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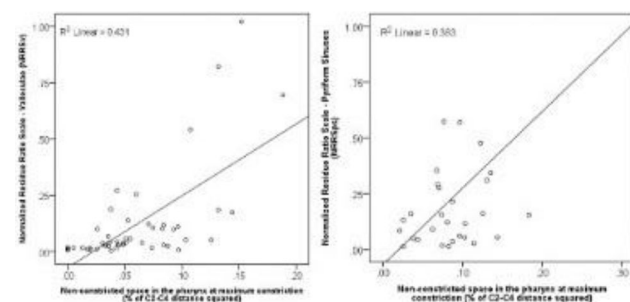
SCIENTIFIC PAPERS

THE RELATIONSHIP BETWEEN PHARYNGEAL CONSTRICTION AND POST-SWALLOW RESIDUE

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Purpose: Prior studies suggest that measures of pharyngeal constriction may distinguish functional from impaired swallows. We used anatomically normalized measures of pharyngeal area at rest and peak constriction, and explored the association with post-swallow residue using the Normalized Residue Ratio Scale (NRRS, Pearson et al. 2012).



Method(s): Videofluoroscopies for 5 ml boluses of 22 %w/v liquid barium were analyzed from 20 healthy young adults and 29 adults with dysphagia. Pixel-based measures of pharyngeal area were made at rest and peak constriction in ImageJ and size-normalized using the squared C2–C4 distance. Post-swallow residue and vallecular and pyriform sinus area were measured at rest to calculate the NRRSv and NRRSps. Mixed model repeated measures ANOVAs were used to compare pharyngeal area (rest, constriction) and the pharyngeal constriction ratio, between individuals with or without residue.

Result(s): Pharyngeal area measures did not differ at rest between those with and without residue. However, measures of pharyngeal area at maximum constriction were significantly larger (i.e., less constricted, $p = 0.000$) in individuals with post-swallow residue in either the vallecule or the pyriform sinus.

Conclusions (including clinical relevance): With thin liquids, the degree of maximum pharyngeal constriction is inversely correlated with the presence of post-swallow residue. This supports the idea that treatments that improve pharyngeal constriction should result in less residue. The relationship between pharyngeal constriction and residue for cases with non-zero Normalized Residue Ratio Scale scores in the vallecule and pyriform sinuses.

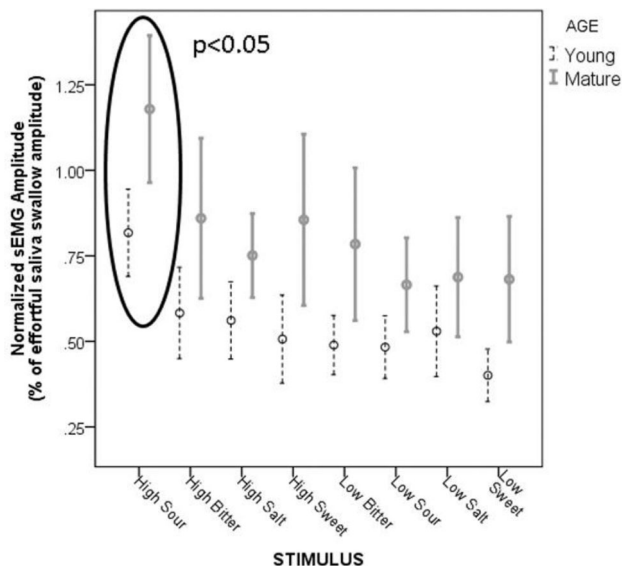
Disclosures: Shauna Stokely: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Sonja Molfenter: *Financial Disclosure:* Salary: New York University; Scholarship: NSERC Create Care Doctoral Scholarship; TRI OSOTF Scholarship; Ontario Graduate Scholarship; Other: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Chelsea Leigh: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Melanie Peladeau-Pigeon: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Catriona Steele: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; Grant/Research Support: National Institute of Deafness and Other Communication Disorders; Other: University of Toronto; Bloorview Research Institute; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

THE EFFECTS OF TASTE CONCENTRATION ON SEMG IN SWALLOWING

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Purpose: Prior electromyography (EMG) studies report that sour stimuli elicit higher amplitudes and tighter approximation of muscle activation. We explored submental EMG amplitudes and timing for high and low concentration taste solutions (sweet, sour, salty and bitter).



Method(s): These data were from the Arkansas Taste and Swallowing Study; 80 women, stratified by age-group and taste genetics, swallowed different taste solutions. sEMG amplitudes (normalized vs. effortful saliva swallows) and durations for high and low concentration taste stimuli were analyzed. Path analysis explored the modulatory effects of taste intensity and palatability ratings on age-group, genetic and stimulus effects.

Result(s): Older women had significantly higher normalized sEMG amplitudes: they used more of their effortful saliva swallow range when swallowing taste stimuli than the younger women. Higher amplitudes were seen with high concentration sour and both the high and low concentration bitter stimuli. Longer sEMG durations were seen for high sour stimuli. Stimulus effects were neutralized when intensity was included in the model. A high concentration sour stimulus elicited both significantly higher amplitudes and significantly longer durations than other tastes. This stimulus was also rated as most strongly disliked by older participants and supertasters.

Conclusions (including clinical relevance): These data show that high concentration sour stimuli elicit higher amplitudes and longer durations of sEMG. The findings are significantly associated with palatability, and reflect strong dislike for high sour stimuli, especially in older participants.

Disclosures: Cathy Pelletier: *Financial Disclosure:* Salary: Charlestown Community, Inc. Grant/Research Support: American Speech-Language Hearing Foundation; University of Arkansas for Medical Sciences; Johns Hopkins University; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Ahmed Nagy: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; Other: University of Fayoum; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Catriona Steele: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; Grant/Research Support: National Institute of Deafness and Other Communication Disorders; Other: University of Toronto; Bloorview Research Institute; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

THIN LIQUID BOLUS VOLUME ALTERS PHARYNGEAL SWALLOWING: KINEMATIC ANALYSIS USING 3D DYNAMIC CT

Inamoto, Yoko¹, Saitoh, Eiichi², Shibata, Seiko², Kagaya, Hitoshi², Aoyagi, Yoichiro², Onogi, Keiko², Katada, Kazuhiro³, Palmer, Jeffrey B⁴

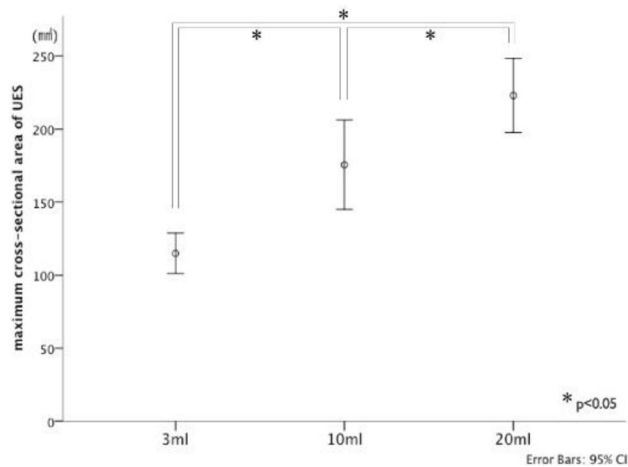
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Purpose: We previously reported spatial-temporal characteristics of swallowing with 3 different volumes of thick liquid using 320-row area detector computed tomography (320-ADCT) and suggested that volume had effects on the timing of bolus propulsion and opening of the upper esophageal sphincter (UES). The purpose of the current study was to evaluate these parameters with thin liquid.

Method(s): Fourteen healthy women (age 28–45 years) underwent 320-ADCT scan during swallows of 3, 10, and 20 ml thin liquid (5 %v/w) in 45° semi-reclining position. Three-dimensional images were created at 10 images/s rate. We measured the timing of critical events, the displacement of the hyoid bone, and maximal cross-sectional area of the UES.

Result(s): Increasing bolus volume had significant effects on timing of events but not hyoid displacement. Velopharyngeal and true vocal cord (TVC) closure and UES opening were earlier as bolus volume increased ($p < 0.05$), indicating earlier or faster bolus propulsion. Maximum area of UES similarly increased (mean area: 3 ml, 115.01 mm²; 10 ml, 175.49 mm²; 20 ml, 223.08 mm²; $p < 0.05$).

Conclusions (including clinical relevance): UES opening became earlier and increased in area as bolus volume increased. Velopharyngeal and TVC closure began earlier and lasted longer, perhaps in response to the change in bolus propulsion. These adaptations to higher volume could potentially reduce the risk of bolus misdirection, including aspiration and nasal regurgitation. The findings suggest that pharyngeal swallow can be modified by afferents in the oral cavity, perhaps reflecting a feed-forward control mechanism.



Disclosures: Yoko Inamoto: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Eiichi Saitoh: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Hitoshi Kagaya: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Seiko Shibata: *Financial*

disclosure: No relevant financial relationships exist. *Nonfinancial disclosure:* Japanese Society of Dysphagia Rehabilitation | Hitoshi Kagaya: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Yoichiro Aoyagi: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Keiko Onogi: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Kazuhiro Katada: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jeffrey Palmer: *Financial Disclosure:* Salaries: Johns Hopkins University, Springer Science + Business Media, LLC; Concession/Honoraria: Showa Univ., Fujita Health Univ. Royalty: Johns Hopkins University Press, Elsevier B.V. Speaker fee: Japanese Society for Dysphagia Rehab., Japanese Association of Rehab Med, International Society of Physical and Rehab Med; Other: Ishiyaku Publishers; *Nonfinancial Disclosure:* Society Member: American Academy of Phys Med and Rehab, Association of Academic Physiatrists, Japanese Society for Dysphagia Rehab., International Society of Physical and Rehab Med; Society Board Member: Assoc of Academic Physiatrists; Society Committee Member: American Academy of Phys Med and Rehab; Volunteer Advisory Committee or Review Panel Member: Foundation for Phys Med and Rehab; Volunteer Teacher/Speaker: American Academy of Phys Med and Rehab, Association of Academic Physiatrists; Member: Dysphagia Research Society.

CHANGES IN PHARYNGEAL MUSCLE ACTIVITIES DURING SWALLOWING: ANALYSIS USING 3D DYNAMIC CT

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Purpose: We previously reported that individual hyoid muscles have specific roles in the upward and forward movements of the hyoid bone during swallowing (Okada et al. 2013). In the present study, we attempted to elucidate the physiological mechanism of the pharyngeal swallowing; we esophageal screening analyzed muscle activity patterns by observing the shortenings of the pharyngeal muscles.

Method(s): Using a 320-row area detector CT, swallowing was evaluated in 26 healthy males while they swallowed 10 ml of liquid. The following parameters were analyzed: (1) origins and insertions of superior and middle pharyngeal constrictors (SPC and MPC), stylopharyngeus (SP), palatopharyngeus (PP), and tensor veli palatini (TVP) and (2) movements of the hyoid bone and laryngeal prominence.

Result(s): SP and PP become shortened first and were synchronized with the upward movement of the laryngeal prominence. Approximately 0.1 s later, SPC and TVP started shortening. The shortening of MPC, however, initiated significantly later, i.e., 0.25 ± 0.08 s later than that of SP ($p < 0.01$). All pharyngeal muscles except MPC showed decreases in length between the upward and forward movements of the hyoid bone. In addition, the shortened lengths of SP and PP significantly correlated with the upward movement distance of the laryngeal prominence ($r = 0.50$ and 0.47 , respectively).

Conclusions (including clinical relevance): Serial contractions of hyoid and pharyngeal muscles significantly influence the trajectory of the hyolaryngeal complex. In particular, SP and PP contribute to not only pharyngeal movement but also laryngeal upward movement.

Disclosures: Yoichiro Aoyagi: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Takeshi Okada: *Financial and*

Nonfinancial Disclosure: No relevant relationships exist. | Saitoh Eiichi: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Yoko Inamoto: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Seiko Shibata: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Hitoshi Kagaya: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Kazuhiro Katada: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

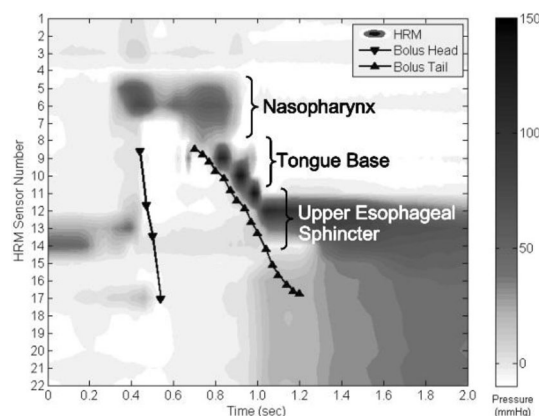
PHARYNGEAL PRESSURE AND TIMING DURING BOLUS TRANSIT

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Purpose: Manometric pressure during pharyngeal compression has been well-described, but it is not well known how pressures change during bolus transport. The purpose of this study was to describe the pressures, velocities, and timing surrounding bolus transport during a 10 mL liquid swallow.

Method(s): Simultaneous high-resolution manometry and videofluoroscopy was performed on 10 healthy subjects (21–52 years). Bolus head and tail coordinates were plotted against sensor position to obtain the corresponding pressures and video frame information. Swallows were scored according to the Modified Barium Swallow Impairment Profile (MBSImP). Comparisons were made using non-parametric tests.



Result(s): Throughout the pharynx, the average pressure at bolus tail passage was at least 2 times greater than the average pressure at bolus head passage ($p = 0.012$). When the MBSImP Tongue Base (TB) retraction score was 1-signifying a trace column of contrast between the tongue base and posterior pharyngeal wall-the bolus tail velocity was significantly slower than if the score was 0, signifying complete contraction ($p = 0.016$). In addition, when the TB retraction score was 1, the timing of the bolus tail relative to the pressure rise ($p = .0001$) and pressure maximum ($p = .0014$) at the sensor(s) was delayed compared to swallows which had TB retraction scores of 0.

Conclusions (including clinical relevance): Results support the idea that a bolus moves strategically from a place of high pressure to low pressure. Bolus velocity and pressure timing variations are reflected in MBSImP scores. Thus, tracking the bolus could be a useful tool for detecting swallowing abnormalities.

Disclosures: Chelsea Walczak: *Financial Disclosure:* Salary: University of Wisconsin - School of Medicine and Public Health; Grant/Research Support: NIH R21/R33 DC011130; *Nonfinancial*

Disclosure: No relevant nonfinancial relationships exist. | Timothy McCulloch: *Financial Disclosure:* Salary: University of Wisconsin-School of Medicine and Public Health; Grant/ Research Support: NIH R21/R33 DC011130; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Corinne Jones: *Financial Disclosure:* Salary: University of Wisconsin-School of Medicine and Public Health, Canterbury Medical Research Foundation; Scholarship: University of Wisconsin (pending); Grant/ Research Support: NIH R21/R33 DC011130; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | William Bleifuss: *Financial Disclosure:* Grant/ Research Support: NIH R21/R33 DC011130; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

EFFECTS OF AGE AND RADIATION TREATMENT ON FUNCTION OF EXTRINSIC TONGUE MUSCLES

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Purpose: Aging and head and neck radiotherapy independently impact swallowing function, which may be due in part to tongue muscle weakness. When aging and radiotherapy interact, it may be expected that there will be even greater deviations in function. However, there have been no investigations of how aging and head and neck cancer radiation treatment combine to impact the muscles of the tongue.

Method(s): Twenty young adult (9 months) and eighteen old (32 months) Fischer 344/Brown Norway rats received either external beam radiation to the head or were non-radiation controls. Radiated rats were exposed to 2 fractions of 13 Gy over two consecutive days. Tongue muscle contractile properties elicited by whole hypoglossal nerve stimulation were examined 12-weeks following radiation exposure.

Result(s): Radiation significantly reduced tongue tetanic and twitch forces in both the young adult and old rats. There were significant interaction effects of age and radiation on muscle contraction time with old radiation rats having the slowest contraction time. In addition, there was an interaction effect of radiation and age on muscle decay time with the old radiation rats having the slowest decay time.

Conclusions (including clinical relevance): Tongue force is reduced following radiation exposure. Tongue muscle contraction speeds are also altered following radiation exposure with greatest effect being on aged muscle. Thus, tongue contraction speed may also contribute to swallowing problems associated with aged individuals receiving radiation treatment for head and neck cancer.

Disclosures: John Russell: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Ben Becker: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Nadine Connor: *Financial Disclosure:* Grant/ Research Support: R01DC005935, Exercise as a treatment for tongue weakness in aged rats; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

DRS NEW INVESTIGATOR AWARD: SECOND PLACE

EFFECTS OF ISOMETRIC PROGRESSIVE RESISTANCE OROPHARYNGEAL (I-PRO) THERAPY ON DYSPHAGIA

Rogus-Pulia, Nicole^{1, 2}, Rusche, Nicole¹, Zielinski, Jill¹, Hind, Jacqueline^{2, 1}, Safdar, Nasia^{1, 2}, Robbins, JoAnne^{2, 1}

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Purpose: Progressive resistance training for the tongue is an emerging rehabilitation technique for dysphagia. The purpose of this study was to determine effects of I-PRO therapy facilitated by use of the Madison Oral Strengthening Therapeutic (MOST) device.

Method(s): 20 patients with a variety of medical conditions and dysphagia (mean age = 70 years) were enrolled. Patients completed 8 weeks of I-PRO therapy, which consisted of pressing anterior and posterior portions of the tongue against a custom-molded mouthpiece with embedded pressure sensors. Various outcome measures were taken at program baseline and week 8.

Result(s): Penetration-aspiration scale scores decreased significantly for teaspoon-size thin liquid boluses ($p < .02$). Maximum isometric pressures significantly increased for tongue placement at front ($p < .001$) and back sensors ($p < .004$). Scores on five Swallowing Quality of Life (SWAL-QOL) questionnaire subscales improved significantly ($p < .04$). Visual analog ratings for the statement "Food sticks in my mouth when eating" decreased significantly ($p < .02$). Although group differences for the Functional Oral Intake Scale were not significant ($p = 0.18$), several patients progressed from feeding tube dependency to full oral intake. The number of pneumonia diagnoses decreased by 62 %, and admissions decreased significantly ($p < .03$) by 96 %.

Conclusions (including clinical relevance): Findings support the role of I-PRO therapy in effectively treating dysphagia and its consequences in patients with various medical etiologies. Research focuses on enrolling more patients and determining ideal dose response.

Disclosures: Nicole Rogus-Pulia: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* Member: Dysphagia Research Society, American Speech-Language-Hearing Association (ASHA); Society Committee Member: ASHA SIG 13 Research Committee Member | Nicole Rusche: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Jill Zielinski: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* Member: American Speech-Language-Hearing Association (ASHA) | Jacqueline Hind: *Financial Disclosure:* Salary: Swallow Solutions, LLC Ownership Interest: Swallow Solutions, LLC; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Nasia Safdar: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | JoAnne Robbins: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; Grant/ Research Support: USDA; Concession/Honoraria: Proposal reviewer, The Retirement Research Foundation; Intellectual Property Rights: 4 patents administered by Wisconsin Alumni Research Foundation (WARF); Ownership Interest: Swallow Solutions LLC Royalties: Northern Speech Services, John Wiley & Sons; Speaker Fee: Northern Speech Services; *Nonfinancial Disclosure:* Member: DRS, ASHA, American Heart Association (AHA); Society Board Member: University of Wisconsin Academic Consortium for Entrepreneurs; Society Committee Member: AHA/American Stroke Assn Nursing & Rehabilitation Committee of the Stroke Council.

DRS NEW INVESTIGATOR AWARD: FIRST PLACE

PERCENTAGE OF MAXIMUM ISOMETRIC TONGUE PRESSURE AS A CLINICAL INDICATOR OF MILD DYSPHAGIA IN PARKINSON'S DISEASE

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Purpose: To explore Percentage of Maximum Tongue Pressure (PMTP) employed during swallowing as a potential indicator of dysphagia in Parkinson's disease.

Method(s): Thirty adults, mean age = 71 (8.2), were equally divided into 3 cohorts (7 male, 3 female): 1. Healthy Controls, 2. Persons with idiopathic PD (PwPD) on a regular diet (Functional Oral Intake Scale (FOIS) of 7), and 3. PwPD on a modified diet (FOIS of 5 or 6). Cohorts were matched by gender, age ($\chi^2(2) = .06, p > .05$), and height ($\chi^2(2) = .53, p > .05$). Cohorts of PwPD did not differ in years since diagnosis ($U = 39.5, p > .05$) and were tested during medication "on" states. Anterior swallowing pressures for honey and puree (10 mL) were obtained using the Iowa Oral Performance Instrument. Swallowing pressures were divided by anterior tongue strength to calculate PMTP.

Result(s): PMTP differed among cohorts ($F(2,27) = 5.00, p = .014$), not by bolus ($p > .05$), and without interaction ($p > .05$). Post-hoc analyses with averaged PMTP across boluses and Bonferroni correction indicated PwPD and modified diets employed higher PMTP (Mdn = 60) than controls (Mdn = 27; $U = 84, p = .009$). PwPD and modified diets also produced higher PMTP than PwPD on regular diets; however, the difference was not significant ($p > .05$) nor did PMTP differ between PwPD on regular diets and controls ($p > .05$).

Conclusions (including clinical relevance): Mild dysphagia in PD requiring diet change may manifest, in part, by increased PMTP for viscous boluses. PMTP may serve as an important clinical indicator of PD-related dysphagia and has potential applications during clinical bedside evaluations to promote early diagnosis and intervention.

