia (30.5%). Both penetration and aspiration were most prevalent for thin fluids (45.1% and 21.5% respectively). Delayed oral transit time was significantly associated with nasoenteric tube feeding ($p = 0.041$) and posterior spillage ($p = 0.007$). Onset of the pharyngeal phase in pyriform sinuses was associated with penetration and aspiration ($p = 0.032$; $p = 0.027$). Aspiration was associated with hospitalization for pneumonia not otherwise specified ($p = 0.002$).

Conclusions (Including Clinical Relevance): This study demonstrated that this pediatric population had several abnormalities in swallowing and a high rate of hospitalization for pulmonary causes.

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Computational Analysis of Rodent Swallowing Biomechanics

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Purpose: Videofluoroscopic swallow studies (VS.S) can provide critical information on swallow biomechanics when subjected to validated kinematic analysis. Our purpose was to adapt Computational Analysis of Swallowing Mechanics (CASM) to allow assessment of swallow biomechanics in rodent models for investigation of underlying musculoskeletal dysfunction in aging.

Method(s): VS.S, kinematic analyses (bolus area & velocity, mastication rate), and a rodent specific multivariate morphometric computational analysis of swallowing biomechanics were performed on 20 swallows from 5 young and 5 old F344/BN rats.

Result(s): Bolus area ($p = .04$) and mastication rate ($p < .001$) were significantly altered with age. Eight anatomical landmarks were identified to characterize morphology of rodent swallow mechanics to track the relative change in position of 3 skeletal levers (cranial base, vertebral column, mandible) and soft tissue landmarks (UES, base of tongue). Aging accounted for 77.1% ($D = 1.9$, $p < .001$) of the variance in swallow biomechanics, and 18.7% was associated with swallow phase (oral vs. pharyngeal; $D = 1.2$, $p < .001$). Post hoc DFA analysis suggests that with aging tongue base retraction was reduced, masticatory movements were more variable, and increased head extension was observed.

Conclusions (Including Clinical Relevance): Geometric morphometric analysis of rodent swallows suggests that swallow biomechanics are altered with age. When used in combination with biological assays of age-related adaptations in neuromuscular systems, this multivariate analysis may increase our understanding of underlying dysfunctions that contribute to swallowing disorders with aging.

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Relevant Non-financial Relationships: Heidi Kletzien: Nothing to Disclose | Nadine Connor: Nothing to Disclose.

Assessing Oral Feeding Skill Levels in Preterm Infants Using a Simulation-Based Approach

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Purpose: Early identification of infant dysphagia is critical for maximizing positive clinical outcomes. General health care professionals are often responsible for screening infant oral feeding readiness. The aim of this study was to determine if a simulation-based training protocol is effective in teaching the use of an Oral Feeding Skills Assessment tool to establish the need for further swallow evaluation in preterm infants.

Method(s): Data were collected from 60 students (20 masters-level Speech-Language Pathology, 20 undergraduate nursing, 20 undergraduate non-health care) in a pre-test/post-test design to determine the impact of simulation-based training on ability to screen for pediatric dysphagia. Participant accuracy scores were calculated based on scoresheet answers on the following criteria: physiological and behavioral markers, and oral feeding skill level. A repeated measures ANOVA compared between group differences (3 levels) and training effect (2 levels).

Result(s): Simulation-based training effectively improved identification of behavior signs of feeding difficulty ($p < 0.001$), physiologic signs ($p < 0.001$), and ability to identify appropriateness for discontinuation of feeding and referral for a swallow evaluation ($p < 0.001$).

Conclusions (Including Clinical Relevance): This study has identified a successful method to train caregivers to screen for infant dysphagia using an Oral Feeding Skills Assessment tool. This training approach has the potential to increase the identification of feeding

difficulty and recognize need for a speech language pathology evaluation to optimize clinical outcomes.

Relevant Financial Relationships: Courtney Broadfoot: Has affiliations to disclose; University of Wisconsin-Madison: Salary/Stipend: Employment | Julie Estis: Has affiliations to disclose; University of South Alabama: Salary/Stipend: Employment.

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How Do Healthy Adults Attempt to Replicate Lingual Pressures for Various Bolus Viscosities

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Purpose: Lingual weakness is assumed to contribute to oral phase dysphagia, particularly as it relates to posterior propulsion of the bolus into the pharynx. Generated pressures vary, with greater pressure needed as bolus viscosity increases. Some patients with dysphagia are trained to increase lingual strength, but it is unclear whether they are aware of the varying pressures needed depending on the viscosity of the bolus. This study sought to examine how healthy adults attempt to replicate the pressures generated by their tongues across four bolus types.

Method(s): 19 adults (10 older, mean age 68.7; 9 younger, mean age 23.2) swallowed four bolus types (random order: apple juice, high pulp orange juice, applesauce, peanut butter) over five consecutive days. Following three boluses of each type, participants were asked to replicate the amount of pressure generated by the tongue for those swallows during a saliva swallow with an air-filled bulb (i.e., Iowa Oral Performance Instrument) placed between tongue and hard palate. Pressure was recorded from the IOPI bulb.

Result(s): Participants generated unique pressures for each bolus type ($p < .01$) with higher lingual pressures when mimicking pressures generated for more viscous boluses ($p < 0.001$). Older adults generated higher pressures for less viscous boluses than younger adults, while younger adults generated higher pressures for more viscous boluses than older adults ($p < 0.001$).

Conclusions (Including Clinical Relevance): Healthy adults are sensitive to differences in force generation requirements as bolus viscosity varies, with a wider range of pressures demonstrated in younger versus older adults.

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Relevant Non-financial Relationships: Alycia Rivet: Nothing to Disclose | Madison Eouse: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.

Lingual Muscle Plasticity with Age and Exercise

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Purpose: Regenerative capacity of tongue muscles changes with age. Mechanisms are unknown and may include increased death (apoptosis) of myonuclei and a diminished pool of muscle stem cells. It is also not known if tongue exercise may rescue cellular mechanisms of muscle regeneration in the tongue. The purpose of this study was to determine the effects of age and exercise on underlying cellular mechanisms of tongue muscle regeneration.

Method(s): Forty-eight young adult, middle-aged, and old rats were assigned to tongue exercise or sham-exercise (control) conditions (5 days/wk for 8wk). Following the study period, cross-sections of the genioglossus (GG) and styloglossus (SG) were immunostained for quantification of apoptotic (TUNEL) and regenerative capacity (Pax7) indices. Western blots for biomarkers of apoptosis and regeneration of whole muscle homogenates will also be performed in the GG and SG.

Result(s): Preliminary analysis of the GG suggest cell death increases with both age ($F_{2,42} = 4.5$, $p = .04$) and tongue exercise ($F_{1,42} = 4.2$, $p = .02$), and that cell death increases in Pax7 + muscle stem cells with aging ($F_{2,42} = 10.3$, $p < .001$).

Conclusions (Including Clinical Relevance): Pro-apoptotic processes that preferentially target muscle stem cells may be an underlying mechanism contributing to age-related degeneration of the tongue musculature. Further understanding of cellular mechanisms of muscle degeneration and regeneration are crucial to the development of exercise-based therapies for dysphagia.

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Applicability of the International Dysphagia Diet Standardisation Initiative(IDDSI) in Different Infant Formula Concentrations: An Experimental Study

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Purpose: Premature neonates may present difficult in the transition from tube to oral feeding. International Dysphagia Diet Standardisation Initiative(IDDSI) has developed 4 levels of liquids that can be easily measured and standardized throughout a 10 ml seringe. This study was developed to describe different infant formulas used for infants according to IDDSI.

Method(s): This was an experimental study performed by two speech language pathologists and two dietiticians. The professionals applied the IDDSI rationale to compare 6 different infant formulas being 2 for premature newborns formulas with 16% and 20% concentration; 2 first semester formulas with 13.3% and 16% and 2 extensively hydrolyzed formulas with 15.5% and 22% concentration. The raters performed the experiment 3 times for each formula.

Result(s): There was no significant difference in levels of the IDDSI in all 6 formulas tested. All of them reached the IDDSI level 0 even with different concentrations. There was a slight difference in time (milliseconds-ms) between the different concentrations. The minimum time of formula flow was a 16% premature formula that lasted 6 segundos 59 ms and the maximum time was for the extensively hydrolyzed formulas with 22% concentration was 9 s and 86 ms.

Conclusions (Including Clinical Relevance): Although there was no difference in the IDDSI levels between the the six infant formulas experimented tested by different examiners, time of formula flow in the 10 ml seringe was different. Further experiments including clinical and instrumental evaluation are needed to compare these differences in concentration in infant formulas.

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Orofacial Strength in Adults with Myotonic Dystrophy Type 1

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Purpose: Dysphagia and dysarthria are common complaints in myotonic dystrophy (DM1), however to date there has not been a way to quantify orofacial strength which may impact functional tasks. We explore use of the Iowa Oral Performance Instrument (IOPI) and a more novel measure, the lip force meter (LFM), to measure lingual and labial strength.
Method(s): Twenty-two adult participants with DM1, average age 39.4 years (range 29–54), completed maximal strength measures for anterior tongue with IOPI and lips with LFM. The LFM consists of a mouth guard, bite plate removed, attached to a strain gauge. The mouth guard is placed posterior to the lips and anterior to the teeth and a steady force is applied until the mouth guard is released. Measures were recorded at baseline and at approximately 3 month follow up. Healthy controls (avg age 41.9 years, range 18–61) also completed maximal labial and lingual strength measures.
Result(s): DM1 participants demonstrated overall average anterior tongue strength of 21.3 kPa versus 58.8 kPa in healthy controls. Labial strength measured with the LFM was 9.4 N overall in DM1 and 19.8 N in healthy controls. Maximal lingual strength at baseline vs. 3 month follow-up (day one measures): baseline average 22.0 kPa, SD 8.0; follow up average 21.2 kPa, SD 9.4. Change in maximal labial strength was more significant (day one): baseline average 10.4 N, SD 6.5; follow up average 8.7 N, SD 2.9.
Conclusions (Including Clinical Relevance): We present orofacial strength data in DM1 and report significant differences relative to healthy controls. These measures may be useful in therapeutic trials in DM1 as endpoints.
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Relevant Non-financial Relationships: Kiera Berggren: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership | Man Hung: Nothing to Disclose | Jerry Bounsanga: Nothing to Disclose | Melissa Dixon: Nothing to Disclose | Russell Butterfield: Nothing to Disclose | Nicholas Johnson: Nothing to Disclose.

AIMplot-Derived Biomechanical Measures: Which Ones Differentiate Normal from Disordered Swallowing?

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Purpose: AIMplot analysis derives biomechanical measures of swallowing function based on high-resolution impedance-manometry (HRIM). The aim of this study was to determine which AIMplot variables could differentiate patients from controls.
Method(s): Ten controls (24–33 years) and 25 patients within 3 subgroups were compared; dysphagia following UPPP sleep apnea surgery (n5, 48–63 years), head & neck cancer treatment (n5, 63–75 years) and ICU patients commencing oral feeding (n15, 50–78 years). During HRIM study participants swallowed 5/10 ml volumes of thin/ext. thick fluid (IDDSI 0/4). Studies were uploaded to the AIMplot open access website (swallowgateway.com). A global Swallow Risk Index (SRI) and 14 individual swallow variables were determined. Results (overall and per-subgroup) were compared. The ability to differentiate was determined using ROC (null hypothesis area = 0.5).
Result(s): The global SRI differentiated patients and controls overall (AUC range 0.924–0.964, $p < 0.0001$) and within each patient subgroup (AUC range UPPP 0.880–0.920, $p = 0.01$–0.02; ICU 0.940–0.980, $p < 0.0001$; HNC 0.920–0.960, $p = 0.005$–0.01). Three measures differentiated patients within all sub-groups; higher intra-bolus pressure (AUC 0.904–0.924, $p < 0.0001$), lower UES opening admittance (AUC 0.084–0.168, $p = 0.0001$–0.002) and lower UES basal pressure (AUC 0.116–0.152, $p < 0.001$). Lumen occlusve pressures did not differentiate groups.
Conclusions (Including Clinical Relevance): In this study, the SRI and specific biomechanical parameters that quantify pharyngeal flow resistance, UES opening extent and UES pre-deglutitive tone appear to be useful biomechanical markers of global swallowing function.
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The Influence of Dysphagia on Length of Stay and Health Care Expenditure—A Systematic Review of the Literature

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Purpose: Patient length of stay (LOS) in hospital and health care cost are influenced by many clinical factors. Due to its significant effects on health outcomes, impaired swallowing (dysphagia) may similarly be associated with increased LOS and health care expenditure.
Method(s): A systematic review of the literature across eight medical data bases was undertaken of studies comparing LOS and dysphagia attributable cost in individuals with and without dysphagia in any setting. 4356 initial search results were dual-screened for relevance before 120 full texts were reviewed in detail. In total, 11 studies providing relevant cost data and 22 studies providing LOS data were included.
Result(s): In all seven cohort and four cross-sectional studies across various settings (stroke, head and neck cancer, cervical spine surgery and Alzheimer's disease), health care costs were significantly higher for those presenting with dysphagia (mean difference in US$: 7409; 34.2% higher than no-dysphagia). LOS was significantly longer in those with all cause dysphagia (excluding stroke) in all 17 cohort studies, 4 cross sectional studies and 2 case series. For dysphagia following stroke, 4/6 studies demonstrated significantly increased LOS.
Conclusions (Including Clinical Relevance): The outcomes of this systematic review provide strong support for the need to prevent and

appropriately manage dysphagia across all fields of medicine, which would lead to significantly reduced LOS and health care expenditure.
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Redefining Elderly Swallowing Through Videofluoroscopy

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Purpose: Impact of age on swallowing has been investigated. As our population ages, the concept of considering 60–70 years old as 'elderly' may need revising. This study presents the largest cohort of quantitative videofluoroscopic swallow (VFSS) parameters measured in healthy older adults. The aim of this prospective observational study was to objectively measure videofluoroscopic swallow studies of normal swallowing adults $>$ 65 years with age stratification through to 100 years, to identify whether there is a physiologic change in swallowing with marked older age.
Method(s): 151 mixed gender adults with no history of dysphagia were recruited. All adults underwent a standardized VFSS protocol. Videos were analyzed using quantitative digital measures of timing and displacement.
Result(s): Mean total pharyngeal transit time was significantly longer in $>$ 80 y ears (0.97 s) than $<$ 80 year olds (.86 s) ($p <$ .001). Mean total airway closure duration was significantly longer in $>$ 80 years (.96 s) than $<$ 80 year olds (.87 s) ($p <$ .001). Increased esophageal transit time was observed in adults $>$ 80 years. No aspiration was detected. Observations in $>$ 80 year olds included penetration events (10%), non-obstructive cricopharyngeal bars (30%), swallow onset at valleculae or below (30%) and mild pharyngeal residue (20%).
Conclusions (Including Clinical Relevance): Swallowing changes observed in healthy adults $>$ 80 years old support the need for age matched comparisons. Given the globally aging population, further development of our understanding of swallowing in the 'oldest old' is warranted.
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Development of an Esophageal Mechanical Stimulation Method for Eliciting the Swallowing Reflex in Healthy Individuals—Difference in Injected Region