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EFFECT OF VISCOSITY ON FOOD MOVEMENT DURING EATING OF TWO-PHASE FOOD IN ELDERLY PERSONS

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Purpose: When eating two-phase food containing both liquid and solid, the liquid component frequently flows into the hypopharynx before swallowing. Our previous study revealed that increased two-phase food viscosity delayed the food entry into the pharynx. In this study, we tested whether the pre-swallow bolus movement would be altered by viscosity of two-phase food in elderly persons.

Method(s): Fiberoptic endoscopic images of the pharynx were recorded while 21 healthy old and 18 young adults ate 5 g of steamed rice, and 5 g of steamed rice with 3 ml of blue-dye water (two-phase food). Liquid viscosity for two-phase food was set at three levels by adding a thickening agent (0, 2, and 4 wt%, respectively). We analyzed the timing of food movement in the pharynx and the location of the leading edge at swallow onset.

Result(s): In the elderly group, regardless of the initial viscosity of the food, the food stayed longer and deeper in the pharynx until

swallow onset, except for thin two-phase food. With thin two-phase food, the timing of swallow onset was not significantly different between the elderly and young groups.

Conclusions (including clinical relevance): The findings suggest that in elderly persons with no dysphagia, swallow initiation was generally delayed except for thin two-phase food. The airway protective mechanism may remain intact to evoke swallowing when eating thin two-phase food in elderly persons.

Disclosures: Koichiro Matsuo: *Financial Disclosure:* Salary: Fujita Health University; Grant/Research Support: Ministry of Education, Culture, Sports, Science, and Technology; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Tsuyoshi Yamada: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry | Tadashi Ogasawara: *Financial Disclosure:* Salary: Matsumoto Dental University; Grant/Research Support: Ministry of Education, Culture, Sports, Science, and Technology; *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry; Society Board Member: Japanese Association of Disability and Oral Health; Society Committee Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry.

ORAL PRESENTATION AWARD WINNER: SECOND PLACE

THE EFFECT OF BOLUS VOLUME ON HYOID KINEMATICS

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Purpose: To determine whether measures of hyoid movement distance, duration or velocity increase with larger bolus volumes for ultra-thin liquid swallows.

Method(s): A sample of 20 healthy young participants (10 male) each swallowed 3 boluses of 22 % w/v ultra-thin liquid barium at each of 3 volumes (5, 10, 20 ml). Using frame by frame tracking of hyoid position, we identified the onset and peak of the hyoid burst movement and derived measures of movement distance (in anatomically normalized units (i.e., % of the C2-4 vertebral distance), duration (ms), velocity (i.e., distance/duration) and peak velocity for the X (anterior), Y (superior) and XY (hypotenuse) movement directions.

Result(s): Repeated measures mixed model ANOVAs failed to find significant differences in hyoid movement distance, duration or velocity between bolus volumes. However, peak velocity for superior hyoid movement was significantly higher for the 20 ml bolus volume ($p < 0.05$) (Table 1).

Conclusions (including clinical relevance): Although lower order parameters of hyoid movement (distance, duration and velocity) do not vary according to bolus volume for thin liquid swallows, peak velocity for superior hyoid movement is significantly faster for larger volumes. Given that skeletal muscle power depends on peak velocity, these data suggest that the generation of hyoid movements with increased power is a strategy for handling increased load with larger volumes.

Disclosures: Ahmed Nagy: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; Other: University of Fayoum; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Sonja Molfenter: *Financial Disclosure:* Salary: New

Table 1 Differences in Hyoid peak velocity according to Bolus volume for ultra-thin liquid barium

Movement direction	Volume (ml)	Mean (% C2–4/s)	95 % Confidence Interval Lower Boundary	95 % Confidence Interval Upper Boundary	<i>p</i> -value versus 5 ml	Cohen's <i>d</i> versus 5 ml	<i>p</i> -value versus 10 ml	Cohen's <i>d</i> versus 10 ml
X (anterior)	5	358	315	401				
	10	376	334	419	0.7	0.15		
	20	380	336	424	0.59	0.18	1.00	0.03
Y (superior)	5	217	187	246				
	10	237	208	266	0.46	0.21		
	20	272	242	303	0.00*	0.58 (Medium)	0.08	0.37
XY (hypotenuse)	5	386	340	432				
	10	403	357	449	0.77	0.13		
	20	417	369	464	0.36	0.23	0.88	0.10

York University; Scholarship: NSERC Create Care Doctoral Scholarship; TRI OSOTF Scholarship; Ontario Graduate Scholarship; Other: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure*: Member: Dysphagia Research Society | Melanie Peladeau-Pigeon: *Financial Disclosure*: Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Shauna Stokely: *Financial Disclosure*: Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Catriona Steele: *Financial Disclosure*: Salary: Toronto Rehabilitation Institute - University Health Network; Grant/Research Support: National Institutes of Deafness and Other Communication Disorders; Other: University of Toronto; Bloorview Research Institute; *Nonfinancial Disclosure*: Member: Dysphagia Research Society.

THE EFFECT OF BOLUS VISCOSITY ON HYOID KINEMATICS

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Purpose: To determine whether measures of hyoid kinematics increase for thicker consistencies at a constant volume.

Method(s): 20 healthy young participants (10 male) each swallowed three 5-ml boluses of barium prepared to different consistencies: ultra-thin (22 %w/v, 20 mPa s@50 s⁻¹); thin (40 %w/v, 17 mPa s); and nectar-thick (40 %w/v, 236 mPa s). Using frame by frame tracking, we identified the onset and peak of the hyoid burst movement and derived measures of movement distance (in anatomically normalized units, i.e. % of C2–4 vertebral distance), duration (ms), velocity (distance/duration) and peak velocity for the X (anterior), Y (superior) and XY (hypotenuse) movement directions.

Result(s): Repeated measures mixed model ANOVAs identified significantly greater XY distance and significantly shorter movement durations (X, Y and XY) for nectar-thick barium ($p < 0.05$) than for ultrathin barium. Faster velocities were found for X and XY movement with nectar-thick barium compared to both thin and ultrathin barium. Peak velocities were significantly higher for the nectar-thick compared to the ultra-thin barium.

Conclusions (including clinical relevance): Anatomically normalized measures of hyoid movement reveal an influence of bolus

consistency, with nectar-thick barium eliciting faster velocity movements. Larger anterior displacements in shorter time-frames account for these results. These data imply that focusing on the speed of hyoid movement may be a relevant dysphagia treatment goal. Interestingly, lower velocities are seen with thinner consistencies, suggesting it may be appropriate to work both on rapid and more gradual hyolaryngeal movement (Table 1).

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NORMATIVE LINGUAL PRESSURES DURING ISOMETRIC PRESSES AND SALIVA AND THIN BOLUS SWALLOWS

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Purpose: Maximum isometric tongue pressures decrease with age. This study compared isometric pressures to swallow pressures at five tongue regions by age.

Method(s): 65 subjects [group 1 (22–33 year), group 2 (41–60 year), and group 3 (61–82 year)] performed: isometric presses, saliva and 5 ml/10 ml thin liquid swallows. Pressures were measured using the Madison Oral Strengthening Therapeutic (MOST) device.

Table 1 Differences in Hyoid kinematics according to Bolus consistency

Parameter	Stimulus	Mean	95 % confidence interval lower boundary	95 % confidence interval upper boundary	<i>p</i> -value versus ultrathin (22 % w/v)	Cohen's <i>d</i> versus ultrathin (22 % w/v)	<i>p</i> -value versus thin (40 % w/v)	Cohen's <i>d</i> versus thin (40 % w/v)
Distance travelled (%C2–4)	Ultrathin (22 % w/v)	49	44	53				
	Thin (40 % w/v)	50	46	55	0.81	0.12		
	Nectar-thick (40 % w/v)	54	50	58	0.02*	0.41 (small)	0.13	0.29
Burst duration (ms)	Ultrathin (22 % w/v)	479	439	519				
	Thin (40 % w/v)	451	411	491	0.57	0.20		
	Nectar-thick (40 % w/v)	420	379	460	0.05*	0.42 (small)	0.49	0.22
Velocity (%C2–4/s)	Ultrathin (22 % w/v)	113	99	127				
	Thin (40 % w/v)	113	99	127	1.00	0.00		
	Nectar-thick (40 % w/v)	136	122	150	0.01*	0.49 (small)	0.01*	0.49 (small)
Peak velocity (%C2–4/s)	Ultrathin (22 % w/v)	389	345	433				
	Thin (40 % w/v)	455	411	499	0.01*	0.46 (small)		
	Nectar-thick (40 % w/v)	460	417	504	0.01*	0.5 (medium)	0.99	0.04

Descriptive statistics are shown for the hypotenuse direction (XY) of hyoid movement for 5 ml swallows of each consistency by healthy adults

Result(s): There was an overall significant interaction effect for a mixed between-within subjects three-way ANOVA with independent variables of age group, sensor location, and pressure task ($p < .001$). At the front sensor, group 1 had significantly higher pressures than group 2 for saliva ($p < .04$) and 5 ml ($p < .05$) thin liquid swallows, and group 3 for saliva ($p < .05$) and 5 ml ($p < .007$) swallows. Groups 1 and 2 had significantly higher isometric pressures than group 3 ($p < .001$) at the front sensor. At the back sensor, group 1 had significantly higher pressures than group 2 ($p < .05$) and group 3 ($p < .02$) for 5 ml swallows, and higher pressures than group 3 ($p < .05$) for 10 ml swallows. Groups 1 ($p < .04$) and 2 ($p < .003$) had significantly higher isometric pressures than group 3 at the back sensor.

Conclusions (including clinical relevance): Decreasing isometric and swallowing pressure generation with age increases risk for dysphagia in elderly healthy individuals. These results indicate that regions of the tongue vary in rate of decline with age (Table 1).

Disclosures: Naomi Humpal: *Financial Disclosure:* Salary: University of Wisconsin-Madison; *Nonfinancial Disclosure:* Volunteer Employee: William S. Middleton Memorial Veterans Hospital | Kelsey Banaszynski: *Financial Disclosure and Nonfinancial Disclosure:* No relevant relationships exist. | Jacqueline Hind: *Financial Disclosure:* Salary: Swallow Solutions, LLC; *Ownership Interest:* Swallow Solutions, LLC; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Nicole Rogus-Pulia: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society, American Speech-Language-Hearing Association; Society Committee Member: ASHA SIG 13 Research Committee Member | JoAnne Robbins: *Financial Disclosure:* Salary: University of Wisconsin, Wm S. Middleton Memorial VA Hospital; *Grant/ Research Support:* USDA; *Concession/Honoraria:* Proposal reviewer, The Retirement Research Foundation; *Intellectual Property Rights:* 4 patents administered by Wisconsin Alumni Research Foundation (WARF); *Ownership Interest:* Founder and equity holder, Swallow Solutions LLC; *Royalties:* Northern Speech Services, John Wiley & Sons; *Speaker fee:* Northern Speech Services; *Nonfinancial Disclosure:* Society Member: DRS, ASHA, American Heart Association (AHA); *Society Board Member:* University of Wisconsin Academic Consortium for Entrepreneurs; *Society Committee Member:* AHA/American

Stroke Assn Nursing & Rehabilitation Committee of the Stroke Council.

APPLYING OBJECTIVITY TO VFS INTERPRETATION: OBJECTIVE MEASURES OF SWALLOWING PHYSIOLOGY

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Purpose: Videofluoroscopic study of swallowing (VFS) has been criticised for its poor objectivity and interater reliability. The purpose of the study was to utilize objective reproducible digital measures of timing and displacement and compare these to traditional analysis methods, particularly with regards to management decisions.

Method(s): Eighteen clinicians of variable years of dysphagia experience rated ten VFS videos; once in real-time (Phase One), unlimited times using frame-by-frame viewing without (Phase Two), and with (Phase Three) digital measures. Digital measure training was provided.

Result(s): Interater reliability in Phase 1 and 2 was fair to moderate ($K < .60$) and did not differ between phases. Interater reliability in Phase 3 improved to substantial ($K > .60$). Clinicians' identification of site / type of dysfunction during VFS altered significantly when using digital measures ($p < .001$).

Conclusions (including clinical relevance): Objective digital measures of timing and displacement lead to improved agreement between clinicians when rating VFS. Objective measures optimise information gained during VFS and alter management recommendations.

Disclosures: Anna Miles: *Financial Disclosure:* Salary: The University of Auckland; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Anthony Ting: *Financial*

Table 1 Significant pressure differences between groups, by sensor and task

Age group	Location	Task			
		Isometric press	Saliva swallow	5 ml thin swallow	10 ml thin swallow
1 (22–33 year)	Front	>3* ($p < .001$)	>2,3 ($p < .05$)	>2,3 ($p < .05$)	
	Back	>3 ($p < .04$)		>2,3 ($p < .05$)	>3 ($p < .05$)
2 (41–60 year)	Front	>3 ($p < .001$)	<1 ($p < .05$)	<1 ($p < .05$)	
	Back	>3 ($p < .003$)		<1 ($p < .05$)	
3 (61–82 year)	Front	<1.2 ($p < .001$)	<1 ($p < .05$)	<1 ($p < .05$)	
	Back	<1.2 ($p < .04$)		<1 ($p < .05$)	<1 ($p < .05$)

* Numbers in table refer to groups 1, 2, and 3. Comparisons are the significant differences between listed groups at the same sensor and for the same task

Disclosure: Salary: Lakes District Health Board; **Nonfinancial Disclosure:** No relevant nonfinancial relationships exist. | Rebecca Leonard: **Financial Disclosure:** No relevant financial relationships exist. **Nonfinancial Disclosure:** Member: Dysphagia Research Society | Jacqui Allen: **Financial Disclosure:** Salary: Waitemata District Health Board; Grant/ Research Support: Rodney Williams Garnett Passe Foundation, University of Auckland; **Nonfinancial Disclosure:** Member: Dysphagia Research Society; NZSOHNS; Society Board Member: Dysphagia Research Society; Society Committee Member: Dysphagia Research Society.

RELATIONSHIP BETWEEN SWALLOWING PHYSIOLOGY MEASURES AND DIET RECOMMENDATIONS

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Purpose: The aim was to study the relationship between swallowing physiology, bolus flow, and dysphagia diet recommendations.

Method(s): Videofluoroscopic swallowing studies (VFSS) data were derived from a prior study of 118 adult stroke patients. Oral and pharyngeal physiologic measures and oral/pharyngeal residue were subjectively rated on a 4 point rating scale. Laryngeal penetration/aspiration were rated using the Penetration-Aspiration Scale. Diet recommendations were made with terminology utilized by the National Dysphagia Diet: Level 1-Pureed; 2-Mechanical Altered; 3-Advanced soft; 4-Regular. Multinomial logistic regression was used to define patterns of impairment for each diet level.

Result(s): Individuals with a score of 1 or 2 on the PA scale were 84 % less likely to be recommended for a Dysphagia 1 diet and 70–80 % less likely ($p = .001$ – $.003$) to be recommended for NPO compared to regular diet. Subjects with greater residue in the pyriform sinuses were 89 % more likely to be recommended for NPO ($p < 0.001$). Subjects with no and minimal pyriform sinus residue were 99 and 96 % more likely to be recommended a regular diet than a Dysphagia 3 diet. No physiologic measures significantly distinguished the diet levels.

Conclusions (including clinical relevance): Results suggest that clinicians make diet recommendations based on bolus flow rather than physiology. Research shows that treatment must be based on physiology, but the considerations for making diet recommendations have not been established. Implications are significant for defining the

utility of VFSS versus FEES, which is criticized to rely on inferences, based on overall goals of assessment.

Disclosures: Balaji Rangarathnam: **Financial Disclosure:** Salary: East Carolina University; **Nonfinancial Disclosure:** No relevant nonfinancial relationships exist. | Gary McCullough: **Financial Disclosure:** Salary: University of Central Arkansas; **Nonfinancial Disclosure:** Member: Dysphagia Research Society.

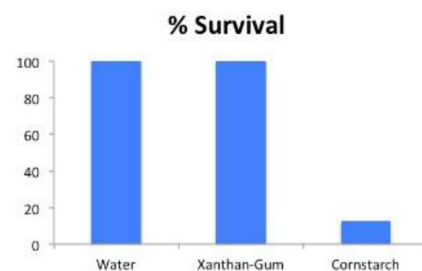
ORAL PRESENTATION AWARD WINNER: FIRST PLACE

EFFECTS OF ASPIRATED THICKENED WATER ON PULMONARY HEALTH AND SURVIVAL IN A LAGOMORPH MODEL

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Purpose: Thickened liquids are prescribed by approximately 50 % of Speech-Language Pathologists to patients who are at risk for aspiration. Although thickening liquids represents one of the most common recommendations for dysphagia, it is unknown what effect these thickeners have on the pulmonary system when aspirated. The purpose of this study was to compare aspiration of water (H₂O), xanthan-gum (XG) thickened H₂O, and cornstarch (CS) thickened H₂O on survival and pulmonary histology in a lagomorph model.



Method(s): 24 adult male New Zealand rabbits underwent 3 consecutive days of instillation (1.5 mL/kg per day) of H₂O (n = 8), XG-thickened H₂O (n = 8), or CS-thickened H₂O (n = 8) directly into the trachea. The primary outcome measure was survival (days). Secondary measures consisted of pulmonary histologic ratings. Statistical analyses included a Chi-square test of independence, a one-way ANOVA, and Tukey's HSD ($\alpha = 0.05$).

Result(s): A significant difference was revealed for survival ($p < 0.0001$) with 100 % of animals instilled with H2O and XG-thickened H2O surviving compared to only 12.5 % of animals instilled with CS-thickened H2O.

Conclusions (including clinical relevance): In this study, more favorable outcomes were associated with aspiration of H2O and XG-thickened H2O. A significantly greater mortality rate was associated with instillation of CS-thickened H2O. These data have both clinical and dietary implications for patients at risk for aspiration.

Disclosures: Amanda Domer: *Financial Disclosure:* No relevant relationships exist. *Nonfinancial Disclosure:* Member and Board Member: Dysphagia Research Society | Brett Adams: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Ryan Traslavina: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Emily Plowman: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Maggie Kuhn: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Peter Belafsky: *Financial Disclosure:* No relevant relationships exist. *Nonfinancial Disclosure:* Member and Board Member: Dysphagia Research Society.

ADVANTAGES OF IOHEXOL AS AN ORAL CONTRAST AGENT FOR VIDEOFLUOROSCOPY IN FREELY BEHAVING ANIMALS: IMPLICATIONS FOR TRANSLATIONAL RESEARCH TO HUMANS

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Purpose: The purpose of this study was to formulate recipes that animals will readily consume during a videofluoroscopic swallow study (VFSS), without behavioral conditioning. This step is necessary to facilitate translational dysphagia research for debilitating human conditions, such as amyotrophic lateral sclerosis (ALS), oculopharyngeal muscular dystrophy (OPMD), Batten disease, and aging.

Method(s): Approximately 60 mice and 40 dogs participated in recipe development of various consistencies using either barium sulfate or iohexol. Mice were from our ALS, OPMD, and presbyphagia colonies. Healthy dogs and those with ALS or Batten disease were from existing colonies or the local community. The following properties of each recipe were investigated: palatability, rheologic characteristics, visibility during VFSS, and adverse effects.

Result(s): Despite exhaustive attempts at flavor enhancement, mice refused all barium-containing recipes and eagerly consumed only one iohexol-containing recipe; no adverse effects occurred. Dogs consistently preferred iohexol-containing recipes over barium, and the only adverse effect from iohexol was mild diarrhea. The most promising thin liquid iohexol recipe was 1.2 cP, which is closer to water (1.0 cP) than Varibar thin liquid barium (4 cP). All barium- and iohexol-containing recipes were readily visible during VFSS.

Conclusions (including clinical relevance): This study highlights an important advantage of iohexol: the aversive flavor can be masked without significantly altering the rheologic properties of foods and liquids. Additional recipe development using iohexol is underway for animals and humans.

Disclosures: Mitchell Allen: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Vanessa Gaiser: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Elizabeth Bearce: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Teresa Lever: *Financial Disclosure:* Salary:

University of Missouri; Grant/ Research Support: Mizzou Advantage Undergraduate Team Award; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

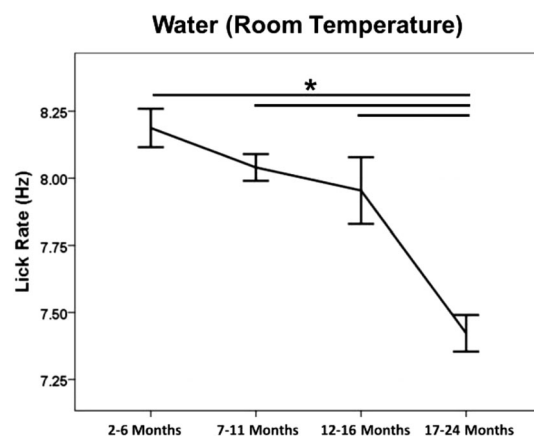
A NEW MOUSE MODEL OF PRESBYPHAGIA AND THE EFFECT OF MENTHOL

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Purpose: Presbyphagia is an age-related decline in swallow function in healthy adults over the age of 65. The primary purpose of this study was to establish a mouse model of presbyphagia suitable for translational research to humans. Additionally, the treatment effect of orally ingested menthol on the swallow function of presbyphagic mice was investigated.

Method(s): Lick rate was measured in healthy C57BL/6 mice ($n = 47$) between 2 and 24 months of age, divided into 4 age groups: 2–6 months, 7–11 months, 12–16 months, and 17–24 months. Two solutions were tested: water and menthol (0.175 mM), both at room temperature and presented in a counterbalanced order.