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Purpose: We aimed to verify whether the swallowing reflex can be evoked by peripheral esophageal stimulation in human, and also whether the response and esophageal movement differ depending on the stimulated area.
Method(s): Ten healthy individuals participated in this study (32 ± 4 years). A catheter was inserted through the nose, and the tip of the catheter was placed at upper, upper middle, lower middle or lower esophageal region for injection. A high resolution manometric catheter was also passed transnasally. In a sitting position, an intraesophageal injection of 10 ml thickened water was administered with the injection rate of 10 ml per second. Also, the subject voluntarily swallowed 10 ml of thickened water for comparison. The injections at four different regions and the voluntary swallowing were repeated twice in a random manner. The latency from the start of the injection to the onset of UES relaxation, and the parameters in UES and LES pressures were compared.
Result(s): Swallowing reflex occurred within 30 s by all injections at upper region. Reflex latency was significantly shorter when injection occurred at the upper region of the esophagus than at the lower region ($p <$ 0.01). Pre- and post- maximum UES opening pressures of voluntary swallowing and injection at upper region were significantly larger than those of injection at lower region ($p <$ 0.01).
Conclusions (Including Clinical Relevance): Esophageal stimulation by fluid injection can induce a swallowing reflex in healthy adults and reflex latency and esophageal movement can be changed by the stimulated location.
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Prevalence and Severity of Dysphagia in Inpatients with Dementia Referred for Swallowing Evaluation

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Purpose: The purpose of this study was to determine prevalence and severity of dysphagia in inpatients with dementia referred for swallowing evaluation.
Method(s): Billing data were used to identify inpatients with a clinical bedside evaluation (CPT code = 92610) at a large, university hospital in calendar year 2014. In-depth abstractions of 2035 electronic health records were performed using a standardized data instrument. Dementia diagnoses were characterized based on a previously validated classification method. Dysphagia severity ratings were derived from bedside swallow evaluation (BSE) and/or videofluoroscopic swallow study (VFSS) clinical reports.
Result(s): 343 patients (16%) were diagnosed with dementia. These patients were significantly more likely to have dysphagia (89.4%; $p < .0001$) than intact swallow function. The majority were diagnosed with mild or mild-moderate dysphagia (65%) as compared to moderate (14%), moderate-severe (6%), or severe dysphagia (3%). 51% of patients with dementia received a BSE only; 46% a BSE and VFSS; and 2% a BSE and flexible endoscopic evaluation of swallowing. Median BSE dysphagia severity ratings were significantly higher than VFSS ratings ($z = -6.889$, $p < .0001$).
Conclusions (Including Clinical Relevance): Inpatients with dementia are likely to experience dysphagia. BSE clinical judgments of dysphagia severity may be more severe than judgments based on VFSS results, emphasizing the importance of instrumental evaluation. Less frequent occurrences of moderate-severe dysphagia may be due to patients with advanced dementia and worse swallow function receiving palliative/hospice care without hospital admission.
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Differences in Nutrition Method and Swallowing Function in Dysphagic Children

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Purpose: Nutrition intake is a serious problem for families who care for dysphagic children, and support of safe oral ingestion is needed. However, primary care physicians, family and care givers usually determine the nutrition method at random in many cases because there is no professional intervention. The purpose of this study is to examine whether nutrition method actually provided and swallowing function are deviated in dysphagic children.
Method(s): The subjects were 158 dysphagic children. We recommended the nutrition intake method based on underlying disease, the physical status and the oral function after videoendoscopy, videofluorography or meal observation to evaluate swallowing function. Furthermore, in subjects for which the nutrition method was changed, no trouble, such as pneumonia, was confirmed for half a year. Nutrition methods were classified into 7 levels using FOIS, and the difference in nutrition method between before and after determination was examined.
Result(s): Fifty-four percent of subjects (100/158) had a difference in FOIS level after determination. Of 100 cases with a difference, 15 had a higher FOIS level before determination. On the other hand, 85 had higher levels after determination, and among them, 58% (49/85) with no oral ingestion before our determination were found to be able to ingest orally.
Conclusions (Including Clinical Relevance): These results demonstrated that there are many dysphagic children who can safely ingest orally if a clinician specializing in dysphagia sufficiently evaluates swallowing function.
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Biomechanical Correlates of Timed Water Swallow Test Metrics Using Pressure-Flow Analysis in Healthy Volunteers

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Purpose: The timed water swallow test (TWST) is used to screen for oropharyngeal dysphagia in neurogenic disease. The aim of our study was to determine the biomechanical correlates of TWST in healthy volunteers.
Method(s): A 150 ml TWST was undertaken with high-resolution impedance manometry in nine volunteers (4 M, 29 ± 7 years). Recordings were exported and pressure flow analysis (PFA) performed via swallowgateway.com. Pearson product correlation was performed for TWST metrics with PFA metrics.
Result(s): The number of swallows ($R = -0.793$; $P = 0.01$) and total duration ($R = -0.754$; $P = 0.02$) of TWST correlated negatively with upper esophageal sphincter (UES) maximum admittance (Max Adm), a biomechanical marker for UES cross-sectional area. Volume per swallow (V/S) and time (V/T) correlated with UES Max Adm (V/S $R = 0.921$; $P < 0.001$; V/T $R = 0.767$; $P = 0.02$) and UES opening time (V/S $R = 0.770$; $P = 0.02$; V/T $R = 0.688$; $P = 0.04$). V/S and V/T also correlated with increased hypopharyngeal (V/S $R = 0.805$; $P = 0.009$; V/T $R = 0.829$; $P = 0.006$) and UES contractile integrals (V/S $R = 0.932$; $P < 0.001$; V/T $R = 0.904$; $P = 0.001$) and an

increased UES post-swallow peak (V/S R = 0.758; P = 0.02; V/T R = 0.734; P = 0.02).

Conclusions (Including Clinical Relevance): Reduced UES cross-sectional area was associated with an increased duration and number of swallows during TWST. Volume per swallow and time increased with longer UES opening of a greater extent, while hypopharyngeal and UES contractility also increased in response. TWST is likely to be abnormal in circumstances of UES dysfunction.

Relevant Financial Relationships: Charles Cock: Nothing to Disclose | Mistyka Schar: Nothing to Disclose | Taher Omari: Nothing to Disclose | Sebastian Doeltgen: Nothing to Disclose.

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Differences in Timing Between Swallows of Healthy Older and Healthy Young Adults

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Purpose: To determine whether timing measures for swallows from healthy older adults differ from comparison measures for healthy young adults.

Method(s): Duplicate blinded ratings were obtained for swallows of 20%w/v thin liquid barium collected under videofluoroscopy at 30 frames/s from 17 healthy older adults, aged 60–84 (12 women). Swallows were compared to data from a retrospective dataset collected in 20 healthy young adults aged 22–45 (10 women). Nine timing measures were studied, including parameters related to swallow response, bolus transit, laryngeal vestibule closure and UES function. We used linear mixed model repeated measures ANOVAs to explore the hypothesis that swallow timing measures would be longer in the older adults.

Result(s): Laryngeal vestibule closure duration, laryngeal vestibule closure reaction time and maximum pharyngeal constriction (MPC) to UES closure did not differ between groups. Hyoid onset to UES opening (UESO) was shorter in the older participants. For all other measures, including bolus passing mandible ramus to UES closure, swallow reaction time, UESO duration and UESO to MPC, significantly longer timing ($p < 0.01$) was seen in the older participant group.

Conclusions (Including Clinical Relevance): Longer swallow timing measures, in general, are a clear factor distinguishing swallows in healthy older adults from swallows in young healthy adults.