Result(s): Elderly mice (>17 months of age) licked significantly slower than younger mice ($p < 0.05$). Menthol had an excitatory effect (faster licking) only on mice >17 months of age ($p < 0.05$); menthol had no effect (faster or slower licking) on mice <17 months of age.

Conclusions (including clinical relevance): The lick rate of C57BL/6 mice significantly declines with advanced age (>17 months) and is immediately improved by oral ingestion of menthol. Impaired licking corresponds with Stage 1 transport (oral preparatory) dysfunction. Therefore, this study provides novel evidence of presbyphagia in otherwise healthy, elderly C57BL/6 mice. We are currently characterizing the underlying mechanisms driving presbyphagia and the positive treatment effect of menthol using a combination of videofluoroscopic, electrophysiologic, histologic, and molecular biology methods with this mouse strain. This research demonstrates the utility of studying mice to better understand swallowing dysfunction in people.

Disclosures: Teresa Lever: *Financial Disclosure:* Salary: University of Missouri | Grant/ Research Support: NIH/NIDCD RO3:DC010895 and University of Missouri REED | *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Laura Powell: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Sabrina Braun: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Ryan Brooks: *Financial and Nonfinancial Disclosure:* No

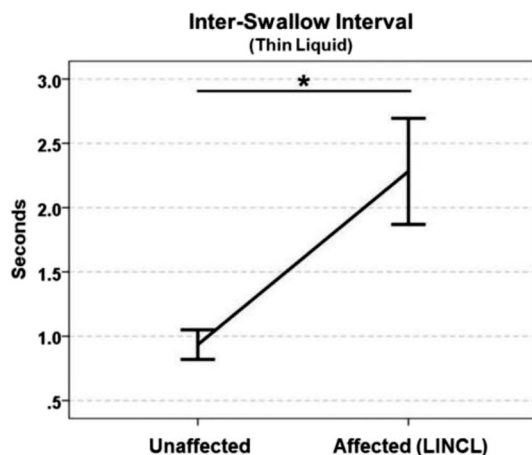
relevant relationships exist. | Danarae Aleman: *Financial and Nonfinancial Disclosure*: No relevant relationships exist.

CHARACTERIZATION OF DYSPHAGIA IN A CANINE MODEL OF LATE INFANTILE NEURONAL CEROID LIPOFUSCINOSIS (LINCL)

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Purpose: Late Infantile Neuronal Ceroid Lipofuscinosis (LINCL) is the most common form of Batten disease in children. Nearly all children with LINCL develop dysphagia that necessitates feeding tube placement. Pneumonia is the most common cause of death, typically occurring by 15 years of age. Despite the prevalence and the devastating outcome of dysphagia in LINCL, limited research exists. The purpose of this study was to characterize dysphagia in LINCL using a spontaneously occurring canine model that develops neurological symptoms ~6 months of age and dies ~10 months of age. **Method(s):** Eleven dachshunds (6 LINCL-affected and 5 healthy, age-matched controls) were tested using a freely behaving videofluoroscopic swallow study (VFSS) protocol established in our lab. Each dog was tested an average of three times between the ages of 6 and 10 months. VFSS recordings (30 fps) were analyzed to quantify 3 swallow parameters: time to maximal pharyngeal constriction, time to UES closure, and inter-swallow interval. Videos for 10 month old dogs have been analyzed.



Result(s): Compared to age-matched controls, inter-swallow interval was significantly longer for LINCL-affected dogs ($p < .05$) for all consistencies tested. No significant differences were identified for the other two swallow parameters.

Conclusions (including clinical relevance): This study provides novel evidence that LINCL-affected dogs develop dysphagia and are therefore suitable for translational dysphagia research to benefit people and dogs. Our ongoing research is focused on elucidating robust biomarkers of dysphagia that can be used to quantify treatment efficacy in clinical trials.

Disclosures: Vanessa Gaiser: *Financial and Nonfinancial Disclosure*: No relevant relationships exist. | Mitchell Allen: *Financial and Nonfinancial Disclosure*: No relevant relationships exist. | Rebecca Harris: *Financial and Nonfinancial Disclosure*: No relevant relationships exist. | Loren Littrell: *Financial and Nonfinancial Disclosure*: No relevant relationships exist. | Mollie Ulsas: *Financial*

and Nonfinancial Disclosure: No relevant relationships exist. | Teresa Lever: *Financial Disclosure*: Salary: University of Missouri; Grant/Research Support: Missouri Advantage Undergraduate Team Award; Hold Patent on Equipment: Pending: University of Missouri; Intellectual Property Rights: University of Missouri; *Nonfinancial Disclosure*: Member: Dysphagia Research Society.

A BIOMECHANICAL STUDY OF HYOLARYNGEAL MOVEMENT COMPARING THE BLOM LOW PROFILE VOICE INNER CANNULA & PASSY-MUIR ONE WAY TRACHEOTOMY TUBE SPEAKING VALVES

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Purpose: This study investigated the biomechanical effects of the Blom low profile voice inner cannula & Passy-Muir one-way tracheotomy tube speaking valves on hyo-laryngeal (hyoid bone & thyroid cartilage) movements during swallowing as well as dysphagia & aspiration status.

Method(s): Digitized videofluoroscopic swallow studies were performed on 8 adult participants (4 with head & neck cancer). 18 swallows (3 each with 5 cc liquid & puree) were performed under 3 randomized conditions: tracheotomy tube with no inner cannula; Blom valve; Passy-Muir valve. Two frames for each swallow were analyzed: 1. Pre-swallow anterior margin of hyoid bone to anterior thyroid cartilage; 2. During swallow maximum hyoid bone & thyroid cartilage displacements. (See Fig. 1) Dysphagia & aspiration status were noted for each swallow.

Result(s): No significant differences were found for maximum hyoid bone or thyroid cartilage displacements during swallowing based

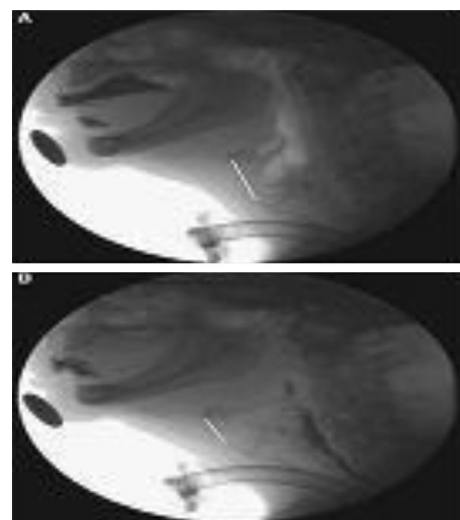


Fig. 1 a Larynx-to-hyoid bone approximation (HLhold - HLmax), defined as the distance between the anterior margin of the hyoid bone and the anterior thyroid cartilage when measured at “hold” position with the bolus in the oral cavity. b From this measurement the distance between the hyoid bone and the cartilage at “max” position subtracted

upon an open tracheotomy tube (no inner cannula), Blom, or Passy-Muir valves. Dysphagia & aspiration status were identical for all 3 cannula & valve conditions.

Conclusions (including clinical relevance): Since no differences in hyo-laryngeal movement or aspiration status were found dependent upon either no inner cannula or presence/absence of the Blom or Passy-Muir valves, the conjectures that use of a one-way tracheotomy tube speaking valve alters hyoid bone & larynx movement or is beneficial to preventing dysphagia & aspiration were not supported.

Disclosures: Prateek Srinet: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Douglas Van Daele: *Financial Disclosure:* No relevant relationships exist. *Nonfinancial Disclosure:* Member and Board Member: Dysphagia Research Society | Stewart Adam: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Morton Burrell: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Steven Leder: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

ROBOTIC MODELLING OF ESOPHAGEAL PERISTALSIS FOR INVESTIGATION OF DYSPHAGIA

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Purpose: Diagnosis of dysphagia and subsequent design of therapeutic interventions for its management, are currently a subjective process based on practitioner experience. Biologically-inspired experimental protocols are required to rigorously investigate swallowing interactions with boluses of differing rheology and limit patient risk.

Method(s): A novel robotic 'oesophagus' was designed, constructed and tested. A series of ballooning pneumatic chambers surrounding a smooth, continuously-deformable silicon lumen was used to simulate oesophageal peristalsis. Videofluorography and manometry were used to assess waveforms, pressure curves and model swallow trajectories to demonstrate congruence between clinical and experimental settings.

Result(s): Manometric evaluation demonstrated biologically faithful swallowing trajectories with velocities of 2–4 cm/s that exhibit occlusion onto a manometric catheter and bolus transport wave tail seal pressure >100 mmHg.

Conclusions (including clinical relevance): The robotic oesophagus is capable of reproducing features of biologically-inspired swallowing enabling aspiration free, non-fatigable testing of material of differing rheology.

Disclosures: Jacqui Allen: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Steven Dirvan: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Leo Cheng: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Weiliang Xu: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

LONG-TERM SUCCESS OF ORAL ALIMENTATION IN ACUTE CARE PATIENTS AFTER PASSING THE YALE SWALLOW PROTOCOL

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Purpose: There is need to demonstrate success of oral alimentation or dysphagia after passing a swallow test. This study investigated long-term success of oral alimentation & patient attrition rate 1–5 days after passing the Yale Swallow Protocol.

Method(s): 200 consecutive hospitalized adults participated. Inclusion criteria: completion of cognitive eval, oral mechanism exam, & passing 3 oz water swallow challenge. Exclusion criteria: altered mental status; failing 3 oz challenge; NPO/modified diet, & tracheotomy tube. Monitoring of electronic medical record for 5 days determined success of oral alimentation & attrition rate.

Result(s): All patients who passed the protocol ate & drank successfully from 1 to 5 days (grand mean 474 cc/day; range 355–519 cc). Patient attrition increased from day-of-testing (n = 200) to post-testing day 5 (n = 95). This was expected due to increasingly rapid transit through acute care settings.

Conclusions (including clinical relevance): For the first time, long-term success of oral alimentation after swallow testing was documented. All patients who passed the protocol & were medically & neurologically stable for the 5 day follow-up period ate & drank successfully. Passing the Yale Swallow Protocol permitted both determination of aspiration risk & ability to make appropriate diet recommendations resulting in long-term successful oral alimentation in acute-care patients.

Disclosures: Steven Leder: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Debra Suiter: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

EFFECT OF CHEMORADIOTHERAPY (CRT) ON MAXIMUM ISOMETRIC TONGUE PRESSURES (MIP) IN HEAD AND NECK CANCER (HNC) PATIENTS DURING AND IMMEDIATELY FOLLOWING TREATMENT: PRELIMINARY DATA

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Purpose: Prophylactic and therapeutic tongue strengthening exercises receive growing interest in HNC-patients treated with CRT. However, little data exist about the spontaneous evolution of MIP during and after CRT. Tongue strength can be influenced by multiple factors like mucositis, pain, loss of tumor bulk and actual muscle changes. This ongoing, prospective multi-centric study aims to expand our knowledge in this domain.

Method(s): Since December 2012 patients with newly diagnosed squamous cell carcinoma in the HN-region are recruited in 3 Belgian Centres (Antwerp University Hospital, UMC-Saint-Pierre, UCL-Mont-Godinne/CMSE Namur). Up till now 24 subjects have been included. Anterior and posterior MIPs were measured (3 trials) by means of the Iowa Oral Performance Instrument at baseline, weekly during CRT, post and 1 and 3 months post CRT. Research questions: (1) feasibility of MIP-measures during CRT (% of performed measures (PPM); n = 24) (2) changes in MIP during CRT (1-way RM ANOVA, n = 10, no missing data).

Result(s): MIP measures were feasible in 87 % of all test moments with a decreasing success rate from baseline (PPM: 100 %) to week 6 of radiotherapy (PPM:71 %). Mean MIP changes over time (Fig. 1). These changes become more apparent when compared to age- and gender- matched normative values (Fig. 2). However these changes are not significant.

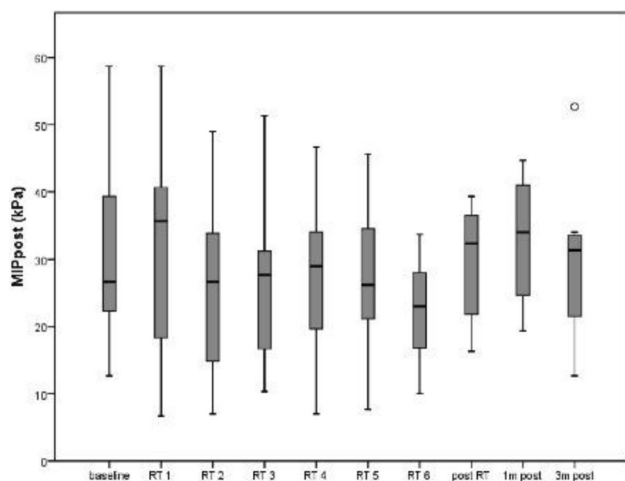


Fig. 1 Mean MIP changes over time

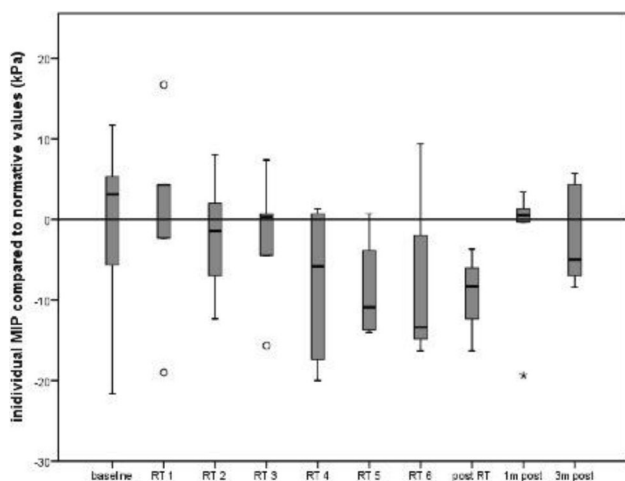


Fig. 2 These changes become more apparent when compared to age- and gender-matched normative values

Conclusions (including clinical relevance): This dataset reveals the first data on the evolution of MIP during CRT. Notwithstanding the acute side effects MIPs can be measured during and immediately after CRT. So far, preliminary data show no significant changes of MIP during and after treatment.

Disclosures: Gwen Van Nuffelen: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Leen Van den Steen: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Johan Allouche: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Laurence Delacroix: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Alixa Schruers: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Marc De Bodt: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Gilbert Chantrain: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Georges Lawson: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Olivier Vanderveken: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jan Vanderveken: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

ESOPHAGEAL PATHOLOGY IN PATIENTS WITH ZENKER'S DIVERTICULUM

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Purpose: Dysphagia persists in up to 25 % of patients treated for Zenker's diverticulum (ZD). Inadequate surgery accounts for many of these symptoms however some linger despite revision surgery. Previous research suggests that additional factors contribute to dysphagia among ZD patients. We investigate the occurrence and spectrum of co-existing esophageal abnormalities in ZD patients.

Method(s): Retrospective review of ZD patients presenting to a university-based swallowing center from 2006 to 2013.

Result(s): Eighty-six ZD patients were identified by fluoroscopic swallow study. 57 % (N = 49) had esophageal evaluations—18 (37 %) had esophagrams, 18 (37 %) had esophagoscopy and 13 (27 %) had both exams. Over 75 % (n = 37) had notable esophageal abnormalities. These included dysmotility (51 %), hiatal hernia (51 %), esophagitis (38 %) and ring or web (32 %). Patients with at least one abnormal esophageal abnormality had a mean pre-surgical EAT10 score of 24.6 (± 7.0) compared to 21.8 (± 10.0) among those without esophageal abnormality [$p = 0.20$]. Post-surgical data were available for 33 (67 %) patients. Patients with at least one esophageal abnormality had a mean post-surgical EAT10 score of 12.1 (± 6.4) compared to 6.1 (± 8.6) among those without esophageal abnormality [$p = 0.03$].

Conclusions (including clinical relevance): Esophageal abnormalities commonly accompany ZD, and their co-existence may reflect a shared pathophysiology. This highlights the importance of esophageal evaluation in ZD patients. Awareness of esophageal pathology is useful for preoperative counseling and treatment planning and to assess persistent or recurrent postoperative dysphagia.

Disclosures: Maggie Kuhn: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Peter Belafsky: *Financial Disclosure:* No relevant relationships exist. *Nonfinancial Disclosure:* Member and Board Member: Dysphagia Research Society.

HEAD AMP; NECK CANCER ALLIANCE AWARD

RELATIONSHIPS BETWEEN DYSPHAGIA AND ORAL MORBIDITIES IN CHEMORADIATION TREATED HEAD AND NECK CANCER PATIENTS

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Purpose: To evaluate relationships among dysphagia, oral pain, xerostomia, and taste/smell functions in patients undergoing chemoradiation (CRT) for head and neck cancer (HNC).

Method(s): A prospective cohort of 33 patients undergoing CRT was evaluated for dysphagia (MASA-C, FOIS, and weight loss), oral pain (gLMS intensity scale), mucositis (WHO scale), xerostomia (Periotron), and taste/smell functions (recognition and gLMS intensity scale). Patients were evaluated at baseline, post treatment, and 3 months following CRT. Data were analyzed using correlations and t-tests.

Result(s): All measures demonstrated a decrease in function following CRT with incomplete recovery at 3 months. Post treatment,

dysphagia was significantly correlated with oral mucositis ($r = -0.488, p = 0.008$); weight loss was significantly related to xerostomia ($r = -0.569, p = 0.027$). Chemosensory acuity (taste and smell) was heightened in patients with dysphagia ($r = -0.390, p = 0.036$) and xerostomia ($r = -.696, p = 0.008$). At 3 months, dysphagia was significantly related to persistent oral mucositis ($r = -0.507, p = 0.027$). A significant difference was noted in mucositis ratings between patients with and without dysphagia ($t = -2.128, p = 0.048$).

Conclusions (including clinical relevance): Dysphagia and oral mucositis may coexist as a distinct symptom cluster in HNC patients following CRT. Intervention for mucositis may facilitate swallowing recovery. Furthermore, heightened chemosensory acuity in patients with dysphagia may exist as a sensory defensive mechanism and contribute to the development and maintenance of dysphagia.

Disclosures: Aarthi Madhavan: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: Florida Dept. of Health, NIH/NCI; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Michael Cray: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: Florida Dept. of Health, NIH/NCI; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Giselle Carnaby: *Financial Disclosure:* Salary: University of Florida; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Linda Bartoshuk: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: Florida Dept. of Health, NIH/NCI; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

REFLEX COUGH SENSITIVITY IN PARKINSON'S DISEASE AND DYSPHAGIA

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Purpose: Pneumonia and lung infection are leading causes of death in persons with Parkinson's disease (PD). The pathogenesis of these infections is largely attributed to the presence of silent aspiration. The goal of this study was to test reflex cough thresholds and associated urge to cough (UTC) ratings in PD participants with and without dysphagia and healthy older controls.

Method(s): Twenty participants with PD and 10 healthy older adults were recruited for this study. Participants completed a capsaicin challenge with three randomized blocks of 0, 50, 100 & 200 μ M capsaicin and rated their UTC by modified Borg scale. The concentration of capsaicin that elicited a two cough response and the sensitivity of the participant to the cough stimulus was measured. Participants with PD were identified as 'dysphagic' or 'non-dysphagic' based on the penetration-aspiration scale.

Result(s): Most participants with PD did not have a reliable C2 cough response to 200 μ M. UTC ratings for dysphagic participants at 200 μ M Capsaicin and total number of coughs produced were significantly lower than non-dysphagic participants ($p = .025$ and $p = .035$, respectively). Cough reflex thresholds were significantly higher and cough sensitivity significantly blunted in dysphagic participants with PD.

Conclusions (including clinical relevance): UTC may be important in understanding the mechanism underlying morbidity related to aspiration pneumonia in people with PD and dysphagia. Further

understanding decreased UTC in people with PD and dysphagia will be essential for the development of strategies and treatments to address deficits of airway protection in this population.

Disclosures: Michelle Troche: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: NIH (NCATS) CTSA awards to the University of Florida UL1TR000064 and KL2TR000065; *Nonfinancial Disclosure:* Society Member: ASHA, ISARP | Alexandra Brandimore: *Financial Disclosure:* Salary: University of Florida; Malcom Randall VAMC; *Nonfinancial Disclosure:* Society Member: ASHA | Michael Okun: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: NIH, NPF, the Michael J. Fox Foundation, the Parkinson Alliance, Smallwood Foundation, the Bachmann-Strauss Foundation, the Tourette Syndrome Association, and the UF Foundation; Royalties: Demos, Manson, Amazon, and Cambridge; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Paul Davenport: *Financial Disclosure:* Salary: University of Florida; Grant NIH; Hold Patent on Equipment: Expiratory muscle strength trainer 150 (Aspire products); *Nonfinancial Disclosure:* Society Member: APS, ASN, ISARP | Karen Hegland: *Financial Disclosure:* Salary: University of Florida; Grant/ Research Support: American Heart Association award #12CRP9010001; Investigative device or drug to be discussed in presentation: Capsaicin; *Nonfinancial Disclosure:* Society Members: APS, ASHA, ISARP.

THE AMERICAN BOARD OF SWALLOWING AND SWALLOWING DISORDERS & SWALLOWING DISORDERS AWARD

FACTORS AFFECTING RETURN TO ORAL INTAKE IN HEAD AND NECK CANCER PATIENTS POST ENDOSCOPIC LUMEN RESTORATION

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Purpose: Total pharyngeal or esophageal lumen obstruction (TLO) is a serious complication of head and neck cancer treatment. There is limited data regarding functional swallowing outcomes after endoscopic lumen restoration (ELR). This study examines functional outcomes of 35 patients after ELR and identifies variables impacting return to oral intake.

Method(s): Retrospective review was performed for 35 head and neck cancer patients treated with XRT/CXRT who underwent successful ELR. Data on aphagia duration, tumor location, treatment type, level of obstruction, maximal lumen dilation, and aspiration status pre-ELR were extracted. A series of Spearman correlations, one-way ANOVA and odds ratios were calculated.

Result(s): All patients underwent successful lumen restoration surgery, however only 64 % resumed safe oral intake. A significant positive correlation existed between tumor location and post-ELR diet ($r = 0.39, p = .03$) while a negative association between maximum caliber diameter of dilation and post-ELR diet approached significance ($r = -0.26, p = .07$). Patients with oral site tumor were 3.0 or 9.0 times more likely to resume an oral diet than those with a pharyngeal or esophageal tumor respectively. Aphagia duration, aspiration status pre-ELR, number of dilations, and obstruction level did not impact return to oral diet.

Conclusions (including clinical relevance): Successful ELR for total lumen obstruction does not ensure return to safe oral intake. Tumor site may be an important factor associated with return to oral diet post-ELR, but other factors in this cohort did not preclude favorable outcomes.

Disclosures: Joy Gaziano: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphasia Research Society, ASHA | H. Worth Boyce: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | David Estores: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jerrica Serrano: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Tapan Padhya: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Emily Plowman: *Financial Disclosure:* Grant/ Research Support: National Institute of Child Health Development (NICHD) 1R21 HDO75327-01; *Nonfinancial Disclosure:* Society Member: DRS, ASHA, SFN; Society Board Member: Dysphagia Research Society; Society Committee Member: DRS Rules of Conduct Committee (Chair); DRS Junior Springer Travel Scholarship Committee (Chair); DRS Bylaws Committee; DRS Ad Hoc Public Relations and Communications Committee | Robert Barker: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

RHEOLOGICAL VALUES IMPACTING PEDIATRIC DYSPHAGIA MANAGEMENT

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Purpose: Experience reflects difficulty ensuring that the viscosity of liquid and puree consistencies presented in UMBS are compatible with the infant/toddler pediatric diet of liquids and purees. Rheological values were compared with undiluted and diluted BaSO₄, infant diet, Simply Thick honey consistency and Gerber stage 1 purees.

Method(s): Samples of breast milk, three infant formulas, undiluted and diluted BaSO₄ and Gerber purees were mixed using a magnetic stirring plate. A Brookfield LVDVE viscometer was used to measure viscosity while temperature was held constant at 25 °C ± 1 %.

Result(s): Undiluted BaSO₄ suspension behaved similar to nectar-thickened liquids. When diluted it behaved as a thin liquid. Findings show Gerber stage 1 purees range from honey to spoon-thick (pudding). Addition of powdered BaSO₄ reduced the viscosity at low shear rates.

Conclusions (including clinical relevance): This new data provides evidence that our ratio of thin liquid to diluted BaSO₄ falls within an infant/toddler liquid pediatric diet. The viscosity of Stage 1 Gerber purees was found to have a rheological range from honey thick to spoon-thick (pudding). These findings are of strong clinical value. Additional investigation is needed to establish further rheological values of infant/toddler purees.

Financial Disclosure: Arwen Jackson: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Amanda Chestnut: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jared Fry: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Daniel Stool: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Laura Pickler: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jacqueline Frazier: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

THE DEVELOPMENT OF A FEEDING, SWALLOWING AND ORAL CARE PROGRAM USING THE PRECEDE-PROCEED MODEL IN AN ORPHANAGE-HOSPITAL IN GUATEMALA

Colodny, Nancy¹, Miller, Lauren¹, Faralli, Mary¹

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Purpose: The purpose of this study was to evaluate a long-term ongoing international academic service-learning (I-ASL) intervention. Its goal was to improve swallowing, feeding and oral care techniques of medical staff and voluntary feeders in an orphanage in Guatemala to children who are medically complex and have special needs.

Method(s): The PRECEDE-PROCEED model was used as the conceptual framework of the program. Six major target areas were identified during the diagnosis, assessment, implementation and evaluation phases of the model: knowledge and skills, feeding equipment, feeding techniques, oral care, positioning, and communication. Verbal instruction, modelling and individual and small group training was provided by the research team across all visits. A 5-day intervention designed to increase feeders' knowledge of feeding techniques and signs and symptoms of dysphagia and improve their feeding, positioning, and oral care techniques was implemented and evaluated.

Result(s): Statistical analyses showed significant increases in knowledge, and appropriate feeding, positioning, and oral care techniques.

Conclusions (including clinical relevance): As a consequence of the intervention, a trusting and mutually supportive relationship was built between the I-ASL team and the host organisation.

Disclosures: Nancy Colodny: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Lauren Miller: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Mary Faralli: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

NEW TECHNIQUE FOR GUIDING DEVIATION OF A MISLOCATED MANDIBLE AFTER SEGMENTAL MANDIBULECTOMY IN ORDER TO IMPROVE EATING ABILITY

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¹Oral Rehabilitation, Showa University, Tokyo, Japan. ²Truesdail Center for Communicative Disorders, University of Redlands, Redlands, CA, USA

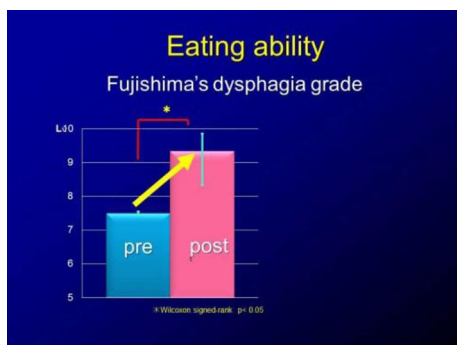
Purpose: Reconstructive techniques are used for fixation of a segmentally resected mandible using a titanium plate with/without free flap. However, reconstructive plates or free flaps should be removed if postoperative complication or cancer recurrence occurs. In these cases, the remaining mandibular bone is pulled by insufficient soft tissue and scar tissue producing significant deviation of the mandible and loss of eating ability. We developed a new technique for repositioning the mandibular deviation of the mandible after segmental mandibulectomy in order to improve eating ability.

Method(s): This technique requires mandible repositioning appliances (MRAs). MRAs include a maxillary and mandibular appliance. The patient's deviated mandible is moved manually toward its normal position after the maxillary and mandible appliances are worn. The appliances are fixed using dental resin material. Patients wear the MRAs during sleep and for 3 h a day for 2–3 weeks to extend scar tissue surrounding the mandible. MRAs are separated to the maxillary and mandible appliances and the same procedures are repeated to

acquire the presurgical mandibular position. Ten patients served as subjects.

Result(s): Eight patients received all procedures and acquired their presurgical mandibular position. Two patients rejected these procedures because of tooth pain and/or discomfort. Eight patients showed significant improvement in eating ability, evaluated by Fujishima's Dysphagia Scale.

Conclusions (including clinical relevance): Effectiveness of our new technique was verified for repositioning the deviated mandible resulting in improved eating ability.



Disclosures: Koji Takahashi: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Yoshiaki Ihara: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Kaoru Yokoyama: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Michael Groher: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

ORAL PRESENTATION AWARD WINNER: THIRD PLACE

RELATIONSHIPS AMONG VIDEOFLUOROSCOPIC SCALES AND STROKE OUTCOME

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Purpose: To evaluate the concordance, reliability and validity of the Penetration-Aspiration scale to an alternate videofluoroscopic [VF] scoring method.

Method(s): Fluoroscopic swallow studies from 152 acute stroke patients were evaluated with the Penetration-Aspiration [Pen-Asp], and Carnaby videofluoroscopic [CVFE] scales. Subjects swallowed 8 bolus preparations during VF. Test-re-test was evaluated using a repeat 10 mL liquid bolus. Baseline VF results were compared to stroke/dysphagia outcomes at 1 and 6 months. The Pen-asp was

scored according to 5 different published conventions to review performance. Relationships were evaluated using coefficient of variation, correlations, *t*-test, and psychometric accuracy.

Result(s): The scales were significantly correlated [r 0.34–0.6]. CVFE was associated with institutionalization [$t = -4.7, p < .0001$]; Glasgow coma scale [$r = -.474, p < .0001$]; length of stay [$r = .616, p < .001$]; and Barthel score [$r = .285, p < .027$], pneumonia [$t = -2.731, p < .015$], tube feeding [$t = -2.9, p < .005$] and Rankin score [$r = .27, p < .03$]. Pen-Asp was not associated with any stroke/dysphagia outcome. Variation for Pen-Asp scoring methods was high (range 0.47–0.66) with poor test-retest reliability [$r = -0.13$]. Diagnostic accuracy for pneumonia and dysphagia varied significantly by VF scoring method [AUC = 0.77 vs. 0.55].

Conclusions (including clinical relevance): Accuracy of VF scoring methods to reflect critical outcomes varies widely. Choice of scoring convention is likely to impact perception of impairment and management.

Disclosures: Giselle Carnaby: *Financial Disclosure:* Salary: University of Florida; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

LINGUAL-PALATAL PRESSURE INTERVENTION FOR PARKINSON'S DISEASE-RELATED DYSPHAGIA: A SINGLE SUBJECT TREATMENT STUDY

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Purpose: To examine whether combined anterior and posterior lingual strengthening and pressure accuracy tasks improve swallowing efficiency for persons with Parkinson's Disease (PD).

Method(s): A 70 year-old female with idiopathic PD (Stage 2) and aspiration of thin liquids completed 4 weeks (16 sessions) of lingual pressure intervention with biofeedback from the Iowa Oral Performance Instrument. Multiple probes of performance on lingual pressure tasks were taken during baseline, treatment and after 4 weeks of maintenance. Videofluoroscopic evaluation of 7 boluses (1, 3, 5, 10 mL, and single sips of thin liquids, 3 cc of pudding, and cookie) and the Swallowing Quality of Life Questionnaire (SWAL-QOL) were obtained at all phases. Blinded reviewers completed videofluoroscopic measures with interrater and intrarater reliability greater than $\alpha = .86$.

Result(s): Probe performance for time to peak pressure and accuracy on submaximal (50 %) pressure targets improved beyond 2 standard deviations at posttreatment and maintenance. Thin liquids aspirated at baseline received averaged Penetration Aspiration Scale scores of 8, which improved to 5.3 at posttreatment and 2.3 at follow-up. Area analysis of residue indicated oral tongue residue was reduced for 4 of 7 boluses and base of tongue residue was reduced for all 7 boluses at posttreatment and follow-up. SWAL-QOL gains (27 points) were largely maintained at follow-up (23 points).

Conclusions (including clinical relevance): Lingual strengthening combined with pressure accuracy tasks demonstrate promise for improved swallow efficiency and pressure control for PD-related dysphagia and warrant further investigation.

Disclosures: Laura Pitts: *Financial Disclosure:* Salary: Rehabilitation Institute of Chicago; Grant/Research Support: American Heart Association; American Speech Language and Hearing Association; Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Meera Rathinasamy: *Financial Disclosure:* Salary: Rehabilitation Institute of Chicago; Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Hannah Newman: *Financial Disclosure:* Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Matthew Oswald: *Financial Disclosure:* Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); *Nonfinancial Disclosure:* Society Member: Chicago Medical Society, Illinois State Medical Society, Association of Academic Physiologists, American Academy of Physical Medicine and Rehabilitation | Leora Cherney: *Financial Disclosure:* Grant/ Research Support: American Heart Association, American Speech-Language-Hearing Foundation; Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Jeri Logemann: *Financial Disclosure:* Salary: Northwestern University; Grant/Research Support: Paul Ruby Foundation; Consulting Fee: National Institute of Aging; Hold Patent on Equipment: Bracco, Inc. Investigative device or drug to be discussed in presentation: Iowa Oral Performance Instrument (IOPI); Speaker fee: PRO-ED, Inc. *Nonfinancial Disclosure:* Volunteer Advisory Committee or Review Panel Member: Communication Sciences and Disorders Clinical Trials Research Group; Member: Dysphagia Research Society.

IS DYSPHAGIA FOLLOWING CARDIAC SURGERY A 'PREEXISTING CONDITION'?

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Purpose: Controversy exists about the incidence of dysphagia following cardiac surgery, and very little is known about the baseline risk in this patient population. This study evaluates the incidence of dysphagia both preoperatively and postoperatively in patients undergoing cardiac surgery.

Method(s): Patients undergoing cardiac surgery were screened for dysphagia preoperatively (PREOP) using a 90 mL water swallow challenge protocol and a simple oral mechanism. The tests were repeated within twelve hours following extubation once the patient was alert and oriented (POSTOP). Patient characteristics were compared using Pearson χ^2 .

Result(s): Of 56 patients tested, five (8.9 %) failed the swallow screen PREOP. Age, gender and comorbidities (HTN, CHF, AMI, DM, PVD, COPD, CRI) were compared. More people who failed the swallow study PREOP presented with an AMI (60.0 vs. 21.6 %, $p = 0.058$) but this trend did not reach statistical significance. All other characteristics were not significantly different. POSTOP, 11 patients failed the swallow screen (20.4 %). All five of the patients who failed the swallow screen PREOP also failed POSTOP (5 of 11, 45.5 %). Age, gender, and comorbidities (including AMI, 27.3 vs. 25.6 %, $p = 0.909$) were not significantly different between those who passed and failed the swallow screen POSTOP.

Conclusions (including clinical relevance): Unrecognized dysphagia in patients who need cardiac surgery is a common problem, and accounts for nearly half of dysphagia seen preoperatively. Age, gender, and medical comorbidities are not predictive of pre- or postoperative dysphagia.

Disclosures: Jo Puntil: *Financial Disclosure:* Salary: Dixie Regional Medical Center; *Nonfinancial Disclosure:* Member: Dysphagia Research Society, ASHA; Society Board Member: Swallowing and Swallowing disorders/board member | B. Jason Bowles: *Financial Disclosure:* Salary: Dixie Regional Medical Center; *Nonfinancial Disclosure:* Member: Society of Thoracic Surgeons, Society of Western Thoracic Surgical Association.

USING HIGH-RESOLUTION MANOMETRY AND VIDEOFUOROSCOPY TO DETECT SUBTLE SWALLOWING CHANGES IN EARLY AND MID-STAGE PARKINSON DISEASE

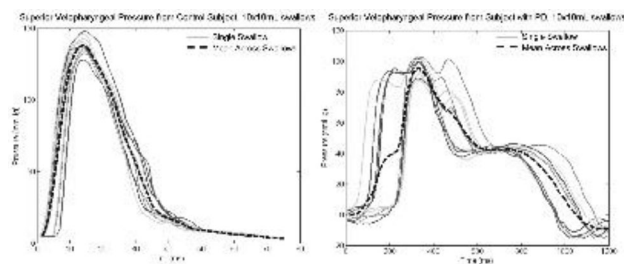
Jones, Corinne A¹, Ciucci Michelle R¹, McCulloch, Timothy¹

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Purpose: Dysphagia secondary to Parkinson Disease (PD) can have devastating effects on health and quality of life. However, standard measurement techniques may not be sensitive enough to detect early and subtle changes in swallowing function. We hypothesized that persons with PD would show differences in coordination and precision of swallowing events on high-resolution manometry.

Method(s): Simultaneous HRM and videofluoroscopy (VF) was performed to examine 22 persons with early to mid-stage PD and 10 normally-aging controls. The Modified Barium Swallow Impairment Profile (MBSImP) was used to quantify VF parameters, and the Sydney Swallowing Questionnaire (SSQ) was used as a measure of self-reported dysphagia symptoms. Swallow precision (variability) was measured by curve-fitting analyses, and swallowing coordination was measured by pressure peak latency. We used logistic regression to test predictive power of the above parameters in determining health state.

Result(s): Logistic regression incorporating SSQ scores, variability in pressure generation across the pharynx, and coordination of pharyngeal pressure generation from the velopharynx to upper esophageal sphincter closure predicted health status of the subjects with <99 % accuracy ($p < 0.001$). Pharyngeal pressures and durations, MBSImP parameters, and airway protection did not predict group differences ($p > 0.05$).



Conclusions (including clinical relevance): Results suggest that HRM and the SSQ are valuable diagnostic tools to detect subtle changes in swallowing function not seen with VF. Improving early detection has the potential to increase long-term swallowing outcomes.

Disclosures: Corinne Jones: *Financial Disclosure:* Salary: University of Wisconsin, Canterbury Medical Research Foundation; Scholarship:

University of Wisconsin (pending); Grant: NIH R33 DC011130; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Michelle Ciucci: *Financial Disclosure*: Salary: University of Wisconsin; Grant: NIH R33 DC011130; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Timothy McCulloch: Salary: University of Wisconsin; Grant: NIH R33 DC011130; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist.

SWALLOWING THERAPY DOES NOT FASTEN RETURN TO NORMAL FOOD INTAKE AFTER RADIOTHERAPY

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Purpose: Radiotherapy (RT) for head and neck cancer (HNC) is known to induce dysphagia, resulting in modified food intake, energy supplements or tube feeding to maintain nutritional status. There is some evidence that swallowing therapy during radiotherapy may limit these side-effects. We aimed to study the effect of swallowing therapy in a large cohort of HNC patients after RT with “normalcy of food intake” (NFI: no tube feeding, supplements or modified food) as the primary endpoint.

Method(s): In a randomized controlled trial, individual dietary counselling (IDC) plus individual swallowing therapy (IST) during RT was compared with IDC as single treatment. Between March 2010 and April 2012, 120 patients with stage T2–4 HNC treated by (adjuvant) (chemo) radiotherapy were randomly assigned to one of these groups. NFI was measured with the Performance Status Scale-HN-normalcy of diet (PSS-HN-ND) at start and end of RT and at 1, 3 and 6 months follow-up. Dysphagia severity was measured on a 6-point scale.

Result(s): Before treatment 54 % in the intervention and 45 % in the control group had NFI and at six months 63 versus 51 % ($p = 0.2$). Mixed models showed no significant difference for PSS-HN-ND (0.48; 95 % CI –5.57 to 6.52) at 6 months. At one month follow-up dysphagia was significantly less in the intervention group, but not at longer follow-up.

Conclusions (including clinical relevance): IST may improve swallowing at one month after RT, but does not fasten return to normal food intake in a heterogeneous cohort. Overall, dysphagia was relatively mild, possibly explaining this lack of effect.

Disclosures: Johanna G. Kalf: *Financial Disclosure*: Salary: Radboud University Medical Center, Department of Rehabilitation; Royalties; Bohn Stafleu Van Loghum, Houten NL; *Nonfinancial Disclosure*: Member: Nederlandse Vereniging voor Logopedie en Foniatrie (NVLF); Society Board Member: Past-president CPLOL; Society Committee Member: Evidence-based practice-committee (NVLF); Volunteer Teacher/ Speaker: Parkinson Vereniging (Dutch Parkinson Association) | Manon Van den Berg: *Financial Disclosure*: Salary: Radboud University Medical Center, Nijmegen NL; Grant/ Research Support: Fresenius Kabi and Sorgente BV; *Nonfinancial Disclosure*: Member: PWHHT; Society Board Member: ESPEN | Matthias A.W. Merckx: *Financial Disclosure*: Salary: Radboud University Medical Center, Nijmegen NL; Scholarship: State University Groningen, The Netherlands; Grant: Sorgente BV; Fresenius Kabi Nederland BV; *Nonfinancial Disclosure*: Member: International Association Oral & Maxillofacial Surgery; Society Board Member: President Dutch Head & Neck Society; Society Committee Member: International Association Oral Oncology | Geert Wanten: *Financial Disclosure*: Salary: Radboud University Medical Center,

Nijmegen NL; Grant/ Research Support: Baxter; Geistlich Pharma, Fresenius Kabi; *Nonfinancial Disclosure*: Society Member: ESPEN council member; Society Board Member: NESPEN (chairman); Dutch Registry of Intestinal Failure and Transplantation (Treasurer) | Johannes H.A.M. Kaanders: *Financial Disclosure*: Salary: Radboud University Medical Center, Nijmegen NL; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist.

VIBROTACTILE STIMULATION EFFECTS ON SWALLOWING FREQUENCY AND CORTICAL RESPONSES

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Purpose: To determine the most effective vibratory rate for increasing swallowing and brain activation, surface vibration was presented over the larynx while using functional near-infrared spectroscopy to continuously record cortical changes in blood oxygenation levels (HbO₂) over the motor and sensory cortices in the right and left hemispheres in healthy volunteers.

Method(s): Thirty 10-s epochs were presented in seven 20-min randomized conditions: no stimulation, 30, 70, 110 and 150 Hz stimulation and hybrid frequencies (combined 70 and 110 Hz) both continuous and pulsed. Spontaneous swallows with and without stimulation were examined for cortical responses.

Result(s): Hybrid motor stimulation increased swallowing by 100–300 %, to a greater degree than 30, 110, or 150 Hz stimulation ($p < .004$). Continuous and pulsed hybrid and 70 Hz stimulation equally increased swallowing. Early (4.5–7 s) and late (14.5–15.5 s) HbO₂ responses occurred following stimulation or swallowing onset. Swallowing produced a greater number of early increases in HbO₂, whereas hybrid and 70 Hz stimulation produced more late reductions in HbO₂. During swallowing with and without vibration, early increases in HbO₂ were more frequent in M1 than S1 ($p = 0.016$).