Relevant Financial Relationships: Weslania Nascimento: Has affiliations to disclose; CAPES (Coordination for the Improvement of Higher Level -or Education- Personnel): Grant: Other Activities | Ashley Waito: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Melanie Peladeau-Pigeon: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Teresa Valenzano: Has affiliations to disclose; Toronto Rehabilitation Institute—University Health Network: Salary/Stipend: Employment | Talia Wolkin: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Roberto Dantas: Has affiliations to disclose; Medical School of Ribeirao Preto: Salary/Stipend: Employment | Catriona Steele: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment; NIDCD: Grant: Independent contractor (Including contracted research).

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Differences in Timing Between Functional Swallows of Older Adults at Risk for Dysphagia and Healthy Older Adults

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Purpose: To determine whether timing measures for functional swallows from older adults at risk of dysphagia differ from comparison measures for healthy older adults.

Method(s): Duplicate blinded ratings were obtained for swallows of 20% w/v thin liquid barium collected under videofluoroscopy at 30 frames/s from 11 older adults at risk for dysphagia, aged 62–87 (3 women). Functional swallows (Penetration-Aspiration Scale scores < 3) were compared to swallows from 17 healthy older adults, aged 60–84 (12 women). Nine timing measures were studied, including parameters related to swallow response, bolus transit, laryngeal vestibule closure and UES function. We used linear mixed model repeated measures ANOVAs to explore the hypothesis that swallow timing measures would be longer in the older adults at risk for dysphagia.

Result(s): Significantly longer timing to laryngeal vestibule closure (LVC) reaction time and hyoid onset to UES opening ($p < 0.01$) were seen in the older participants at risk of dysphagia. Also, this group presented longer intervals from LVC to UES opening and from maximum pharyngeal constriction to UES closure.

Conclusions (Including Clinical Relevance): In general, swallows in older adults at risk of dysphagia could be distinguished from healthy older adults by longer timing measures.

Relevant Financial Relationships: Weslania Nascimento: Has affiliations to disclose; CAPES (Coordination for the Improvement of Higher Level -or Education- Personnel): Grant: Other Activities | Ashley Waito: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Melanie Peladeau-Pigeon: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Teresa Valenzano: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Talia Wolkin: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment | Roberto Dantas: Has affiliations to disclose; Medical School of Ribeirao Preto: Salary/Stipend: Employment | Catriona Steele: Has affiliations to disclose; University Health Network: Salary/Stipend: Employment; NIDCD: Grant: Independent contractor (Including contracted research).

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Effect of Temperature in Eliciting Swallowing Reflex by Esophageal Stimulation in Humans

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Purpose: We have shown that swallowing reflex can be evoked through intraesophageal stimulation by fluid injection in another study. By fluid injection at upper or middle esophageal region in healthy adults, swallowing reflex occurred spontaneously within 30 s with probabilities of more than 90%. To verify the most effective condition for inducing swallowing reflex, we investigated whether the response differs depending on the physical property of fluid temperature.
Method(s): Ten healthy adults (30 ± 2 years) participated in this study. A catheter was inserted through the nose, and the tip of the catheter was placed at the upper esophageal region for injection. A high resolution manometric catheter was then passed transnasally. Intraesophageal injection of 3 ml thickened water controlled at 1 degree, 25 degrees or 35 degrees Celsius was administered. Each trial was repeated three times randomly. The latencies from the start of the injection to the onset of upper esophageal sphincter relaxation were compared.
Result(s): Swallowing reflex occurred with probabilities of 100, 92 and 55% within 30 s at 1 degree, 25 degrees or 35 degrees Celsius of water, respectively. The latencies were 4.8 ± 5.1 (average ± SD), 9.8 ± 8.5, and 16.7 ± 9.6 ms. Thus, the latency with 1 degree Celsius was significantly shorter than that with 25 degrees or 35 degrees Celsius ($p < 0.01$, repeated-measures ANOVA & Tukey's post hoc test).
Conclusions (Including Clinical Relevance): Reflex latency induced by intraesophageal injection of fluid can be changed by fluid temperature and the most effective condition for inducing the swallowing reflex is cold stimulation.
Relevant Financial Relationships: Yoichiro Aoyagi: Nothing to Disclose | Hiroshige Taniguchi: Nothing to Disclose | Sayuri Imaeda: Nothing to Disclose | Makoto Hirumuta: Nothing to Disclose | Eiichi Saitoh: Nothing to Disclose.
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Effects of Expiratory Strength Task with Different Devices on Electrical Activity of Submental Muscles

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Purpose: Although the goals of dysphagia rehabilitation are the same, availability of resources varies greatly around the world. Literature points to the benefits of expiratory muscle strength training in swallowing, however, research with cheap devices is still insufficient. Aim: To compare suprahyoid muscles contraction obtained with EMST–150 (Aspire Products LLC, USA) that presents scientific evidence for dysphagia rehabilitation with those existing in Brazil that were adapted for this purpose.
Method(s): Prospective study conducted with 50 healthy male adults (20–58 years old). Participants performed expiratory tasks in 3 different devices in counterbalanced order: EMST-150 in low (60 cmH_2O) and high (150 cmH_2O) loads, inverted Respiron in load 0 (minimal) and 3 (maximum) and Shaker (both from NCS, Brazil). sEMG activity of the submental muscle group was measured using the Myotool 400 (RS,Brazil) during all the exercise tasks.
Result(s): EMST-150 with high load showed maximum sEMG values during expiratory strength task. Inverted Respiron in load 3 presented the higher intraclass correlation coefficient (0.683) when compared with EMST-150 in minimal load, followed by inverted Respiron® in load 0 (0.646) and Shaker (0.642).
Conclusions (Including Clinical Relevance): Inverted Respiron® in maximum load was the Brazilian device that most closely resembled to the EMST-150 at its minimum load in healthy adults. Although most of the correlations were moderate probably because of the lack of calibrated load, future studies should address the potential benefit from these more accessible devices to patients with dysphagia in underdeveloped countries.
Relevant Financial Relationships: Luciana DAllagnoll: Nothing to Disclose | Thami Vilas Boas: Nothing to Disclose | Neyller Montoni: Nothing to Disclose | Jessica Cordeiro: Nothing to Disclose | Dhyanna Suzart: Nothing to Disclose | Patricia Milanello: Nothing to Disclose | Leandro Viana: Nothing to Disclose | Irene Netto: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.
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Swallowing Pressure and Limb Motor Variability in Early-Stage Parkinson Disease

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Purpose: Within-individual swallowing pressure variability is elevated in persons with early and mid-stage Parkinson disease (PD). Other reports indicate variability in limb movements, such as finger-tapping and gait. Since there are differences in swallowing and limb sensorimotor control, we hypothesized that swallowing pressure variability would differ between patients with PD and controls and would not be related to finger-tapping and gait variability.
Method(s): Eleven patients in the first 5 years after PD diagnosis and 9 healthy age/sex-matched controls underwent pharyngeal high-

resolution manometry, a finger-tapping task, and gait testing. A firth logistic regression with forward- backward model selection was used to identify parameters that best differentiated patients and controls, and Pearson correlations were used to evaluate relationships between parameters.

Result(s): Preliminary analysis revealed that velopharynx pressure variability, hypopharynx (HP) maximum pressure, UES minimum pressure, and step length variability in dual-task walking differentiated patients from controls ($\chi^2(5) = 12.87$, $p = 0.02$). There were no differences in finger-tapping variability between patients and controls. Gait variability was only related to UES nadir duration variability ($r = 0.63$, $p = 0.038$) in patients with PD.

Conclusions (Including Clinical Relevance): Subtle swallowing pressure changes occur early in the progression of PD. Gait variability is increased in PD but is only related to one parameter of swallowing pressure variability, suggesting different control mechanisms.

Relevant Financial Relationships: Corinne Jones: Has affiliations to disclose; NIH: Salary/Stipend: Employment | Michelle Ciucci: Has affiliations to disclose; NIH: Salary/Stipend: Employment | Christine Samuelsen: Nothing to Disclose | Kristen Pickett: Nothing to Disclose | Timothy McCulloch: Has affiliations to disclose; NIH: Salary/Stipend: Employment.

Relevant Non-financial Relationships: Corinne Jones: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ESSD: Professional: Membership; American Parkinson Disease Association-WI Chapter: Professional: Board membership; ASHA: Professional: Membership | Michelle Ciucci: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ASHA: Professional: Membership | Christine Samuelsen: Nothing to Disclose | Kristen Pickett: Nothing to Disclose | Timothy McCulloch: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership.

Relationship Between Reflex Cough and Swallow Timing in Parkinson's Disease

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Purpose: Parkinson's disease (PD) is associated with airway protection disorders. Deficits in reflexive cough are strongly correlated with decreased swallowing safety in PD, however the relationship of reflex cough to metrics of swallow physiology are unknown. The goal of this study was to investigate the relationship between reflex cough and swallowing physiology in PD.

Method(s): Sixty patients with PD (47 male) consented to participate. Disease duration and presence of deep brain stimulation electrodes (DBS) were disease-specific factors. Reflex cough and video fluoroscopic swallow evaluations were completed. Measures included urge-to-cough (UtC) sensitivity, responder/non-responder to distilled water (fog) and capsaicin, penetration-aspiration scores and swallow timing latencies and durations.

Result(s): Regression analysis showed UtC is linearly related to disease duration ($p = .002$), duration from swallow onset to laryngeal vestibule closure (LVC; $p = .016$), and duration of LVC ($p = .041$). A multivariate ANOVA revealed a significant interaction effect for DBS and response to fog ($F(4,41) = 4.05$; $p = .007$). Participants who had DBS and responded to fog had worse PA scores, and shorter LVC duration than responders without DBS.

Conclusions (Including Clinical Relevance): The relationship between reflex cough sensitivity and swallowing physiology relates primarily to the latency and duration of LVC. This is important because when cough sensitivity decreases, there may be delays and/or shortened duration of LVC, putting patients at higher risk for uncompensated airway compromise during swallowing and the risk may be higher in those with DBS.

Relevant Financial Relationships: Karen Hegland: Has affiliations to disclose; National Institutes of Health: Grant: Other Activities | Alexandra Brandimore: Nothing to Disclose | Shannon O'Donnell-Tatum: Nothing to Disclose | Michelle Troche: Has affiliations to disclose; MJFox Foundation: Grant: Other Activities; National Institutes of Health: Grant: Other Activities.

Relevant Non-financial Relationships: Karen Hegland: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ISARP: Professional: Membership; ASHA: Professional: Membership; MDS: Professional: Membership | Alexandra Brandimore: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ASHA: Professional: Membership; ISARP: Professional: Membership | Shannon O'Donnell-Tatum: Has a Non-Financial Disclosure Affliation; ASHA: Professional: Membership | Michelle Troche: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ASHA: Professional: Membership.

The Application of High Resolution Pharyngeal Manometry for Biofeedback in Dysphagia Therapy

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Purpose: High-resolution pharyngeal manometry (HRPM) allows vizualization of how different maneuvers can change swallowing physiology in real time. This visual feedback may reinforce a more accurate replication of exercises and strategies in the home setting and provides objective measurement of function during therapy. Our study sought to identify changes in pharyngeal manometry and quality of life parameters in patients undergoing HRPM biofeedback dysphagia therapy.

Method(s): Ten patients underwent a pilot program of HRPM biofeedback dysphagia therapy, participating in one HRPM therapy session per week and a daily home therapy program. Five saliva swallows at the initial treatment session were compared to five saliva swallows at the final treatment session. Differences in pharyngeal (PCI), velopharyngeal (VPCI), tongue base region (TBRCI), and hypopharyngeal (HPCI) contractile integrals were evaluated. Pre and post treatment Eating Assessment Tool (EAT-10) and Dysphagia Handicap Index (DHI) were compared.

Result(s): Seven of ten patients (70%) showed improvement in HPRM parameters with an average increase of 87.1 mmHg-cm-s in PCI, 37.1 in VPCI, 45.1 in TBRCI, and 7.5 in HPCI. EAT-10 scores improved from 25.7 to 21.6 post- treatment. DHI total scores decreased from 64.2 pre-treatment to 57.1 post-treatment. There were no adverse events.

Conclusions (Including Clinical Relevance): HRPM as a biofeedback tool is well tolerated and both patients and clinicians reported high satisfaction with the pilot program. Further study with control groups and standardized therapy programs is needed.

Relevant Financial Relationships: Kate Humphries: Has affiliations to disclose; Medtronic: Consulting fee: Consulting | Julie Blair: Nothing to Disclose | Ashli O'Rourke: Has affiliations to disclose;

Medtronic Inc: Consulting fee: Consulting; Carolina Speech Services: Honoraria: Board membership.
Relevant Non-financial Relationships: Kate Humphries: Nothing to Disclose | Julie Blair: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership | Ashli O'Rourke: Has a Non-Financial Disclosure Affliation; DRS : Professional: Membership.

The Differential Effect of Monetary Reward on Motor Planning in Swallowing Airway Protection

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Purpose: Evidence shows that the expectation of a rewards biases human performance and acts as a powerful motivator. We examined the effect of financial reward on laryngeal vestibule closure reaction time (LVCrt) when performing the volitional laryngeal vestibule closure (vLVC) maneuver (vLVC = swallow and prolong LVC for 2 s). LVCrt was the outcome variable of the study because it indicates motor planning.
Method(s): 40 healthy adults participated in three sessions (Day 1, 7, 14; videofluoroscopy recorded throughout). Each participant performed alternating tasks: (a) swallow; (b) vLVC swallow (reward only based on successful vLVC). To manipulate vLVC motor planning, participants were randomized to 1 of 4 groups: (1) Catch trial reward; (2) Catch trial control; (3) Prep time reward; 4) Prep time control. In Catch trial groups, some swallow trials were unexpectedly changed to vLVC trials. In Prep time groups, the preparatory time before the "vLVC go" command randomly changed during the study (1, 1.5, 2 s). All participants completed $\sim$ 40 trials across 3 visits with feedback about success of vLVC trials. Only reward groups advanced monetarily with accurate performance, while the control groups' performances had no bearing on financial gain.
Result(s): Reward prolonged LVC reaction time in the catch trial group, but shortened LVCrt in the Prep time group (both $p = 0.001$).
Conclusions (Including Clinical Relevance): Financial reward can modify motor planning of swallowing airway protection depending upon the task requirements and difficulty.
Relevant Financial Relationships: Renata Guedes: Nothing to Disclose | Kirstyn Sunday: Nothing to Disclose | Alycia Rivet: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.
Relevant Non-financial Relationships: Renata Guedes: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership; ESSD: Professional: Membership | Kirstyn Sunday: Nothing to Disclose | Alycia Rivet: Nothing to Disclose | Ianessa Humbert: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership.