Conclusions (including clinical relevance): Vibratory stimulation increases swallowing frequency and enhances cortical activation particularly in the motor area during swallowing. These findings suggest that surface vibratory stimulation may enhance cortical control for retraining swallowing in patients with dysphagia.

Disclosures: Rachel Mulheren: *Financial and Nonfinancial Disclosure*: No relevant relationships exist. | Christy Ludlow: *Financial Disclosure*: Grant/Research Support: National Institutes of Health; Passy Muir, Inc., Consulting Fee: Passy Muir, Inc. Hold Patent on Equipment: Passy Muir Swallowing Self Trainer, Intellectual Property Rights: 3 patents held by National Institutes of Health and Passy Muir, Inc. Royalties: Plural Publishing; Speaker fee: Northern Speech Services; *Nonfinancial Disclosure*: Member: Dysphagia Research Society.

SPONTANEOUS SWALLOW FREQUENCY AND DYSPHAGIA RELATED OUTCOMES IN ACUTE STROKE

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Purpose: To examine dysphagia related outcomes in acute stroke patients subsequent to dysphagia screening with spontaneous swallow frequency analysis (SFA).

Method(s): 96 stroke patients received SFA dysphagia screening an average of 3 days following onset of symptoms. Dysphagia (MASA, FOIS), stroke severity (NIHSS), and stroke impairment (Barthel [BI]) were assessed at baseline and discharge. Dysphagia related outcomes included: length of stay, infections, dysphagia evaluation, dysphagia treatment, PEG placement, dysphagia at discharge, diet level at discharge, and death. Univariate statistics were used to investigate associations between SFA and dysphagia related outcomes.

Result(s): Mean swallow frequency rate was lower in patients with dysphagia (0.51 vs. 0.27; $p < 0.0001$). At baseline SFA was significantly correlated with dysphagia (MASA: $r = 0.30$, $pp = 0.003$; FOIS: $r = 0.32$, $p = 0.002$) and stroke impairment (BI: $r = 0.34$, $p = 0.001$), but not stroke severity (NIHSS), age, or time to screening. Baseline SFA was significantly associated with SLP dysphagia evaluation ($t = 2.14$, $p = 0.04$), dysphagia at discharge ($t = 1.99$, $p = 0.05$), modified diet at discharge ($t = 2.25$, $p = 0.02$), and stroke impairment at discharge ($t = 2.38$, $p = 0.02$).

Conclusions (including clinical relevance): As a dysphagia screening tool, SFA has high potential to identify dysphagia and is associated with dysphagia related outcomes in acute stroke.

Disclosures: Michael Cray: *Financial Disclosure:* Salary: University of Florida; Hold Patent on Equipment: The University of Florida holds a patent on this concept; Intellectual Property Rights: The University of Florida owns the IP for this concept; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Giselle Carnaby: Salary: University of Florida; Hold Patent on Equipment: The University of Florida holds a patent on this concept; Intellectual Property Rights: The University of Florida owns the IP for this concept; *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Lisa LaGorio: Salary: University of Florida; Hold Patent on Equipment: The University of Florida holds a patent on this concept; Intellectual Property Rights: The University of Florida owns the IP for this concept; *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

LEARNING-RELATED CHANGES IN THE OROFACIAL SENSORIMOTOR CORTEX

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Purpose: The sensorimotor cortices have long been implicated in motor skill acquisition. However, how learning affects the mutual information (MuI) and the across-trial variability in the spiking of neuronal ensembles in the orofacial motor (MIO) and somatosensory (SIO) cortices is still unknown.

Method(s): Two naïve monkeys (*Macaca mulatta*) were chronically implanted with microelectrode arrays to track neuroplastic changes in MIO and SIO as monkeys learned a novel tongue-protrusion task over a period of 8–12 days.

Result(s): The temporal evolution of the MuI across populations of MIO and SIO neurons matched that of the force profile. With practice, both monkeys exhibited a progressive increase in MuI which correlated with faster reaction times ($p < 0.05$). The faster build-up of information was also accompanied by a reduction in the across-trial variability in both MIO and SIO ($p < 0.001$).

Conclusions (including clinical relevance): The results suggest that the build-up of information and the improved reliability in the firing of the task-modulated MIO and SIO neurons allowed for improved information processing and transmission for selecting the optimal movement strategies with learning.

Disclosures: Fritzie Arce: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Nicholas Hatsopoulos: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Jason Lee: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Barry Sessle: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Callum Ross: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

SWALLOWING DYSFUNCTION AND APRAXIA OF SPEECH AFTER STROKE

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Purpose: Recent literature has identified similarities between certain types of swallowing dysfunction and other motor disorders, such as apraxia of speech (AOS). This study sought to identify common neural mechanisms between dysphagia and AOS.

Method(s): We tested a series of 79 patients within 24 hours post onset of left hemisphere ischemic stroke, in addition to 25 controls, with the Apraxia Battery for Adults II (ABA II, Dabul, 2000) and obtained concurrent MRI. Each patient received a 3 oz. water swallow screening upon admission. Patients who did not pass the swallow screening were referred for SLP evaluation. MRI scans were analyzed for presence or absence of ischemia in each of 11 Brodmann's areas (BA) and anterior and posterior insula.

Result(s): We identified a significant association between AOS measures and impaired swallowing function (as defined by a failed water swallowing screen) using Fishers exact tests ($p = 0.042$; OR = 5.8). Lesions in left premotor cortex (BA 6) were associated with both AOS ($p = 0.015$; OR = 5.8) and impaired swallowing function ($p = 0.045$; OR = 3.43). Lesions in pars triangularis of Broca's area (BA 44) showed a trend toward an association with AOS ($p = 0.059$; OR = 8.4) and were significantly associated with impaired swallowing ($p = 0.019$; OR = 5.84). Impaired swallowing function was also associated with lesions in Wernicke's area (BA 22; $p = 0.013$; OR = 4.57) and pars triangularis (BA 45; $p = 0.019$; OR = 5.84).

Conclusions (including clinical relevance): AOS and dysphagia are highly associated in patients with acute left hemisphere stroke. Acute infarct in left premotor cortex is associated with both of these deficits.

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SPATIOTEMPORAL CHARACTERISTICS OF THE PHARYNGEAL CORTICAL SENSORY EVOKED POTENTIAL IN HEALTHY SUBJECTS

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Purpose: Sensory input is crucial to the modulation of swallowing. However, how this sensory input is processed at cortical level has not been clearly defined. We aimed to characterize the spatiotemporal

characteristics of the cortical response to a pharyngeal electrical stimulus.

Method(s): 8 healthy volunteers were studied by EEG. 4 trains of 50 intra-pharyngeal electrical stimuli were applied. Pharyngeal sensory evoked potentials (PSEP) were measured via a 32-electrode cap (10–20 System). Latency, amplitude and cortical distribution of the PSEP were measured.

Result(s): The PSEP wave form was characterized by initial negative and positive components (N1, P1) with mean latencies of 69 ± 15 ms and 135 ± 11 ms respectively. These peaks were followed by second negative and positive components (N2, P2) with mean latencies of 178 ± 13 and 330 ± 14 ms respectively. The early negative peak N1 showed a centro-parietal lateral distribution (C3, C4, CP3, CP4) and the P1 showed maximal amplitude in the electrodes of the frontal region (F3, F4, Fz). The N2 component showed a similar distribution to the N1, and P2 showed maximal amplitude at the vertex.

Conclusions (including clinical relevance): We have characterized the morphology and topography of the PSEP that showed small inter-subject variability. We observed an earlier activation of the somatosensory cortex followed by activation of the frontal cortex, an area implicated in sensorimotor modulation of swallowing as well as later peaks likely to be related with secondary process of the stimulus.

Disclosures: Laia Rofes: *Financial Disclosure:* Salary: Centro de Investigación Biomédica en Red de enfermedades hepáticas y digestivas (CIBERehd), Instituto de Salud Carlos III, Ministry of Economy and Competitiveness (Spain); Grant/ Research Support: Fundació la Marató de TV3; *Nonfinancial Disclosure:* Member: European Society for Swallowing Disorders (ESSD) | Natalia Vilar-dell: *Financial Disclosure:* Salary: Fundació Salut Consorci Sanitari del Maresme; Grant/ Research Support: Fundació La Marató TV3; *Nonfinancial Disclosure:* Member: European Society for Swallowing Disorders (ESSD) | Pere Clavé: *Financial Disclosure:* Salary: Consorci Sanitari del Maresme; Grant/ Research Support: Fundació La Marató TV; *Nonfinancial Disclosure:* Member: European Society for Swallowing Disorders (ESSD); Society Board Member: European Society for Swallowing Disorders (ESSD).

CHANGES IN QUALITY OF LIFE AND COUGH AFTER EXPIRATORY MUSCLE STRENGTH TRAINING (EMST) IN INDIVIDUALS WITH MULTIPLE SCLEROSIS (MS)

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Purpose: MS is a progressive demyelinating disease of the CNS. MS can decrease respiratory muscle strength. Swallow dysfunction, coupled with impaired respiratory muscle strength and impaired cough, places those with MS at high risk for respiratory-swallow compromise.

Method(s): Swallow-related QOL and measures of expiratory muscle strength and cough were obtained in 32 individuals with relapsing-remitting MS. 19 were assigned to the EMST group and 13 to a sham group. The EMST group received 5 weeks of EMST training set to 75 % their average maximum expiratory pressure (MEP). The sham group was given a device and training protocol identical in appearance and operation to the EMST group, however the sham devices were nonfunctional.

Result(s): Both groups exhibited a significant improvement in MEP and SWAL-QOL pre- to post- training. Item analysis of SWAL-QOL results suggested that EMST group demonstrated improvements in pharyngeal swallow function and saliva management, results not seen in the Sham group. Significant changes were observed in measures of cough airflow within the EMST group. A moderately strong, positive correlation was found between MEP and SWAL-QOL scores.



Conclusions (including clinical relevance): These results show a treatment effect for EMST in those with MS with unanticipated training effects in the Sham group. MEP reassessment and improved coordination of breathing are discussed as possible source. SWAL-QOL scores were significantly different on questions pertaining to pharyngeal swallow function and saliva management for the EMST group. Treatment considerations are examined in light of these mixed findings.

Disclosures: Erin Silverman: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Sarah Miller: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Paul Davenport: *Financial Disclosure:* Consultant or employee: Aspire LLC; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Nan Musson: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | James Yeager: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

IMPROVING CLINICAL DYSPHAGIA INTERVIEWING SKILLS BY VIRTUAL PATIENT CREATION

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Purpose: To evaluate the impact of creating virtual patients on improving clinical dysphagia interviewing skills.

Method(s): 29 graduate students in a dysphagia management class created and/or interviewed virtual patients (VPs). The VP creation group (n = 15) created interactive VPs through an on-line web application. The VP interview group (n = 14) interviewed preexisting VPs. VPs were interviewed by both groups at the start, mid-point, and end of the semester. Clinical dysphagia interviewing skills were assessed at each time point by calculating percent information discovered, number of questions per discovery, and diagnostic accuracy. ANOVAs examined differences in interviewing skills by group and time point.

Result(s): Percent information discovered did not differ by group or time point. A significant reduction in number of questions per

discovery was found for both groups at mid-point ($F(1,26) = 14.1$, $p = .001$) and end of the semester ($F(1,26) = 33.1$, $p < .001$). A significant time \times group interaction was found for diagnostic accuracy ($F(1.77,46.0) = 3.41$, $p = .047$). The VP creation group improved most at mid-point assessment ($F(1,26) = 5.3$, $p = .03$).

Conclusions (including clinical relevance): Creation of VPs improved diagnostic accuracy during clinical dysphagia interviewing. Application of virtual reality may be a novel way to augment education of dysphagia clinicians.

Disclosures: Isaac Sia: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Shivashankar Halan: *Financial Disclosure:* Salary: University of Florida; Scholarship: University of Florida; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Benjamin Lok: *Financial Disclosure:* Salary: University of Florida; Grant: Research/ Support: NSF, NIH Intellectual Property Rights: University of Florida; Hold Patent on Equipment: University of Florida; Ownership Interest: Shadow Learning, Inc., Shadow Health, Inc. Royalties: University of Florida; *Nonfinancial Disclosure:* Member: IEEE, ACM | Michael Cray: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

UTILITY OF SELF-REPORT PATIENT SCALES IN THE ASSESSMENT OF DYSPHAGIA

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Purpose: Assess associations between patient-rated indices of swallow severity and swallow-related quality of life with validated objective measures of swallowing function.

Method(s): 40 Amyotrophic Lateral Sclerosis (ALS) patients completed the Eating Assessment Tool 10 (EAT-10), the Swal-QOL and underwent a videofluoroscopic evaluation. Objective swallow measures, Penetration-Aspiration Scale (PAS) Scores and the Functional Oral Intake Scale (FOIS) were completed by an experienced blinded clinician. Spearman's Rho correlation analyses were conducted between patient-rated and clinician-rated validated outcome measures.

Result(s): Patient-rated dysphagia severity (EAT-10) was significantly correlated with: PAS scores ($r = .55$, $p = .001$), pharyngeal constriction ratio ($r = 0.71$, $p = .000$); oropharyngeal transit time ($r = 0.51$, $p = .002$); and FOIS ($r = -0.75$, $p = .000$). In addition, ALS patients who penetrated/aspirated demonstrated significantly higher EAT-10 scores than those who did not ($p = 0.006$). Patient-reported swallow-related QOL was significantly correlated with: PAS scores ($r = -.47$, $p = .005$), hyoid displacement ($r = .44$, $p = .01$), hyoid duration ($r = -.41$, $p = .01$); pharyngeal constriction ratio ($r = -.60$, $p = .000$); oropharyngeal transit time ($r = -.50$, $p = .003$); hypopharyngeal transit time ($r = -.53$, $p = .001$) and FOIS ($r = -0.71$, $p = .000$).

Conclusions (including clinical relevance): In this group of individuals with ALS, patient ratings of swallow severity were strongly related to objective temporal & kinematic swallow measures, degree of airway protection during swallowing and functional oral intake. These data highlight the utility of validated patient scales in the assessment of dysphagia.

Disclosures: Emily Plowman: *Financial Disclosure:* Grant/Research Support: NICHD; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Stephanie Watts: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Amanda Domer: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Joy Gaziano: *Financial and Nonfinancial Disclosure:* No

relevant relationships exist. | Lauren Tabor: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

SHOULD DYSPHAGIA RESEARCH FOCUS SOCIAL/ECONOMIC ISSUES? A QUALITATIVE ANALYSIS

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Purpose: Globally, two paradigm shifts affect dysphagia management. First, is growing awareness that dysphagia is a disability. Secondly, 'gold standard' dysphagia practices are re-negotiated in economically constrained contexts. A critical question arises: should social-economic issues influence how we research dysphagia?

Method(s): Data sets included: (i) two significant disability/nutrition reports from international organisations; (ii) 21 international articles in a special edition of International Journal of Speech Language Pathology on the 2011 World Report on Disability; and (iii) 12 transcribed presentations from a dysphagia panel at the 2013 International Association for Logopedics and Phoniatrics conference. This panel focussed dysphagia in resource constraints in 11 Minority/Majority world countries in North America, Europe, Asia, Africa and the Middle East and migrants. Data was qualitatively analysed using Atlas.ti software for scanning, coding, categorisation and factoring. Triangulation, blinded coding and author/member-checking ensured trustworthiness/validity.

Result(s): International organisations rarely report dysphagia as a disability. Practitioners position dysphagia as biological and socio-economic realities. Dysphagics constitute an underserved population, receiving inequitable services and globally experience food security risks.

Conclusions (including clinical relevance): Dysphagia as food insecurity for people with disabilities implies a body-to-environment shift for researchers. Hence a population based approach to dysphagia practice/research, is discussed.

Disclosures: Mershen Pillay: *Financial Disclosure:* Salary: Stellenbosch University, South Africa; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

ESOPHAGEAL SCREENING AS AN ADJUNCT TO THE VIDEOFUOROSCOPIC STUDY OF SWALLOWING

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Purpose: Complaints of solid dysphagia lead to speech-language pathology (SLP) referral. Yet many of these patients are later diagnosed with esophageal rather than oropharyngeal dysphagia. Fluoroscopic screening involving oropharynx alone fails to identify these patients. The aim of this study was to evaluate the clinical benefit of esophageal screening in a SLP videofluoroscopic study of swallowing (VFS) clinic.

Method(s): One hundred consecutive mixed aetiology patients referred by Otorhinolaryngology (50) or by SLP (50) were recruited. All VFS recordings were analysed using objective digital measures of timing and displacement.

Result(s): 50 % of patients referred to VFS clinic presented with abnormal esophageal transit. 10 % of these patients presented only with esophageal abnormalities. Oral or pharyngeal abnormalities were not significantly associated with esophageal abnormalities. Pharyngo-esophageal segment abnormalities were significantly associated with esophageal abnormalities ($p < .005$).

Conclusions (including clinical relevance): Fluoroscopic screening of the pharynx alone, without esophageal review, risks misdiagnosis and incomplete management of patients with dysphagia. Utilising an esophageal screen, timely referral to the appropriate medical speciality can occur.

Financial Disclosure: Anna Miles: *Financial Disclosure:* Salary: The University of Auckland; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Jessica McMillan: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Katie Ward: *Financial Disclosure:* Salary: Waitemata District Health Board; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Jacqui Allen: *Financial Disclosure:* Salary: Waitemata District Health Board; Grant: Waitemata District Health Board; *Nonfinancial Disclosure:* Member: Dysphagia Research Society, NZSOHNS; Board Member: Dysphagia Research Society; Committee Member: Dysphagia Research Society.

EFFECT OF LIDOCAINE ON SWALLOWING DURING FEES IN DYSPHAGIC PATIENTS

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Purpose: To test whether 0.2 cc of 4 % atomized lidocaine affects the swallow and/or tolerability during Flexible Endoscopic Evaluation of Swallowing (FEES).

Method(s): 17 dysphagic patients received 4 standardized boluses in sequential FEES exams; first with decongestant, then with lidocaine. Patients were blinded. Pain scales were completed after each exam. Blinded clinicians scored randomized clips with the Penetration Aspiration Scale (PAS) and a 5-point residue rating scale. A series of Wilcoxon signed-rank tests were conducted to detect differences between the two conditions.

Result(s): There were no significant differences between groups in mean PAS ($p = 0.157-0.892$) or residue ($p = 0.317-1.000$) scores for any of the 4 boluses. Mean pain scores were significantly lower in patients who received lidocaine as compared to patients who received decongestant ($p = 0.035$).

Conclusions (including clinical relevance): A recent study reported that 1 cc of lidocaine can impair normal swallow function. This current study demonstrates that 0.2 cc of lidocaine does not impair the swallow in dysphagic patients, but enhances exam tolerability.

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Financial and Nonfinancial Disclosure: No relevant relationships exist. | Asako Kaneoka: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Susan Butler: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphagia Research Society | Gintas Krisciunas: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Member: Dysphagia Research Society.

PREVALENCE AND CHARACTERISTICS OF FEED-THICKENING PRACTICES FOR DYSPHAGIA IN NICU INFANTS

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ABSTRACT BODY:

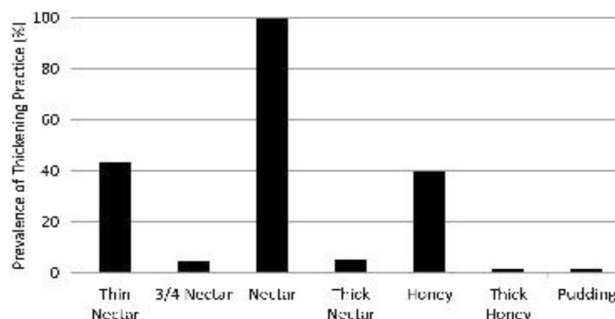
Purpose: Thickening feeds to treat dysphagia in infants is controversial due to concerns of digestive immaturity and malabsorption, necrotizing enterocolitis, and arsenic exposure. Despite uncertainty regarding its safety, thickening remains a prevalent feeding strategy.

Method(s): To examine feed-thickening practices, an international online survey was distributed to Neonatal Intensive Care Units (NICUs) via ASHA's Special Interest Group 13 and a Rehab Director's List Serve.

Result(s): Responses from 70 NICUs were analyzed. 90 % of NICUs reported thickening to alleviate aspiration risk. Occurrence of reported thickness characteristics is shown in Graph 1. 60 % exclusively use infant cereal to thicken; 14 % exclusively use commercial thickener; 21 % use combinations of infant cereal, commercial thickener or pureed fruit; and 4 % did not specify thickener. Additionally, infant cereal thickness definitions are presented as median (range): Thin Nectar 1 (0.75–1.125) tsp/oz, Nectar 1.5 (1-4.5) tsp/oz., and Honey 3 (2–3) tsp/oz (Graph 1).

Conclusions (including clinical relevance): These responses reinforce the notion that in spite of concerns expressed by the FDA and AAP regarding the use of thickened feeds for infants, the vast majority of NICUs continue to thicken. No standard thickening practice or definition is used indicating that current methods should be examined to determine best practices for both efficacy and patient safety.