Mano-Videoendoscopic Assessment of Pharyngeal Stage in Dysphagic Patients

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Purpose: Mano-videoendoscopy (MVE) is a manometry technique with endoscopic confirmation of the pressure catheter. The purpose of this study is to investigate the usefulness of MVE in evaluating pharyngeal swallowing pressure and upper esophageal sphincter (UES) function.
Method(s): The data from 75 patients with dysphagia were retrospectively reviewed. All patients underwent both MVE and videofluorography. Manometry was performed with a catheter (2.6-mm outer diameter and 4 pressure sensors). The sensors were kept at tongue base, upper and apex of the pyriform sinus, and UES. We evaluated the pharyngeal contraction and UES function fluorographically, and statistically compared the manometric parameters.
Result(s): The fluorographic pharyngeal contraction was diagnosed as poor in 45 patients. The UES opening was poor in 27 patients. A stepwise logistic regression test revealed that the peak pressure at upper pyriform sinus was a robust predictor of fluorographic pharyngeal contraction, and the cutoff level was $>$ 81.5 mmHg. The pressure drop—the gap between resting pressure and nadir of UES pressure—was a robust predictor of fluorographic UES opening, and the cutoff level was $\geq$ 33.5 mmHg.
Conclusions (Including Clinical Relevance): MVE can supplement the information on obtained regarding the pharyngeal contraction and UES function.
Relevant Financial Relationships: Takehiro Karaho: Nothing to Disclose | Junko Nakajima: Nothing to Disclose.
Relevant Non-financial Relationships: Takehiro Karaho: Nothing to Disclose | Junko Nakajima: Nothing to Disclose.

Effects of Chin Tuck Against Resistance Exercise Program On Suprahyoid Muscle Activity And Tongue Function

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Purpose: Chin Tuck against resistance (CTAR) exercises was specifically designed to improve swallowing by strengthening the suprahyoid muscles. The aim of this study was to evaluate the effects of a training program with CTAR exercises and to analyze the impact of exercise frequency on electrical activity of suprahyoid muscles and tongue strength and endurance of healthy young adults.
Method(s): Prospective study conducted with 52 healthy adults aged between 20 and 50 years, of both sexes. Participants were randomized into two groups: control (no exercise) and experimental (instructed to perform CTAR exercises on the isometric and isotonic tasks 3 times a day, 5 times a week for 6 weeks). Subjects underwent baseline and 6 weeks post-baseline assessments of tongue function (strength and resistance) using the Iowa Oral Performance Instrument (IOPI) and sEMG activity of the submental muscles was measured using the Myotool 400 (Porto Alegre, RS, Brazil). Subjects were asked to write down frequency of home exercises.
Result(s): Results revealed a significantly increase in maximum tongue strength ($p = 0.003$) and endurance ($p = 0.046$) in the group that performed CTAR exercises. Control group did not present any difference. Participants who performed more than 60% of the proposed exercises significantly increased the activity of the suprahyoid muscles ($p = 0.023$) and the tongue strength ($p = 0.021$) after training.
Conclusions (Including Clinical Relevance): A program with CTAR exercises increased tongue function of healthy young adults. High

frequency of exercises affected the electrical activation of the suprahyoid muscles and the strength of the tongue.

Relevant Financial Relationships: Thami Vilas Boas: Nothing to Disclose | Luciana DAllagnoll: Nothing to Disclose | Camila Barcelos: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Mariana Neves: Nothing to Disclose | Roberta Santos: Nothing to Disclose | Tairine Santos: Nothing to Disclose | Irene Netto: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.

Relevant Non-financial Relationships: Thami Vilas Boas: Nothing to Disclose | Luciana DAllagnoll: Nothing to Disclose | Camila Barcelos: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Mariana Neves: Nothing to Disclose | Roberta Santos: Nothing to Disclose | Tairine Santos: Nothing to Disclose | Irene Netto: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.

Preclinical Dysphagia and Changes to Laryngeal Muscles in a Translational Model of Parkinson Disease

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Purpose: Our hypothesis is that peripheral neuromuscular pathology occurs in the preclinical stages of Parkinson disease (PD) and may be linked to emergence of swallowing dysfunction. We used a translational genetic model (Pink1−/− rat) that recapitulates early swallowing deficits (Grant et al. 2014) and assayed laryngeal muscles.

Method(s): Thyroarytenoid (TA) muscles were isolated from Pink1−/− and WT controls at 4 and 6 months of age (n = 7–12/group). Sections of the external (TA-Ex) and vocalis (TA-V) were analyzed for: centrally-nucleated myofibers, cross-sectional area, and minimum Feret diameter. Then, muscle was processed to quantify myosin heavy chain isoforms (MyHC). Two-way analysis of variance (genotype, age) and a Fisher's Least Significant Differences were used to compare dependent variables ($\alpha < .01$).

Result(s): There was a significant increase in centrally-nucleated myofibers in the TA-Ex of Pink1−/− rats at both timepoints ($p < 0.001$). Significantly smaller cross-sectional area and minimum Feret diameter in the TA-V were found in 6 mo old Pink1−/− rats ($p = 0.002$). Pink1−/− TA MyHC profiles showed significantly greater proportions of the MyHC 2L isoform ($p = 0.003$) and reductions in the 2X isoform ($p = .005$).

Conclusions (Including Clinical Relevance): Myofiber differences occur in a preclinical stage of PD. Notably, there are more fatigable faster contracting fiber types at 4 and 6 months. Previously reported swallowing dysfunction in this model could be related to these changes and represent a paradigm shift in our understanding of the onset and mechanisms of dysphagia in PD.

Relevant Financial Relationships: Tiffany Glass: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment; National Institutes of Health: Grant: Other Activities | Cynthia Kelm-Nelson: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment; National Institutes of Health: Grant: Other Activities | Jacob Lake: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment | John Szot: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment | Nadine Connor: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment; National Institutes of Health: Grant: Other Activities | Michelle Ciucci: Has affiliations to disclose; University of Wisconsin: Salary/Stipend: Employment; National Institutes of Health: Grant: Other Activities.

Relevant Non-financial Relationships: Tiffany Glass: Nothing to Disclose | Cynthia Kelm-Nelson: Nothing to Disclose | Jacob Lake: Nothing to Disclose | John Szot: Nothing to Disclose | Nadine Connor: Nothing to Disclose | Michelle Ciucci: Has a Non-Financial Disclosure Affliation; National Foundation of Swallowing Disorders: Professional: Board membership.

Yale Swallow Protocol For Detection Of Aspiration Risk In Hospitalized Cancer Patients

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Purpose: Application of Yale Swallow Protocol in hospitalized cancer patients.

Method(s): Prospective study with 60 patients, mean age 68 ± 6.33 years old, who met the inclusion criteria of completion of a brief cognitive assessment, oral mechanism examination and no tracheotomy tube or alternative feeding routes. Participants responded to the protocol translated and culturally adapted to the Brazilian Portuguese. First, all participants were administered the Yale Swallow Protocol by two experienced SLP trained in protocol administration. Failure criteria were inability to drink the entire amount (90 ml of water in a glass), interrupted drinking or coughing during or immediately after drinking. Second, all participants completed a videofluoroscopic swallow study (VFSS) within 5-10 min of protocol administration. A SLP blinded to protocol results reviewed the VFSS to determine aspiration status in a binary (yes/no) manner.

Result(s): Forty-four patients passed the three steps of the protocol and 15 failed at least in 1 step. The Kappa concordance index among the evaluators for presence/absence of aspiration in VFSS was significant (< 0.0001). The sensitivity and specificity of the protocol were 75.4% and 33.3%, respectively. The positive predictive value for aspiration was 95.6%, negative predictive was 6.7% and accuracy was 73.33%.

Conclusions (Including Clinical Relevance): Yale Swallow Protocol can be used in clinical practice in order to predict the risk of aspiration of hospitalized cancer patients. However, for this specific population, it should be used in a complementary way to the clinical evaluation.

Relevant Financial Relationships: Mariana Neves: Nothing to Disclose | Elisa Vieira: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Luciana DAllagnoll: Nothing to Disclose | Camila Barcelos: Nothing to Disclose | Jaqueline Fonseca: Nothing to Disclose | Renata Guedes: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.