Disclosures: Lauren Keil: *Financial Disclosure:* Salary: Nationwide Children's Hospital; *Nonfinancial Disclosure:* Member: ASHA | Kathryn Hasenstab: *Financial Disclosure:* Salary: Nationwide Children's Hospital; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Sudarshan Jadcherla: *Financial Disclosure:*



Graph 1 Characterization of feeding-thickness utilized in NICUs

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VIDEOFLUOROSCOPIC ANALYSIS TO DETERMINE THE EFFECTS OF THICKENED LIQUIDS ON OROPHARYNGEAL SWALLOWING FUNCTION IN INFANTS WITH RESPIRATORY COMPROMISE

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Purpose: This study evaluated the effects of thickened liquids in a homogenous sample of infants through retrospective analysis of archived videofluoroscopic swallow studies.

Method(s): Fifteen different temporal and physiologic measures were recorded from frame by frame analysis of 242 swallows (121 swallows of thin barium and 121 swallows of nectar barium) from 25 infants with respiratory compromise. Each subject provided a sample of both thin and nectar thickened liquid swallows for comparison.

Result(s): Significant differences were found among the following variables between swallows of thin liquid barium and swallows of nectar thickened liquid barium: number of sucks per swallow, suck time, oral transit time, time to initiate velar movement, scores on the penetration-aspiration scale, location of the bolus before the swallow, and presence of residue after the swallow. There were greater numbers of sucks per swallow, longer suck and oral transit times, lower mean scores on the penetration-aspiration scale, and longer time to initiate velar movement for swallows of nectar thickened liquid barium as compared to swallows of thin liquid barium. Bolus material collected at a more inferior location along the upper aerodigestive tract and there was greater frequency of residue in the pharynx for swallows of the nectar barium.

Conclusions (including clinical relevance): Results indicate reduced airway invasion with the use of nectar thickened liquids as a result of prolonging the oral phase of swallowing, thereby reducing the frequency of pharyngeal swallow and opportunities for airway compromise during bottle feeding.

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FEEDING SKILLS AND DIETARY INTAKE OF PRETERM INFANTS AT 12 MONTHS CORRECTED AGE

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Purpose: It is well known that preterm neonates often display difficulty establishing oral feeding and meeting their nutritional requirements in the weeks following birth. Less is known about their feeding patterns beyond discharge from the neonatal unit. This study aimed to document feeding skills and typical dietary intake of preterm infants at 12 months corrected age (CA).

Method(s): Data on 75 preterm (PT) and 75 full-term (FT) infants are presented. Dietary intake was recorded using a 3-day diet record and oral motor skills were rated from observation using the Pre-Feeding Checklist.

Result(s): Overall, PT infants were found to consume significantly less total energy than FT infants ($p < 0.01$) and their diet consisted of a smaller proportion of protein ($p < 0.01$). The PT group failed to meet recommended intake across a number of key nutrients. Oral motor delay was correlated with energy and nutrient deficiency ($r = 0.58$).

Conclusions (including clinical relevance): This study shows that preterm infants continue to display feeding difficulties at 12 months CA, and that this is associated with dietary inadequacy. Further research is required to investigate possible interventions.

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NUTRITION AND BODY COMPOSITION IN CHILDREN WITH FEEDING DIFFICULTIES

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Purpose: Feeding difficulties have been linked to nutrient deficiencies and growth disturbances.

Method(s): Nutrition data are presented on 73 children presenting to an intervention clinic for feeding difficulties. Information was collected through prospective 3-day diaries, anthropometric measures, and bioelectrical impedance analysis (BIA).

Result(s): Most children did not meet recommended dietary intake across a number of key nutrients, in particular fiber, vitamin D, and iron. Despite this, few had BMI < 10 percentile ($n = 2, 3\%$) and a number had BMI > 85 percentile ($n = 8, 11\%$). Excessive sodium intake was positively correlated with BMI ($r = 0.45, p < 0.01$). A subset ($n = 12$) who complied with BIA testing all presented with body fat >95 percentile.

Conclusions (including clinical relevance): Children with feeding difficulties can present as normal to over-weight, in contrast to the traditional image of this population as under-weight. Nutrient deficiencies and excessive sodium intake appear common. This has implications for long term health.

Male, n (%)	55 (75 %)
Age in months, mean (SD)	51 (±11.5)
Height z-score, mean {SD}	0.67 (±1.01)
Weight z-score, mean (SD)	0.51 (±0.86)
BMI z-score mean (SD)	0.15 (±0.87)
Body fat % (BIA), mean (SD)	33 % (±6 %)
Inadequate intake of:	
Fiber, n(%)	57 (78 %)
Vitamin D, n(%)	63 (86 %)
Iron, n(%)	59 (81 %)
Exceeding upper limit of sodium, n (%)	52 (71 %)

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MULTIDISCIPLINARY DIAGNOSTIC FINDINGS IN MEDICALLY COMPLEX CHILDREN WITH FEEDING/SWALLOWING DYSFUNCTION

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Purpose: Many children with feeding/swallowing dysfunction (FSD) have underlying aerodigestive disease. The Johns Hopkins Multidisciplinary Pediatric Aerodigestive Center (MPACT) was established to provide combined gastroenterology, otolaryngology, pulmonary and speech-language pathology assessment of these children, and coordinated evaluation under anesthesia (EUA) when indicated. We hypothesized that MPACT care improves diagnostic efficiency and reduces anesthesia events.

Method(s): Retrospective chart review of patients with FSD from 125 consecutive MPACT patients (June 2010–August 2013).

Result(s): 63 patients presented with FSD. 43 patients had EUA, with 27 having procedures by multiple services during a single anesthesia (MS-EUA). 85 % of MS-EUA patients had multiple diagnostically positive findings. Of FSD patients, 34 % (14 of 41) had aspiration on videofluoroscopic (VFSS) or flexible endoscopic swallow evaluation (FEES). 26 patients had VFSS/FEES alone, 12 had MS-EUA alone, 15 had both, and 10 had no additional evaluations after MPACT visit. Of those undergoing MS-EUA alone, 10 had laryngeal cleft or pulmonary findings consistent with aspiration. Laryngeal cleft was diagnosed in 44 % of FSD patients.

Conclusions (including clinical relevance): In comparison to serial EUA’s, MS-EUA reduced anesthesia events and related risks, and decreased time to diagnosis. MPACT care, with MS-EUA when indicated, provided diagnostic information to guide decision-making and determine utility of VFSS, and improved diagnostic efficiency through reduced time to diagnosis and clinic, anesthesia, and radiographic events.

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relationships exist. | Margaret Skinner: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

ORAL PRESENTATION AWARD WINNER: FIRST PLACE; NATIONAL FOUNDATION OF SWALLOWING DISORDERS AWARD

MULTIDISCIPLINARY PEDIATRIC AERODIGESTIVE CARE REDUCES HEALTHCARE COSTS AND BURDEN IN CHILDREN WITH FEEDING OR SWALLOWING DYSFUNCTION

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Purpose: Children with aerodigestive disease and feeding/swallowing dysfunction (FSD) frequently require care from multiple pediatric subspecialists. In 2010, The Johns Hopkins Multidisciplinary Pediatric Aerodigestive Center (MPACT) was established to coordinate clinical and operative gastroenterology, ENT, pulmonary, and speech-language pathology care for these complex patients. We hypothesized that MPACT management reduces healthcare costs and burden (Table 1). **Method(s):** Retrospective chart review of 125 consecutive MPACT patients evaluated for FSD (June 2010 – August 2013).

Result(s): 63 patients were evaluated for FSD. During the initial visit each patients saw a mean of 3.4 ± 0.7 of 4 possible services. Families lived a median distance of 25.3 miles (range 0.6–2099) from clinic. Based on estimated parking, travel and facility expenses, the average cost savings per family per MPACT visit was \$182. 43 patients were referred for endoscopy under general anesthesia (GA) (68 %). By coordinating recommended procedures, 46 GA encounters were avoided (-35 %), eliminating the risks of anesthesia, related costs, and travel expenses for procedures.

Conclusions (including clinical relevance): MPACT care resulted in substantial cost savings and reduced healthcare burden realized

Table 1 Demographic and clinic utilization data

Characteristic	Patients seen by SLP in AD clinic (n = 63)	
Sex	Female	24 (38.1 %)
	Male	39 (61.9 %)
Race/ethnicity	White	47 (74.6 %)
	Black	8 (12.7 %)
	Hispanic	2 (3.2 %)
	Other	6 (9.5 %)
Age (years)	Median: 0.95 Range: 0.08, 20.31	
Median distance to clinic (miles)	25.3 Range: 0.6, 2099	
Number services seeing pPatient	2 Services	6 (9.5 %)
During initial clinic encounter	3 Services	25 (39.7 %)
	4 Services	32 (50.8 %)

through reduced clinic and GA encounters, decreased lost time from work and family responsibilities. Fewer GA events reduce costs, utilization and may reduce neurocognitive risks associated with multiple GA exposures. Costs related to childcare, meals, and missed time from work could not be calculated, but likely increased cost savings and reduced familial burden.

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IMPACT OF FEES ON FEEDING STATUS IN CHILDREN WITH AND WITHOUT NEUROLOGIC IMPAIRMENT

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Purpose: Fiberoptic endoscopy evaluation of swallowing (FEES) with sensory testing has been used to predict aspiration potential and feeding outcomes in children. We sought to determine whether neurologic status or other patient variables would modify the relationship between laryngeal sensation and feeding status.

Method(s): Retrospective consecutive case series of children undergoing standardized FEES evaluation at a tertiary care center from 2009 to 2012.

Result(s): 118 children (mean age: 2.8 ± 4.7 years; 61 [52 %] female) underwent FEES. Of these children, 66 (56 %) were classified as white, 32 (27 %) black, and 20 (17 %) as other. Neurologic impairment had been identified in 71 (60 %). NPO status was higher prior to FEES (43 %, 50/115) than after FEES (21 %, 24/115; $p = 0.0004$). There was no significant difference in NPO status before and after FEES by neurologic status ($p = 0.81$), although, abnormalities on FEES (e.g., penetration, aspiration, incomplete clearance or delayed swallow) with water bolus presentation were significantly more common in those with neurological impairments ($p = 0.024$). Feeding status was comparable for children regardless of race ($p > 0.99$), sex ($p = 0.80$), neurologic ($p > 0.99$), cardiac ($p = 0.58$), or syndromic status ($p > 0.99$). Changes in feeding status were not associated with sensation scores ($p = 0.29$).

Conclusions (including clinical relevance): FEES findings liberalized oral feeding status in 52 % of children who were NPO. Sensation on FEES did not predict feeding status, nor did race, gender, neurologic, cardiac or syndromic status. Future investigations are needed to define further pathophysiology of these impairments.

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Disclosure: No relevant relationships exist. | Veronica Vigilar: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Rebecca Anderson: *Financial and Nonfinancial Disclosure:* No relevant relationships exist. | Maureen Lefton-Greif: *Financial and Nonfinancial Disclosure:* No relevant relationships exist.

SCIENTIFIC POSTERS

THE CAPACITY FOR CORTICAL CONTROL OF PHARYNGEAL SWALLOWING IN HEALTHY ADULTS

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Purpose: Research suggests that the duration of brainstem-generated pharyngeal swallowing can be cortically modulated for various textures during ingestion, but the sequence of contraction remains constant. Recent clinical experience has identified a patient cohort with mis-sequenced pharyngeal pressure when swallowing, contributing to significant dysphagia. This study examined if healthy adults can produce mis-sequenced pressure generation given intensive training.

Method(s): The latency of upper and lower pharyngeal pressure generation was measured with discrete sensor pharyngeal manometry. Five healthy participants were seen for 10 one-hour sessions over two weeks. With manometry as visual biofeedback, their goal was to reduce the peak-to-peak interval between two pharyngeal sensors during swallowing.

Result(s): Following training, there was a marginally significant reduction of temporal separation of peak pressure between the upper and lower pharyngeal sensors ($p = .052$), from an average of 165 ms (SD = 111 ms) to an average of 56 ms (SD = 79 ms, >1.5 SD below mean). This was accompanied by a reduction in swallowing duration from a baseline of 436 ms (SD = 94 ms) to 381 ms (SD = 108 ms).

Conclusions (including clinical relevance): This study supports that the duration of the brainstem-generated pharyngeal swallow can be cortically modulated. However, the reduction of the temporal separation of peak pressure was accompanied with reduction of overall swallowing duration, not seen in the clinical cohort. This has potential implications for the aetiology and characterization of pharyngeal mis-sequencing in dysphagic patients.

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DIFFERENCES IN TONGUE PRESSURE DURING SWALLOWING IN VARIATIONS OF THE CHIN-DOWN POSTURE

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Purpose: Although various definitions of the chin-down maneuver have been used for positioning the head and neck, differences in tongue-palate contact among each position have yet to be clarified. This study investigated the influence of different chin-down postures on tongue pressure generation against the hard palate.

Method(s): Participants were 22 young healthy subjects (8 women, 14 men, mean age; 30.6 years). Subjects performed a 5-ml swallow task in neutral position and three chin-down positions: head flexion (HF); neck flexion (NF); and combined head and neck flexion (HFNF). Tongue pressure was measured using a sensor sheet system with five measurement points on the hard palate. Sequential order, duration, maximal magnitude, and the integrated value of tongue pressure at each measurement point were compared among positions.

Result(s): Duration and maximal magnitude of tongue pressure at the anterior and posterior parts were significantly larger in HF and HFNF than in other positions. At all measurement points, the integrated value of tongue pressure was significantly larger in HF than in neutral position.

Conclusions (including clinical relevance): HF and HFNF can increase bolus driving force in the oral phase with greater tongue pressure generation along a wide area on the hard palate than in a neutral position or with NF.

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SWALLOWING OUTCOMES FOR ELDERLY INPATIENTS REFERRED WITH DYSPHAGIA

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Purpose: As the population ages and longevity increases, speech pathologists will see more elderly with dysphagia and complicated comorbidities. Pressures are placed on physicians to discharge patients early. The purpose of this study is to evaluate the initial versus final swallowing status of inpatients over 65 referred with dysphagia.

Method(s): Retrospective chart review was performed on inpatients over 65 referred with dysphagia from 01/2011 - 12/2011. Variables assessed include demographics, admitting diagnosis, medical factors. Outcome variables include swallowing status (upon referral and prior to discharge from speech service), type of swallowing evaluation (CSE and/or MBS), and time between initial patient contact and final swallowing status.

Result(s): 277 patients were identified with mean age of 80.3 (65-102); 146 males and 131 females. The most common admitting diagnoses were respiratory insufficiency (21 %), Altered Mental Status (19 %), Cardiac (17 %), and Neurologic (13 %). MBS studies were performed significantly more in patients with Respiratory Insufficiency (41/58), Neurologic (26/37), Cancer (18/26) and least likely with Altered Mental Status (15/52). 75 % of patients remained PO.

Conclusions (including clinical relevance): 75 % of elderly patients with dysphagia remained PO on a modified or regular diet. 62.5 % of initial NPO patients remained NPO after evaluation with 50 % admitted with altered mental status.

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SOUR BOLUS FACILITATES SPONTANEOUS SWALLOW IN PARKINSON'S DISEASE

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Purpose: Sour bolus has been used to stimulate swallow activity in human and non-human models of deglutition. However, our understanding of whether a sour bolus may alter swallow in persons with Parkinson's disease (PD) is incomplete. We tested the hypothesis that spontaneous swallow frequency would increase after ingestion of a lemon bolus, and that pharyngeal pressure would increase in a subset of participants with PD.

Method(s): We used high-resolution 36-channel manometry with a group of 20 participants with moderate PD alternating between blocks of 5 ml water trials and blocks of 5 ml lemon juice trials.

Result(s): The frequency of spontaneous swallows increased following ingestion of the lemon bolus, yet the magnitude and duration of swallow-related pharyngeal pressure increased only in a subset of participants. Participants also exhibited significantly greater difficulty suppressing the swallow with the lemon bolus.

Conclusions (including clinical relevance): Our results suggest that a sour bolus may aid the initiation of swallow and increase the frequency of spontaneous swallows. However, changes in the magnitude and duration of pharyngeal pressure were inconsistent. Therefore, sour bolus may complement other techniques to increase the effectiveness of swallow function in individuals with PD.

Disclosures: Michael Hammer: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Corinne Jones: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Suzan Abdelhalim: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Timothy McCulloch: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

NEUROMUSCULAR ELECTRICAL STIMULATION DOES NOT EFFECT GENERATION OF MTDNA DELETION MUTATIONS IN TONGUE MUSCLES

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Purpose: The abundance of mitochondrial DNA (mtDNA) deletion mutations in tongue muscles may increase with age and contribute to muscle dysfunction associated with age-related swallowing deficits. It is controversial whether exercise effects generation of mtDNA deletion mutations in skeletal muscle. We examined the effects of age and neuromuscular electrical stimulation (NMES), a clinical treatment for oropharyngeal dysphagia, on mtDNA deletion mutations and their associated electron transport system (ETS) abnormalities in the tongue musculature.

Method(s): Young Adult (9-month-old; n = 15), middle-aged (24-month-old; n = 12), and old (32-month-old; n = 16) rats were divided into groups that received hypoglossal nerve stimulation at 10 Hz or 100 Hz (5 days/week). The presence of mtDNA deletions and ETS abnormalities were analyzed after 8 weeks in the genioglossus (GG), hyoglossus (HG), and styloglossus (SG) muscles.

Result(s): MtDNA deletions of the major arc were identified in all three muscles after NMES. Statistical analysis did not show a significant difference in the presence of mtDNA deletions between young and old or the intensity of exercise. Deletions ranged from 1 to 10 kilobases in size as shown by standard PCR. A pre-screening histological analysis did not show ETS abnormal muscle fibers in old normal or stimulated styloglossus muscle.

Conclusions (including clinical relevance): Our data show that NMES does not promote mtDNA deletion formation in the tongue musculature.

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FEEDING BEHAVIORS IN TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH FEEDING DIFFICULTIES

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Purpose: Many parents report their children display undesirable feeding behaviors; hence, it is difficult for MDs to know when to reassure or refer for intervention. This study aimed to compare data on feeding behaviors in typically developing children (TD) and children diagnosed with feeding difficulties (FD).

Method(s): Data on 54 TD and 71 FD children aged 2–6 years are presented. Parents completed the Behavioral Pediatric Feeding Assessment Scale (BPFAS) and the Eating Skills & Behaviors Questionnaire (ESBQ).

Result(s): There was a significant difference ($p < 0.01$) in feeding difficulty scores on the BPFAS (68 vs. 100/175) and ESBQ (98 vs. 133/240) and in problem scores on the BPFAS (4 vs. 19/35) and ESBQ (4 vs. 20/48). Parents of TD children reported concerns, most related to dietary variety.

Conclusions (including clinical relevance): Typically developing children display few difficult feeding behaviors, and few behaviors are perceived as problems by parents. Therefore, any child presenting with a large number of problems, particularly skill-based or behavior problems, should be referred for further evaluation and treatment as required.

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POSTER PRESENTATION AWARD WINNER: SECOND PLACE

A PROSPECTIVE STUDY OF COUGH RESPONSE TO NEBULISED CITRIC ACID FOLLOWING VENTILATION FOR ELECTIVE CARDIAC SURGERY

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Purpose: This study examined the effect of intubation on cough in ICU patients who have undergone coronary artery bypass grafting.

Method(s): 84 participants underwent cough reflex testing (CRT) prior to intubation. Baseline assessment established the presence of an intact reflexive cough to nebulised citric acid and determined the threshold for suppressed cough. CRT was repeated within two hours of extubation (CRT2) and every morning (CRT3 etc) and evening thereafter until the participant coughed at baseline level, was discharged from hospital or died.

Result(s): 40 % of participants coughed at CRT2 ($\chi = 1.17$ h), 66 % at CRT3 ($\chi = 12$ h), 80 % at CRT4 ($\chi = 24$ h) and 89% at CRT5

($\chi = 38$ h). Age, gender and APACHE III score did not significantly impact cough recovery.

Conclusions (including clinical relevance): Patients who are intubated for coronary artery bypass grafting may take several hours to recover reflexive cough after extubation. This may impact their ability to eat and drink safely. More research is needed to determine if cough reflex is affected in the wider ICU population post-extubation and to determine the role of opiates in cough suppression.

Disclosures: Molly Kallesen: *Financial Disclosure:* Salary: Capital & Coast District Health Board; *Scholarship:* University of Canterbury, Brownlie Scholarship; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Alex Psirides: *Financial Disclosure:* Salary: Capital & Coast District Health Board; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Maggie-Lee Huckabee: *Financial Disclosure:* Salary: The University of Canterbury; *Grant:* Canterbury Medical Research Foundation; New Zealand Ministry of Health, New Zealand Neurological Foundation; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society.

QUANTITATIVE ASSESSMENT OF ORAL PHASE EFFICIENCY: TOMASS NORMS AND PRELIMINARY VALIDATION

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Purpose: The Test of Mastication and Swallowing of Solids (TOMASS) is a clinical test of oral swallowing efficiency. Normative data and results of a small validity study in healthy controls will be presented.

Method(s): TOMASS consists of ingesting a single Salada™ cracker - “eat this as quickly as is comfortably possible”. 80 healthy adults, distributed equally across sex and 4 age groups, provided normative data. Number of discrete bites, masticatory cycles, swallows and total time per cracker were acquired. Sensitivity was assessed in 20 healthy controls before, during and after oral anesthesia with a topical gel.

Result(s): Normative data will be presented. Significant main effects were identified for gender ($F = 5.061$; $p < .001$) with males taking fewer bites per cracker, and age ($F = 3.424$; $p < .001$) with decreased efficiency on all measures with increasing age. Oral anesthesia produced less efficient performance on all measures ($p < .001$) that returned to baseline after two hours.