Relevant Non-financial Relationships: Mariana Neves: Nothing to Disclose | Elisa Vieira: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Luciana DAllagnoll: Nothing to Disclose | Camila Barcelos: Nothing to Disclose | Jaqueline Fonseca: Nothing to Disclose | Renata Guedes: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.

Laryngeal Vestibule Airway Protection Patterns (LVAPP): Initial Scale Development and Validation

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Purpose: Laryngeal vestibule closure (LVC) is the primary swallowing airway protection mechanism. Currently, LVC is measured as present, incomplete, or absent. However, detailed consideration of arytenoid-to-epiglottic (A–E) relationships do not exist. We sought to develop an MBS scale to grade LVC airway protection patterns (LVAPP) at increasing severity levels based on detailed A–E relationships. We hypothesized that a 5-point scale is feasible, reliable, and valid.
Method(s): Two blinded raters scored 735 videofluoroscopic swallows from healthy (n = 231) and post-stroke patients (n = 494). LVAPP 5-point scale includes: (0) Present EI and AC (Normal); (1) Absent EI, present AC; (2) Present EI, partial AC; (3) Absent EI, partial AC; (4) Present EI, absent AC; (5) Absent EI, absent AC. A modified Delphi exercise was conducted for content validation, expert consensus, and operationalization of LVAPP criteria. Intra- and inter-rater reliability were tested by Cronbach's α and weighted k. Criterion validity against MBSImP and PAS was assessed with Pearson Correlation Coefficient.
Result(s): Intra- and inter-reliability were excellent (α = 0.94) and (α = 0.92). LVAPP significantly correlated with MBSImP components (LVC, r = 0.857, EI, r = 0.77, both $p < 0.0001$) and airway safety (PAS, r = .707, $p < 0.0001$). The 5-point LVAPP scale also distinguishes detailed A–E relationships not captured by MBSImP or PAS between (a) normal and patients and (b) 5 distinct LVC patterns within patients (both $p < 0.0001$).
Conclusions (Including Clinical Relevance): LVAPP offers a reliable and valid measure for assessing changes in airway protection patterns.
Relevant Financial Relationships: Alicia Vose: Nothing to Disclose | Katherine Hutcheson: Nothing to Disclose | Emily Plowman: Nothing to Disclose | Ianessa Humbert: Nothing to Disclose.
Relevant Non-financial Relationships: Alicia Vose: Nothing to Disclose | Katherine Hutcheson: Nothing to Disclose | Emily Plowman: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership | Ianessa Humbert: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership.

The Ability of the Eating Assessment Tool—10 (EAT-10) to Detect Aspiration and Dysphagia in Cancer Patients

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Purpose: Dysphagia is common in cancer patients. There is a need to identify patients at aspiration/dysphagia risk early to prevent its serious complications. The aim of this study was to determine the ability of the EAT-10 to detect aspiration and/or dysphagia in hospitalized câncer patients.
Method(s): Retrospective study with 58 hospitalized cancer patients, 55.2% of males with mean age of 68.3 years (60–82). All patients were assessed by videofluoroscopy and responded to the Portuguese-version of EAT-10 self- assessment questionnaire. Demographic and clinical data were collected.
Result(s): The total EAT-10 score was altered in 37.9% (22) of the individuals. Related to dysphagia, we found EAT-10 specificity of 54.1%, sensitivity of 30%, positive predictive value (PPV) of 42.8% and negative predictive value (NPV) of 43.2%. Corcerning aspiration, specificity was 60%, sensitivity 0%, PPV 0% and NPV 91.7%. The receiver operating characteristic (ROC) curve that aims to compare the total score of EAT-10 with PAS did not find cutoff for this study population.
Conclusions (Including Clinical Relevance): The EAT-10 was unsatisfactory to detect the risk of dysphagian or aspiration in hospitalized cancer patients.
Relevant Financial Relationships: Mariana Neves: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Aline Gonçalves: Nothing to Disclose | Bruna Geraldini: Nothing to Disclose | Thami Vilas Boas: Nothing to Disclose | Poliana Pompeo: Nothing to Disclose | Gabrielle Moraes: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.
Relevant Non-financial Relationships: Mariana Neves: Nothing to Disclose | Simone Claudino: Nothing to Disclose | Aline Gonçalves: Nothing to Disclose | Bruna Geraldini: Nothing to Disclose | Thami Vilas Boas: Nothing to Disclose | Poliana Pompeo: Nothing to Disclose | Gabrielle Moraes: Nothing to Disclose | Elisabete Carrara-de Angelis: Nothing to Disclose.

Development & Validation of the Swallowing Kinesophobia Scale [SWKS] for Head Neck Cancer (HNC) Patients

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Purpose: Fear of swallowing movement and re-injury is thought to underlie reduced adherence to exercise and other self-help behaviors in HNC. We developed a reliable and valid scale to assess this novel concept in HNC.
Method(s): 50 patients with confirmed HNC presenting for external radiation and/or chemotherapy completed a survey including self-help behaviors' Performance Status Scale, and feeding history [FOIS] along with scales for cancer pain [visual analogue scale], Brief Worry scale, quality of life [FACT H/N], depression[PHQ-9] and swallowing fear. Surveys were completed before and after treatment. Content validity was ensured by expert focus group. Internal consistency [Cronbach α], split half and corrected item-total were assessed along with concurrent validity via comparison among health status instruments administered simultaneously. Known groups'were compared to evaluate discrimination using ANOVA.
Result(s): SWKS Cronbach α was 0.849. Test re-test reliability was r = 0.69, $p > < .027$. Concurrent validity demonstrated moderate relationship to depression score (0.46) and worry (0.43). Baseline SWKS demonstrated a significant relationship to patients' perception of swallowing difficulty post treatment (0.45) and baseline SWKS was related to reduced self-help behavior e.g. oral hygiene and swallow exercise [$F(2,46)2.608$, $p < .04$].
Conclusions (Including Clinical Relevance): SWKS is a valid tool to evaluate swallowing related fear and avoidance of swallow movement in HNC. It can help identify individuals who would benefit from increased therapeutic support in swallow exercise and graded activity exposure.
Relevant Financial Relationships: Giselle Carnaby: Nothing to Disclose.
Relevant Non-financial Relationships: Giselle Carnaby: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership.

Differential Upper Airway Sensitivity in Total Laryngectomy

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Purpose: Vagal afferents elicit cough in the upper airway: chemosensors responsive to capsaicin (Cap) via transient receptor potential V1 (TRPV1) and acids via acid sensitive ion channels (ASICs). This study aimed to determine the differential response to citric acid (CA) and Cap in the absence of laryngeal afferents (i.e., following total laryngectomy; TL).
Method(s): Data were collected from 20 adults (14 male) with TL, age 50–80 (mean 60 years.). Participants were presented with Cap trials (0, 25, 50, 100, 200 μM) and CA trials (0, 30, 100, 300, 1000 mM) delivered via a stomal adaptor coupled to a pneumotachograph. Ratings of urge to cough (UtC) were made on a modified Borg Scale (0 = none, 10 = max). Repeated measures analysis of variance was used to determine differences in cough sensitivity and airflow between stimulus types and concentrations.
Result(s): There was a significant interaction for stimulus and concentration ($F(8,11) = 5.87$; $p = .004$) on UtC, and a significant main effect for concentration on CrTot ($F(8,11) = 4.93$; $p = .009$). UtC was reduced at the highest 3 concentrations of CA vs. Cap, and CrTot increased with increasing concentration for both stimuli.
Conclusions (Including Clinical Relevance): Reduced sensory perception (UtC) in the context of equivalent motor output (CrTot) may suggest role of TRPV1 afferents in cortical control of airway protective responses. Given the known relationship of UtC and CrTot in other patient populations, there is a need for further investigation of the potential therapeutic effect for Cap on the volitional up-regulation of the CrTot, in patients with dysphagia.
Relevant Financial Relationships: Yuhan Mou: Nothing to Disclose | Amy Fullerton: Nothing to Disclose | Karen Hegland: Has affiliations to disclose; University of Florida: Salary/Stipend: Employment.
Relevant Non-financial Relationships: Yuhan Mou: Nothing to Disclose | Amy Fullerton: Nothing to Disclose | Karen Hegland: Has a Non-Financial Disclosure Affliation; DRS: Professional: Membership.

Patient Adherence, Tongue Force Generative Capacity, and Swallowing Outcomes

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Purpose: The purpose of this study was to assess whether patient adherence to a lingual-exercise program was related to tongue force generative capacity and functional swallowing outcomes.
Method(s): Participants (57 m; 2 f; mean age = 69 year) with varied primary diagnoses enrolled in an 8-week lingual exercise program facilitated with the SwallowSTRONG® device. Treatment dose (10 anterior press repetitions, 3x/day, 3 day/week) was selected based on previously published lingual exercise programs. Force targets were progressively increased over the 8-week protocol. Participant adherence was objectively recorded by the device. Max lingual pressures, Penetration-Aspiration Scale (PAS) scores, and Functional Oral Intake Scale (FOIS) scores were recorded pre- and post-treatment. ANOVAs were performed to evaluate relationships outcomes and percent adherence.
Result(s): Lingual exercise resulted in significantly increased max lingual pressures from baseline ($p < 0.001$). However, patient adherence to treatment (avg = 43.26; SD = 25.24) was not associated with increased maximal lingual pressure ($r = 0.04$; $p = 0.766$). Adherence was not significantly associated with changes in PAS and FOIS scores ($r = -0.066$; $p = 0.621$ and $r = -0.133$; $p = 0.314$, respectively).
Conclusions (Including Clinical Relevance): Adherence was not related to increases in tongue strength or changes in swallowing-related outcomes. As such, quantitative measures of exercise frequency did not appear to influence performance metrics. Because optimal treatment doses are not known, these data suggest that exploration of optimal doses should be conducted to align exercise frequency and performance outcomes.
Relevant Financial Relationships: Brittany Krekeler: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | Joanne Yee: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment; William S. Middleton Memorial Veterans Hospital: Salary/Stipend: Employment | Sarah Daggett: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment; William S. Middleton Memorial Veterans Hospital: Salary/Stipend: Employment | Glen Leverson: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | Nadine Connor: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment | Nicole Rogus-Pulia: Has affiliations to disclose; UW Madison: Salary/Stipend: Employment; William S. Middleton Memorial Veterans Hospital: Salary/Stipend: Employment.
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The Effects of Age and Swallowing Pressure on Penetration/Aspiration in Healthy Older Adults

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Purpose: To examine the effects of age and swallowing pressure on penetration/aspiration (PA) in healthy older adults.
Method(s): 30 subjects aged 60–88 years, grouped by age decade, swallowed 32 boluses systematically varying by volume (5, 10 mL) and viscosity (thin, nectar, pudding, semi-solid). Integrated videomanofluorography captured 5 swallowing pressures (anterior, middle, posterior tongue; superior, inferior pharynx). Penetration and Aspiration Scale (PAS) score was determined for each swallow. PA was dichotomized into "No" (PAS = 1) and "Yes" (PAS ≥ 2). Chi square (X^2) analyses investigated categorical variables' effect on PA; logistic regression investigated odds of each swallowing pressure predicting PA.
Result(s): 948 boluses were analyzed. Oldest subjects produced significantly lower swallowing pressures at each location ($p < .0001$ per

pressure). Overall penetration incidence = 21.7% and aspiration = 0.5%. Significant viscosity effect identified (X^2 = 178.49, df = 3, p < .0001); thin liquid was penetrated the most often (21%). No significant volume or age effects were identified. A 10-point decrease in each tongue pressure and the superior pharynx pressure increased odds of penetrating thin liquids [ORs: AntTong = 16.57; MidTong = 18.28; PostTong = 17.261; SupPhar = 14.032]. Inferior pharynx pressure was not significant.

Conclusions (Including Clinical Relevance): Results support prior research that lower pressures increase odds of PA events. However, contrary to prior literature, lower pressures in oldest adults did not result in increased PA incidence. Clinical implication may be that lower pressures are not the only factor underlying PA in older adults.

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Pre-clinical Dysphagia in Community Dwelling Odler Adults—Experiences with Developing a Novel Screening Tool

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Purpose: Early identification of risk for dysphagia in commuinity dwelling elderly (CDE) can help mitigate morbidities related to dysphagia. Lack of validated tools significantly impacts our ability to intervene early. The purpose of this study was to develop a valid, comprehensive, and reliable tool to screen for pre-clinical dysphagia in the CDE.

Method(s): This novel screening tool was constructed based on theoretical evidence of multiple domains that potentially contribute to pre-clinical dysphagia in the CDE. The tool was subject to extensive psychometric testing including detailed item analyses, reliability, and validity including factor analysis. The tool was also compared to current screening tools to test for convergent validity.

Result(s): The final tool of 17 items includes questions related to swallowing, motor abilities including activities of daily living, and cognitive-communication abilities. The tool demonstrated strong psychometric properties including reliability (Cronbach's alpha = 0.908), construct validity, and concurrent validity against a validated tool, the EAT-10 (rho = 0.719). Additionally, the tool demonstrated high sensitivity (80.3), specificity (82.6), and negative predictive value (96).

Conclusions (Including Clinical Relevance): The newly developed screening tool reflects the complex symptomology identifying the risk for development of difficulty swallowing. By considering domains not included in other dysphagia screeners, this novel PRO tool is more comprehensive than other tools. As a PRO, it is easy to complete and disseminate, and has the potential for a wide range of clinical applications.

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Swallowing, Tongue Function and QOL following Transoral Robotic Surgery (TORS)

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Purpose: Transoral robotic surgery (TORS) has been shown to have excellent functional results[1–4]. However, limited data exist on functionafter surgery prior toadjuvant therapy. Objective swallowing measures pre- and post- surgery have not been previously reported.. This prospective study examined the impact of TORS on tongue, swallowing function, and swallow QOL pre and 1-month post-surgery.

Method(s): Eleven patients with SCCA undergoing TORS surgery with concurrent or staged selective neck dissection were seen pre- and 1 month post-op. Disease site was oropharynx (10) and supraglottic (1). The 1 month post-op evaluation occurred prior to adjuvant therapy. MBS[9–10] was completed with the DIGEST swallow toxicity scale[11]. Tongue ROM was measured with the Tongue Composite Score[12]. The Performance Status Scale (PSS) was scored[13]. QOL was examined with the MDADI[14] global score.

Result(s): All patients were on normal diets pre and 1-mo post-op. Mean DIGEST scores pre and post-op were 0 and 0 (normal safety/efficiency). Tongue composite scores were 100/100 pre- and post-op. PSS scores were not significantly different pre- to post-op (Table 1). MDADI mean scores were 92 and 86, pre- and post-op. No patient required adjuvant CRT and 6 required adjuvant XRT alone. No patient needed PEG or tracheostomy.

Conclusions (Including Clinical Relevance): Patients undergoing TORS demonstrated normal speech, diet, eating out ability, and tongue ROM post-op with limited change from pre-op levels. Swallowing function revealed normal safety and efficiency, with high levels of swallow QOL observed post-op. Future studies will examine function over time.

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