Conclusions (including clinical relevance): The TOMASS represents a single means of quantifying swallowing oral phase and is sensitive to change in function due to topical oral anesthesia.

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CORRECTING FOR HEAD MOVEMENT DURING MEASUREMENT OF HYOID DISPLACEMENT

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Purpose: Hyoid trajectory during swallowing is often measured relative to the angle between C2–C4 to control for head movement. No studies have investigated whether this referent provides a valid measure of head movement in the absence of swallowing.

Method(s): Seven subjects performed two repetitions of both neck flexion and extension. Frame-by-frame movement of the hyoid and six referents was measured. The referents included C2, C4, the C2–C4 angle, 2 lead markers placed above the zygomatic arch, and the angle between the two lead markers. Hyoid movement was then correlated with each referent.

Result(s): Large variation occurred in correlation coefficients for all referents, both within and across subjects. Minimum and maximum correlation coefficients for each referent ranged from 0.00 to 0.08, and 0.43 to 0.99, respectively.

Conclusions (including clinical relevance): The use of C2–C4 angle does not provide a reliable correction for head movement. Head movement occurs in many planes, making it difficult to accurately correct for its effects on hyoid displacement during swallowing. To achieve a more accurate representation of hyoid displacement, we propose a margin of error system by which experimental effects can be compared, rather than correction according to referent movement.

Disclosures: Phoebe Macrae: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Ianessa Humbert: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | James Finely: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

KINEMATIC FEEDBACK IMPROVES SWALLOWING MANEUVER OUTCOMES

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Purpose: Swallowing maneuvers can immediately improve kinematics, reducing aspiration. However, long-term studies of intense swallowing maneuver training commonly report disappointing negative outcomes, likely because training did not include kinematic feedback. We examined whether providing kinematic feedback about laryngeal vestibule closure (LVC) during swallowing maneuver training changed LVC durations in bolus swallowing after training.

Method(s): Healthy adults and stroke patients were trained to perform a volitional laryngeal vestibule closure maneuver (vLVC), involving LVC beginning during a swallow and maintained for at least 2 sec. Accurate vLVC performance was first confirmed with videofluoroscopy (VF). Participants were then split into either the VF feedback group, which trained vLVC with verbal cues based on LVC kinematics seen on VF (healthy $N = 8$, stroke $N = 3$) or the no-VF group, which trained without cues (healthy $N = 8$, stroke $N = 1$). We then compared LVC durations between pre- and post-training bolus swallows (5 ml thin liquid barium).

Result(s): A mixed models analysis showed that, after vLVC training, bolus swallows in the VF group had significantly longer LVC durations (+63msec; $p = 0.006$), however bolus swallows in the no-VF group had significantly shorter LVC durations (–222 ms; $p = 0.003$).

Conclusions (including clinical relevance): Providing kinematic cues during swallowing maneuver training can directly impact how bolus swallowing is affected after training in both patients and healthy adults.

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ELECTROMYOGRAPHY OF STAGE II FOOD TRANSPORT WITH INTRAMUSCULAR FINE WIRE ELECTRODES: ACTIVITY OF SELECTED HYOID MUSCLES

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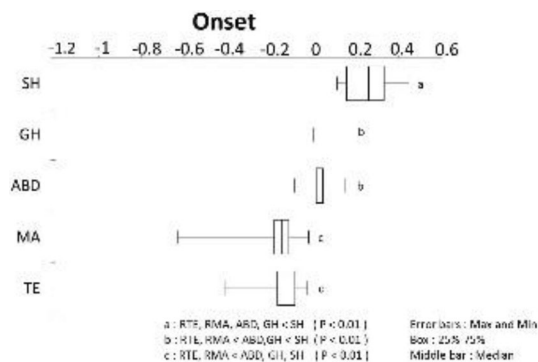
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Purpose: Stage II Transport (St2Tr) is propulsion of triturated food to the pharynx without prompt pharyngeal swallow. Thus, a bolus collects in the pharynx before the swallow. Timing of activation of discrete hyoid muscles in St2Tr has not been reported. We address this with electromyography (EMG) using fine wire intramuscular electrodes.

Method(s): 14 healthy adults ingested 6 g each of Banana and Cookie during videofluoroscopy with concurrent EMG of anterior belly of digastric (ABD), geniohyoid (GH), and sternohyoid (SH) muscles with fine wire electrodes and Masseter (MA) and Temporalis (TE) with surface electrodes. Signals were filtered, rectified, and integrated. We identified 19 St2Tr cycles in the recordings and timed the onset and offset of myoelectric activity for each muscle in each cycle (relative to the onset of GH activity). Statistical analysis was performed with ANOVA and Bonferroni correction.

Result(s): Onset was significantly earlier for MA and TE than for the other muscles. GH and ABD followed; SH onset was significantly later. This specific sequence of muscle onset (and offset) was found in 18 of the 19 cycles identified. In the one exception, ABD activity was delayed.

Conclusions (including clinical relevance): The sequence of muscle activation in St2Tr was similar to the sequence reported in swallowing a during masticatory (chew/swallow) sequences. In St2Tr, however, the upper esophageal sphincter remained closed. Future studies should examine the biomechanical basis for this difference in sphincter activity by analyzing in detail the relationship of muscle activity to motion in St2Tr and swallowing.



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LINGUAL PRESSURE CHANGES IN HEALTHY NORMAL INDIVIDUALS

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Purpose: The purpose of this study was to determine the changes that occur in lingual pressure (strength) in healthy normal individuals.

Method(s): Three separate measurements were taken from 44 subjects. The subjects were divided into two groups based on age: younger and older subjects. Lingual pressure measurements were

taken using a Kaypentax Digital Swallowing Workstation using a 3-bulb tongue array that was placed in each subject's oral cavity. Lingual pressure measurements in the study included three lingual tasks: Anterior, middle and posterior lingual elevation. Three trials were conducted for each lingual task. The average of three trials was taken for analysis. Statistical comparisons were made by a three-way analysis of variance (ANOVA). A Bonferroni Correction was applied for post-hoc analysis with $p < 0.0167$.

Result(s): The younger subjects exhibited significantly higher mean peak lingual pressure than the older subjects. There were no significant gender differences in lingual pressures. There were significant differences in mean peak lingual pressures among the three tasks, with anterior lingual pressure being the highest.

Conclusions (including clinical relevance): It is necessary to present an exercise program to improve lingual pressure in older populations, which may improve muscular reserve for swallowing and the quality of life. This study was partially supported from CHSP Summer Research Award, Ohio University.

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LATE-RADIATION-ASSOCIATED DYSPHAGIA (LATE-RAD) WITH LOWER CRANIAL NEUROPATHIES (LCNP) IN LONG-TERM OROPHARYNGEAL CANCER (OPC) SURVIVORS: CASE REPORTS

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Purpose: LCNP are a rare complication of radiation, typically reported in nasopharyngeal cancer survivors. Limited data examine LCNP after treatment of OPC, particularly as they relate to late-RAD.

Method(s): Cases with late-RAD and LCNP in long-term survivorship after OPC were examined longitudinally. Late-RAD was assessed per MBSImp, PAS, PSS-HN, and MDADI; LCNP per clinical cranial nerve examination and laryngeal videostroboscopy.

Result(s): Two cases presenting with LCNP and late-RAD 4.5 and 19 years after nonsurgical organ preservation were examined for 6 and 4 years, respectively. Distinct trajectories of late-RAD were seen in the setting of stable versus progressive LCNP. Phenotypes of dysphagia mirrored loss of specific cranial nerve functions, and standardized scores indicated pro-found impairment in both cases (Table 1).

Conclusions (including clinical relevance): Late-RAD with LCNP causes profound functional impairment and adversely affects quality of life. Radiation-associated LCNP can be a stable or progressive condition. Trajectories of late-RAD may follow loss of cranial nerve functions.

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COMPARISON OF ORAL PHASE SWALLOWING EFFICIENCY FOR LIQUIDS AND SOLIDS IN PARKINSON'S DISEASE, MULTIPLE SCLEROSIS AND HEALTHY CONTROLS

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Purpose: This study compared the oral swallowing efficiency of patients with Parkinson's disease (PD) and Multiple sclerosis (MS) to healthy controls (HC) as a step toward validation of the Test of Mastication and Swallowing of Solids (TOMASS).

Method(s): Participants included 68 adults (PD = 23, MS = 23, HC = 22) approximately matched for age and sex. All completed the TOMASS [ingestion of dry SaladaTM cracker] and the Timed Water Swallow Test [TWST: ingestion of 150 ml water] in a single session.

Result(s): On the TOMASS, PD and MS patients performed poorer than HC for # of masticatory cycles, # of swallows and total time ($p < .01$). Patients with PD and MS did not significantly differ from each other on any measure ($p > .05$). On the TWST, patients with PD required a greater number of swallows ($p < .01$) and were slower than patients with MS or HC ($p < .01$) with no difference between MS and HC on any measure.

Conclusions (including clinical relevance): Oral efficiency for solid texture ingestion appears more affected than liquid ingestion in patients with neuromuscular disease, particularly PD, when compared to age and gender matched controls.

Disclosures: Irene Battel: *Financial Disclosure:* Salary: Fondazione Ospedale San Camillo, Venice, Italy; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Maggie-Lee Huckabee: *Financial Disclosure:* Salary: The University of Canterbury; Grant:

Table 1 Longitudinal functional assessments

	Case 1		Case 2	
	Initial presentation	Last examination	Initial presentation	Last examination
CN palsies	Left XII, right VII	Bilateral XII, left X, right VII	Bilateral XII	Bilateral XII
MBSImp-oral	9	17	14	15
MBSImp-Pharyngeal	17	20	21	22
PAS	7	7	8	8
MDADI	34.74		53.68	65.25
PSSHN-Diet	50	30	70	90
PSSHN-Speech	100	25	75	50

Canterbury Medical Research Foundation; New Zealand Ministry of Health, New Zealand Neurological Foundation; *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society.

PRESSURE GRADATION AND GENERATION DURING ISOMETRIC GROSS AND FINE MOTOR LINGUAL TASKS IN HEALTHY ADULTS

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Purpose: This project work was designed to compare two isometric lingual press tasks at multiple sensor locations in relation to gender and age.

Method(s): 71 healthy adults (21–82 years) completed, in random order, two isometric tasks: (1) Fine Motor: tongue press maximally and discretely against each sensor (anterior, middle, posterior, left, right) (2) Gross Motor: tongue press maximally against all five sensors simultaneously. Pressures (hPa) and time to reach peak pressure(s) were collected using the Madison Oral Strengthening Therapeutic (MOST) device.

Result(s): Maximum pressure significantly decreased with age at all sensor locations for both Fine motor and Gross motor lingual tasks. Pressure differences between tasks ($p = 0.0012$) resulted in Gross motor task generating lower pressures at front and higher at middle sensors for all ages, however pressure differences became significantly similar with increasing age. Gross motor gender differences revealed higher isometric pressures in males, at the front, left, and right sensor locations ($p = 0.0014$). Time to reach peak pressures ($p = 0.04$) was faster with Gross motor at all sensor locations than Fine motor, however this magnitude in time difference also decreased with age. Gross motor task produced faster rate of pressure increase at the anterior sensor location ($p = 0.0016$).

Conclusions (including clinical relevance): Results indicate a difference by age in time to reach peak and maximum pressure between lingual motor tasks. These results indicate that Gross motor tasks may be more efficient/ effective than Fine motor tasks for use therapeutically during oropharyngeal strengthening interventions.

Disclosures: Kim Churness: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Kelsey Banaszynski: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Jacqueline Hind: *Financial Disclosure:* Salary: Swallow Solutions, LLC; Ownership Interest: Swallow Solutions LLC; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Naomi Humpal: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Ronald Gangnon: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Nicole Rogus-Pulia: *Financial Disclosure:* Salary: William S. Middleton Memorial Veterans Hospital; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society, American Speech-Language-Hearing Association; Society Committee Member: ASHA SIG 13 Research Committee | JoAnne Robbins: *Financial Disclosure:* Salary: University of Wisconsin, Madison School of Medicine and Public Health and William S. Middleton Memorial Veterans Hospital, Madison, Wisconsin; Founder and Equity holder: Swallow Solutions LLC; Intellectual Property Rights: Four patents administered by Wisconsin Alumni Research Foundation; Faculty Concession/Honorarium/Speaker fee: Northern Speech Services; Proposal reviewer, The Retirement Research Foundation; Grant: USDA; *Nonfinancial Disclosure:* Society Member: Dysphagia

Research Society; ASHA American Heart Association; Society Board Member: University of Wisconsin Academic Consortium for Entrepreneurs; Society Committee Member: AHA/American Stroke Assn Nursing & Rehabil Committee of the Stroke Council.

A NOVEL CENTRAL-PART LARYNGECTOMY FOR RESOLUTION OF INTRACTABLE ASPIRATION

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Purpose: A novel narrow field laryngectomy procedure known as central-part laryngectomy for less invasive laryngeal diversion in patients with intractable aspiration is introduced.

Method(s): We conducted retrospective clinical case reviews of 17 patients treated using central-part laryngectomy. In this procedure, a relatively small area including the glottis is removed to separate the digestive tract from the air way. In comparison with previous narrow field laryngectomy, the surgical area is limited to the mid part of the thyroid cartilage and the cricoid cartilage. The lateral part of the thyroid cartilage, the entire hypopharyngeal mucosa, strap muscles, epiglottis and hyoid bone are preserved. The thyroid gland and superior laryngeal vessels and nerve are also not invaded.

Result(s): All patients were relieved of intractable aspiration without major surgical complications. 14 of the 17 patients were able to resume oral food intake.

Conclusions (including clinical relevance): Central-part laryngectomy is a useful surgical procedure that is preferable to other laryngectomy methods for treatment of intractable aspiration.

Disclosures: Ai Kawamoto: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Kenichi Watanabe: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Yukio Katori: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

TRANSNASAL GASTROSCOPY: WILL IT WORK? AN IRISH PILOT STUDY

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Purpose: To compare the feasibility, safety, tolerance and yield of transnasal gastroscopes as an alternative to standard endoscopy (SE) and standard FEES.

Method(s): This was an exploratory, between subject research design with 2 branches: (1) Patients scheduled for SE were invited to undergo transnasal gastroscopy (TNG). Patients opting for unsedated SE were controls. (2) Normal subjects were recruited to undergo FEES (GFEES) using the gastroscope. Patients scheduled for standard FEES were controls. Indication, findings, duration & complications were recorded. A visual analogue scale assessed participant tolerance. All statistics performed using SPSS19. Results expressed as a mean compared with student *t*-test.

Result(s): (1)19 (TNG = 10 SE = 9) patients. Intubation achieved with all patients with no reported complications. No difference in pain between

the 2 groups. Choking on intubation was significantly lower in TNG compared to SE ($p < 0.05$). Gagging on intubation & during the procedure was significantly lower in TNG group ($p < 0.05$). (2)18 participants (GFEES = 11 FEES = 7). Intubation success higher with FEES (100 %) as to GFEES (72 %). No difference in pain, anxiety, choking or gagging between the 2 groups. FEES was better tolerated than GFEES on participant self-rated tolerability ($p < 0.05$).

Conclusions (including clinical relevance): This small pilot study has shown that transnasal gastroscopes may be a valuable alternative to SE & FEES in the assessment of dysphagia. Potential added advantages include greater patient acceptability leading to increased accuracy of assessment. Ongoing recruitment will be required to address this.

Disclosures: Susan Lawson: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Barry Hall: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Grainne Holleran: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Maeve Murphy: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Julie Regan: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Barry McMahon: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Deirdre McNamara: *Financial Disclosure:* Salary: Tallaght Hospital, Dublin 24, Ireland; Investigative device or drug to be discussed in presentation: Gastroscope (on loan from Pentax UK); *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

DOES THE ADDITION OF ACOUSTIC INFORMATION AND FACIAL APPEARANCE IMPROVE THE INTERPRETATION OF VIDEOFLUOROSCOPY (VF)?

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Purpose: The clinical evaluation of swallowing includes observation of physique, level of alertness, facial expression, posture, movement of swallow musculature, respiratory changes, and episodes of cough. To document these observations objectively, we have designed a system to be used concurrently while taking VF images (VFI).

Method(s): Swallowing, respiratory, and cough sounds (SS) were detected and stored to the digital video recorder with VFI. By using another digital video recorder, subjects' facial image (FI) was recorded separately. The two digital video data were combined later using the image editing system. In order to evaluate the effectiveness of this system, four kinds of images (VFI alone, VFI + SS, VFI + FI,

and VFI + SS + FI) were shown to dentists familiar with dysphagia and with no experience with dysphagia. They were asked to judge each sample focusing on understandability of swallowing episode of each sample using the visual analogue scale.

Result(s): 243 dentists with no experience in dysphagia treatment rated averaged understandability of swallowing episode; 59.2 % for VFI alone, 76.0 % for VFI + SS, 74.2 % for VFI + FI, and 89.4 % for VFI + SS + FI. Also, 72 dentists with experience in dysphagia treatment rated averaged understandability of swallowing episode; 69.4, 77.8, 85.5, and 93.4 % respectively.

Conclusions (including clinical relevance): These results verified that the combination of the VFI sound and the visual reaction of the patient provides better assessment of the swallowing episode than when judgments are made without multiple visual and sound cues.

Disclosures: Yoshiaki Ihara: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Koji Takahashi: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Kaoru Yokoyama: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Michael Groher: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society

RELATIONSHIPS AMONG BOLUS FORMATION ABILITY, MASTICATORY FUNCTION, AND THE NUMBER OF MASTICATORY STROKES PRIOR TO SWALLOWING

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Purpose: The purpose of the study was to investigate the relationships among bolus formation prior to swallowing and masticatory function in feeding sequence. Bolus formation would be influenced by an individual's usual feeding manner related to masticatory function, but the details are still unclear.

Method(s): Participants were 31 volunteers. Endoscopic evaluation of bolus formation was performed using the bolus formation index that was calculated from the color of the bolus just before swallowing. The number of masticatory strokes was counted. Masticatory performance was evaluated by the color difference of color changeable gum. Occlusal force and occlusal contact area were measured using the Dental Prescale. Spearman's correlation was used for the statistical analysis and the level of significance was set to 5 %.

Result(s): A strong significant positive correlation was found between the bolus formation index and the number of masticatory strokes, and a moderate positive correlation was found between the bolus formation index and occlusal force, and between the bolus formation index and occlusal contact area. There was no significant correlation between the bolus formation index and masticatory performance.

Conclusions (including clinical relevance): The larger number of masticatory strokes prior to swallowing, a higher occlusal force, and wider occlusal contact area facilitated bolus formation. Present results indicate that oral rehabilitation to recover occlusal contacts may contribute to safe swallowing.

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Disclosures: No relevant relationships exist. | Kanji Nohara *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Hisatomo Kondo: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

DYSPHAGIA DECREASES SUPRAHYOID MUSCLE STRENGTH

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Purpose: Abnormalities in suprahyoid muscle strength is considered one of the principal etiologies of dysphagia. We previously developed a jaw-opening sthenometer (JOS) to evaluate suprahyoid muscle strength. The purpose of this study was to identify abnormalities in suprahyoid muscle strength via jaw-opening force (JOF) in elderly patients with dysphagia.

Method(s): Subjects were 74 healthy volunteers aged >70 years (37 men and 37 women; mean age 78 ± 5 years) and 68 dysphagia patients aged >70 years (35 men and 33 women; mean age 81 ± 6 years). The patients were evaluated by videoendoscopic swallowing study. JOF was measured with a JOS and compared between the two groups.

Result(s): Mean JOFs were about 7.0 kg in men and 4.4 kg in women in the healthy elderly group, which were significantly greater than those in men (4.5 kg) and women (3.7 kg) in the dysphagia group.

Conclusions (including clinical relevance): These results suggest that elderly dysphagia patients have weaker suprahyoid muscle strength than healthy elderly people. JOF may become an important indicator of dysphagia rehabilitation.

Disclosures: Takatoshi Iida: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry, Japanese Society for Parenteral and Enteral Nutrition; Other: Graduate School Nihon University School of Dentistry | Haruka Tohara: *Financial Disclosure:* Salary: Tokyo Medical and Dental University; Grant: The Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (NCGG), Japan; *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry, The Society of Swallowing and Dysphagia of Japan, the Japanese Academy of Homecare Physicians, Japanese Society of Anti-Aging Medicine, The Society for Nursing Science and Engineering, Dysphagia Research Society; Society Committee Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry | Satoko Wada: *Financial Disclosure:* Salary: Nihon University; *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry | Koji Hara: *Financial Disclosure:* Salary: Tokyo Medical and Dental University; *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry | Ayako Nakane: *Financial Disclosure:* Salary: Tokyo Medical and Dental University; Grant: The Ministry of Education, Culture, Sports, Science and Technology; *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japanese Association of Disability and Oral Health, Japanese Society of Geriatric Dentistry, The Society of Swallowing and Dysphagia of

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IMMEDIATE EFFECTS ON TONGUE PRESSURE OF SURFACE ELECTRICAL STIMULATION

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Purpose: Surface electrical stimulation to the submental region is used for dysphagic patients to improve hyoid elevation though little is known about how the stimulation affects the swallowing function precisely. We previously clarified that the tongue pressure generation related to hyoid elevation. The aim of present study is to investigate the effects of electrical stimulation on the tongue pressure during swallowing.

Method(s): Ten healthy young subjects received the electrical stimulation (0.2 ms duration, 80 Hz) applied to the neck surface corresponding to thyrohyoid muscles. The intensity was set at the level of maximal tolerance in each subject. Tongue pressure in 5-ml water swallowing before, during, and after stimulation was measured by sensor sheet system with five sensitive points and was compared. **Result(s):** The tongue pressure during stimulation was significantly decreased than before and after stimulation, and that after stimulation was significantly larger than before stimulation ($p < .05$). These results suggested that the suppression of hyoid elevation resulted from surface electrical stimulation leads to the compensatory changes of tongue pressure.

Conclusions (including clinical relevance): Surface electrical stimulation applied to laryngeal regions muscles during swallowing may have a facilitatory effect on the tongue pressure generation.

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AGE-RELATED CHANGES IN THREE-DIMENSIONAL SHAPE OF THE PHARYNX

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Purpose: The purpose of the study was to compare three-dimensional pharyngeal shape between elderly and young adults. The pharynx would be enlarged as a result of laryngeal declination associated with aging. Pharyngeal expansion may exacerbate the decline of swallowing reserve capacity that is characteristic of elderly populations. **Method(s):** Participants were 20 young female volunteers and 20 elderly female volunteers. Cone beam computed tomography of the pharynx of each participant in an upright position was conducted. The pharyngeal sectional area at the height of the first, second, third, and fourth cervical vertebrae were calculated. The pharyngeal volume between each cervical vertebrae height were measured. Student *t*-tests and Mann-Whitney's *U* test were used for statistical analyses.

Result(s): At the height of fourth cervical vertebrae, the pharyngeal sectional area was significantly larger in the elderly group. There was no significant difference at the height of first, second, and third cervical vertebrae. The pharyngeal volume from the height of third cervical vertebrae to the bottom of epiglottic vallecula was significantly increased in the elderly group.

Conclusions (including clinical relevance): The inferior part of the pharynx had significantly expanded in the anteroposterior and vertical directions in elderly participants. This expansion may be due to an age-related drop in the position of the tongue, hyoid, and larynx. As a result, the hyoid and pharynx may work to compensate for this expansion to maintain smooth and safe swallowing.

Disclosures: Yasushi Tamada: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Junichi Furuya: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Hisanori Yamamoto: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Atsushi Hara: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Hisatomo Kondo: *Financial and Nonfinancial Disclosures*: No relevant relationships exist.

SCREENING FOR OROPHARYNGEAL DYSPHAGIA IN STROKE

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Purpose: To report a systematic review conducted to analyze the most common parameters included in screenings for oropharyngeal dysphagia in stroke.

Method(s): An electronic database search was realized using Medline and Cochrane. The first search terms were deglutition Disorders/diagnosis, stroke, screening and assessment. Another search was

conducted with the key words dysphagia, screening and stroke. Included articles that described the tools.

Result(s): Twenty out of 614 articles were included. We found 65 % of alert level and voice quality, 55 % test with liquid and swallowing saliva, 45 % voluntary cough, 40 % gag reflex, 35 % dysarthria, 30 % test with multiple consistencies, swallowing complaints and asymmetry of the palate, 25 % asymmetry facial, 20 % mobility tongue and breathing, 15 % tongue asymmetry, aphasia, head control and mobility lips, 10 %, nothing by mouth status, comprehension, orientation/attention, history of pneumonia and cooperation, 5 % tongue strength, able to clench teeth, throat clearing, intubation history and stroke location/gravity.

Conclusions (including clinical relevance): The alert level, voice quality, water test and swallowing saliva parameters were the most frequent screenings.

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EFFECTS OF AGE AND BOLUS VOLUME ON VELOCITY OF HYOLARYNGEAL EXCURSION IN HEALTHY ADULTS

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Purpose: To compare effects of age and bolus volume on the velocity of hyoid and laryngeal excursion during swallowing in healthy adults. **Method(s):** 44 healthy volunteers were categorized into three age bands (young: 20-35 years, middle aged: 36-55 years, older: 56 \geq years). All subjects swallowed 5 and 20 mL of thin liquids during fluoroscopic recording. Fluoroscopic images were extracted from the rest and maximum excursion positions of the hyoid and larynx for each swallow. Superior and anterior excursion and the time difference between rest and maximum excursion were calculated. Velocity was calculated as a ratio of distance over time. Data were analyzed with ANOVA.

Result(s): Hyoid excursion velocity revealed a volume effect for superior movement only [F (1, 40) = 424.9, *p* < .001]. Hyoid velocity was significantly faster for the 20 mL volume. Laryngeal excursion velocity revealed a significant age x volume interaction for both superior [F (3, 33) = 3.7, *p* < .036] and anterior [F (2, 36) = 4, *p* < .028] movements. Velocity was significantly faster for 20 mL in the older group.

Conclusions (including clinical relevance): Velocity of hyoid and laryngeal excursion during swallowing varies with age and bolus volume. Kinematic velocity is a unique metric to evaluate swallowing performance.

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EFFECT OF TRANSCUTANEOUS ELECTRICAL STIMULATION (TES) AMPLITUDE ON TIMING OF SWALLOW PRESSURE PEAKS BETWEEN HEALTHY YOUNG AND OLDER ADULTS

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Purpose: We compared three electrical stimulation amplitudes on timing of lingual-palatal and pharyngeal peak pressures during swallowing in healthy young and older adults.

Method(s): 34 healthy subjects: 20 young (20–30 years) and 14 older (>60 years) swallowed 10 mL nectar boluses under 3 conditions: no stimulation, low amplitude stimulation (2 mA below motor response) and high amplitude stimulation (2 mA below maximum tolerance). TES was delivered by surface electrodes on the anterior neck. Timing of pressure peaks for lingual-palatal contacts (anterior, middle, and posterior) and pharyngeal pressures (base of tongue and hypopharynx) were measured using the PES clearing wave as the anchor point. Data were analyzed with ANOVA.

Result(s): Timing of lingual-palatal pressure was not significantly affected by stimulation amplitude or age. However, a significant age x stimulation amplitude interaction was identified for the base of tongue [$F(2, 32) = 4.42, p < .02$] and the hypopharynx [$F(1.4, 32) = 5.6, p < .013$]. In each case, low amplitude stimulation resulted in faster swallows in the older subjects.

Conclusions (including clinical relevance): Low amplitude TES may facilitate faster swallows in healthy older adults. These results question the application of fixed parameters in TES.

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TREATMENT EFFECTS FOR DYSPHAGIA IN PARKINSON'S DISEASE: A SYSTEMATIC REVIEW

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Purpose: Dysphagia remains a common problem in Parkinson's disease. Previous systematic reviews on therapy effects for oropharyngeal dysphagia have shown a lack of evidence. In the past 5 years several placebo or sham controlled trials with varying results have been published. The aim of this systematic review of the literature is to summarize and qualitatively analyze the published studies on this matter.

Method(s): Studies published up to September 2013 were found via a systematic comprehensive electronic database search using PubMed, Embase, and The Cochrane Library. Two reviewers independently assessed the studies using strict inclusion criteria.

Result(s): Twelve studies were included and qualitatively analyzed using critical appraisal items. The review includes rehabilitative (exercises, electrical stimulation, bolus modification etc.) and pharmacologic treatments. Some well-designed controlled trials were included. However, none of the included studies fulfilled all criteria for external and internal validity. Furthermore the conclusions of most

studies cannot be compared with one another because of heterogeneous therapy methods and outcome measures.

Conclusions (including clinical relevance): Video-assisted swallowing therapy (VAST) and expiratory muscle strength training (EMST) may be effective dysphagia treatments solely or in addition to pharmacologic therapy in Parkinson's disease. However, these preliminary results warrant further investigation concerning clinical applicability and further research should be based on randomized controlled trials to determine the effectiveness of different therapies for dysphagia in Parkinson's disease.

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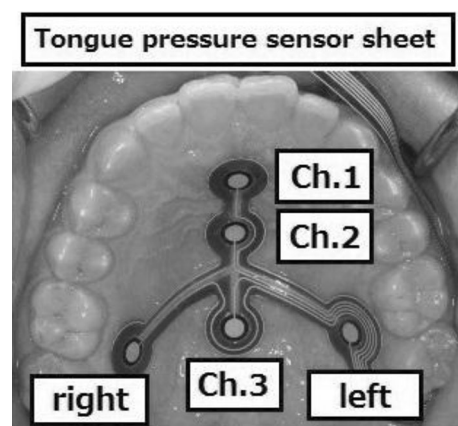
THE EFFECT OF BOLUS VISCOSITY ON TONGUE PRESSURE PRODUCTION DURING SUPRAGLOTTIC AND SUPER-SUPRAGLOTTIC SWALLOWS

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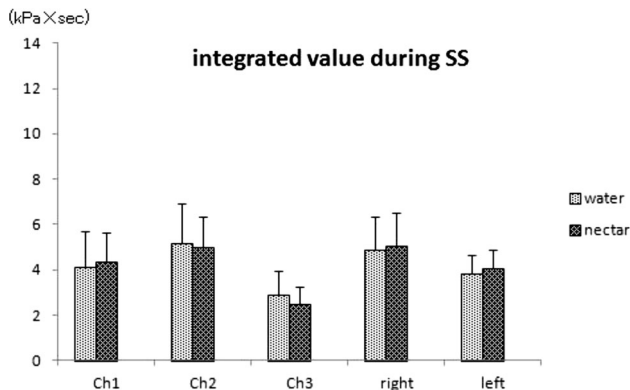
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Purpose: Viscosity changes of liquid bolus and swallow maneuvers are often used in dysphagia rehabilitation. However, little is known about the tongue kinetics when such strategies are combined. The purpose of this study is to investigate the effect of thick liquid on tongue pressure production against hard palate during normal swallow (NS), supraglottic swallow (SS) and super-supraglottic swallow (SSS).

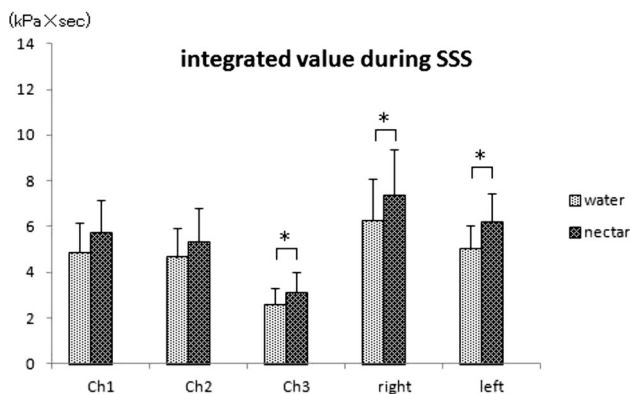
Method(s): Nineteen healthy adults (average age 25.9 years) participated in this study. Subjects swallowed 5 ml of water and nectar thick liquid with NS, SS, and SSS. Tongue pressure was measured by using an ultra-thin tongue pressure sensor sheet with 5 pressure-sensitive points attached to the hard palate. Maximal magnitude, duration and integrated value of tongue pressure were analyzed and compared between water and thick liquid during NS, SS, and SSS, respectively.



Result(s): There were no statistically significant differences in any parameter of tongue pressure between water and thick liquids during NS and SS. During SSS, maximal magnitude, duration and integrated value of tongue pressure at posterior part of the hard palate were significantly larger with thick liquid than those with water.



Conclusions (including clinical relevance): These results suggest that the effect of thick liquid on tongue kinetics changes with different swallowing maneuvers.



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ORAL AND PHARYNGEAL FUNCTION IN CHILDREN WITH SEVERE CEREBRAL PALSY BY THE GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM

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Purpose: Children diagnosed with cerebral palsy (CP) often present with oropharyngeal dysphagia due to aggression that occurs in the central nervous system affecting, among other areas, the neuromotor control of swallowing. The aim of this study was to assess dysphagia in children with severe CP by the Gross Motor Function Classification System (GMFCS).

Method(s): From 2008 to 2013, swallowing assessment, by videofluoroscopy was applied to 27 children (17 girls and 10 boys), aged between 7 months and 16 years, with oropharyngeal dysphagia consequent to CP. Each subject was asked to swallow solid, paste and liquid boluses.

Result(s): Oral phase videofluoroscopic findings in patients were: ineffective labial closure in 24 (88.9 %) patients, inadequate formation and organization of bolus in 25 (92.6 %), presence of anterior leakage in 22 (81.5 %); deficient ejection of bolus in 23 (85.2 %), 19 (70.4 %) patients with inadequate movements of the tongue, inadequate bolus control in 25 (92.6 %) and oral residue present in 21 (77.8 %) patients. In the pharyngeal phase, we observed reduced hyoid and laryngeal elevation in 23 (85.2 %) patients, cough in 4 patients (14.8 %) and choking in 1 (3.7 %). Furthermore, aspiration was found in 22 (81.5 %) patients.

Conclusions (including clinical relevance): Dysphagia consequent of severe cerebral palsy (GMFCS grades IV and V) are consistent with the degree of motor impairment, showing the influence of this disorder in swallowing.

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EVALUATION OF SWALLOWING IN PATIENTS WITH THYROID NODULES BEFORE AND AFTER SURGICAL TREATMENT

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Purpose: Thyroid nodules may cause dysphagia. Thyroidectomy is a surgical procedure used in treatment and may cause abnormal sensitivity and motility in the organ near the site and affect the pharyngeal phase of swallowing. Our goal in this investigation was to evaluate the oral and pharyngeal phases of swallowing, by videofluoroscopy, in patients with thyroid nodules before and up to 5 days after thyroidectomy.

Method(s): We studied 26 patients with thyroid nodules (age: 47 ± 11 years). Individuals swallowed, in duplicate, 5 and 10 ml boluses of liquid and pasty consistency.

Result(s): There was no difference between the pre- and post-thyroidectomy in oral and pharyngeal transit times. Before the surgical procedure, laryngeal penetration was observed in 1 individual, early loss with 10 ml of liquid in 3, early loss with 10 ml liquid in 1, early loss with 5 ml of liquid in 2, stasis in the oral cavity with 10 ml of pasty in 1, stasis the piriform sinus with 5 ml of pasty in 1 and stasis in the upper esophageal sphincter with 10 ml of pasty in 1. After surgery, early loss was observed with 10 ml of pasty in 3, early loss with 5 ml of pasty in 6, early loss with 10 ml of liquid in 3, early loss with 5 ml of liquid in 2, stasis in the vallecula with 10 ml of pasty in 1, stasis in the vallecula with 5 ml of pasty 2 and stasis in the hypopharynx with 5 ml of pasty in 1.

Conclusions (including clinical relevance): We found no differences between preoperative assessments and those performed shortly after the surgery, except for premature leakage of pasty bolus, which is more frequent after the thyroidectomy.

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LONGITUDINAL STUDY OF DYSPHAGIA PROGRESSION IN PARKINSON'S DISEASE: CASE SERIES

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Purpose: To describe a swallowing management and investigate associated factors with swallowing in a case series of patients with Parkinson's disease.

Method(s): It is a long-term study with 24 patients. The patients were observed in a five year period (2006–2011). They underwent Fiberoptic Endoscopic Evaluation of Swallowing, Functional Oral Intake Scale and therapeutic intervention every three months. After the evaluation the patients received orientation about compensatory and rehabilitation intervention to improve swallowing. The Chi-square, Kruskal-Wallis and Fisher tests were used to investigate association between factors such as age, gender and disease duration with swallowing status. The period of time for swallowing changes was described by Kaplan-Meier analysis.

Result(s): There were 16 men and 8 women. The average age of onset of disease symptoms was 53.8 years old. The average disease duration was 11 years. Ten patients improved, five stayed the same and nine worsened their swallowing functionality. The median time to improvement was ten months. Prior the worsening there was a median time of 33 months of follow-up. The maneuvers frequently indicated in therapeutic intervention were: chin-tuck, bolus consistency, bolus effect, strengthening-tongue, multiple swallows and vocal exercises.

Conclusions (including clinical relevance): There was found a predominance of improvement and maintenance of swallowing during the follow-up. There was no associated factor with swallowing. The swallowing management was characterized by compensatory maneuvers and motor exercises with and without swallowing.

Disclosures: Karen Luchesi: *Financial Disclosure:* Salary: Public Health; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Lucia Mourao: *Financial Disclosure:* Salary: University of Campinas; Grant: FAEPEX; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Satoshi Kitamura: *Financial Disclosure:* Salary: University of Campinas; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

POSTER PRESENTATION AWARD WINNER: FIRST PLACE

PEAK EXPIRATORY FLOW IN PARKINSON'S DISEASE

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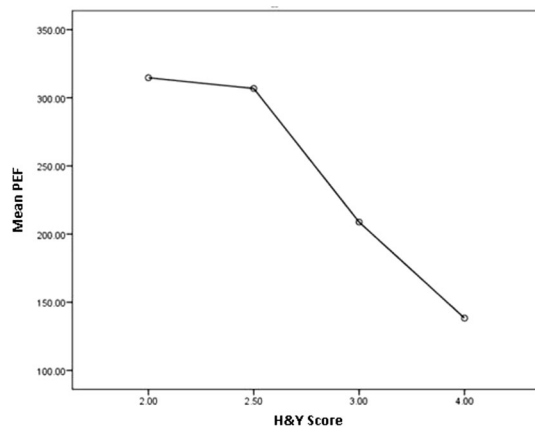
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Purpose: Cough is an airway defensive behavior that serves to eject foreign material that has entered the airways as a result of disordered swallowing, or dysphagia. Peak expiratory flow (PEF) is a measure of cough effectiveness which has been found to correlate with swallowing dysfunction in Parkinson's disease (PD). The aim of this study is to evaluate the impact of PD severity on PEF in a large cohort of participants across multiple Hoehn & Yahr (H&Y) stages. It was hypothesized that PEF would decrease as H&Y stage increased.

Method(s): PEF was evaluated in 120 consecutive patients with PD who presented to the University of Florida Center for Movement Disorders and Neurorestoration. Each patient produced three strong coughs into a digital peak flow meter and values were recorded. H&Y scores were used as a measure of disease severity. Multiple regression analysis was completed including PD severity and factors known to influence PEF.

Result(s): PD severity significantly influenced PEF ($p = .018$) above and beyond the effect of height and age. As PD severity increased,

PEF decreased. For example the mean PEF for participants in H&Y stage II was 314.6 and 138.3 L/min for H&Y stage IV.



Conclusions (including clinical relevance): As PD progresses, there is an increased risk for death secondary to aspiration pneumonia. This is the first study to show that PEF decreases as a function of increasing PD severity. This may provide evidence for the need to target cough function in advancing PD to improve airway protective health outcomes in this population.

Disclosures: Alexandra Brandimore: *Financial Disclosure:* Salary: University of Florida; Malcom Randall VAMC, Gainesville, Florida; *Nonfinancial Disclosure:* Society Member: ASHA, International Society for the Advancement of Respiratory Psychophysiology | Karen Hegland: *Financial Disclosure:* Salary: University of Florida; Grant: American Heart Association Award #12CRP9010001; Investigative device or drug to be discussed in presentation: Capsaicin; *Nonfinancial Disclosure:* Society Member: ASHA, American Physiological Society, International Society for the Advancement of Respiratory Psychophysiology | Michelle Troche: *Financial Disclosure:* Salary: University of Florida; Grant: NIH (NCATS) CTSA awards to the University of Florida UL1TR000064 and KL2TR000065; *Nonfinancial Disclosure:* Society Member: ASHA, International Society for the Advancement of Respiratory Psychophysiology.

RISK FACTORS, PULMONARY FUNCTION AND QUALITY OF LIFE ASSOCIATED WITH PRE TREATMENT DYSPHAGIA IN PATIENTS WITH HEAD AND NECK CANCER

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Purpose: To determine risk factors, pulmonary function and quality of life (QoL) associated with dysphagia before head and neck cancer (HNC) treatment.

Method(s): Risk factors, pulmonary function and QoL associated with Dysphagia Outcome and Severity Scale (DOSS) and penetration and aspiration scale (PAS) were investigated prospectively in 30 patients with HNC using videofluoroscopy, pulmonary test (spirometry), Hospital Anxiety and Depression Scale (HAD), University of

Washington QoL (UW-QoL), Saint George Hospital Questionnaire (SGRQ) and M.D. Anderson Dysphagia Inventory (MDADI).

Result(s): A univariate analysis revealed that smoking abuse, Glasgow and depression were significantly associated with DOSS; Glasgow and depression were significantly associated with PAS ($p < 0.05$). Spirometry was significantly associated with PAS. With respect to QoL, DOSS was associated with taste domain in the UW-QoL and functional score in the MDADI. PAS was associated with activities and impact domains in SGRQ; pain, appearance, activity, recreation, speech and saliva domains in UW-QoL, and Global assessment and Physical subscores in MDADI.

Conclusions (including clinical relevance): The major risk factors associated with pretreatment dysphagia in patients with HNC were smoking abuse, depression and conscious state. Patients who aspirate pre-treatment have worse pulmonary function. The severity of the dysphagia and penetration/aspiration events are associated with pre-treatment QoL.

Disclosures: Simone Silva: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Ana Francisco: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Bruna Geraldini: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Luciana Siqueira: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Pedro Caruso: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Luiz Kowalski: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Elisabete Carrara-de Angelis: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

DYSPHAGIA-SPECIFIC QUALITY OF LIFE AND VIDEOFLUOROSCOPY IN HEAD AND NECK CANCER PATIENTS

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Purpose: The aim of this study was to analyze the association between a dysphagia-specific quality of life questionnaire and videofluoroscopy on head and neck cancer (HNC) patients.

Method(s): Prospective study. Twenty seven HNC patients (oral cavity, oropharynx, larynx and hypopharynx), regardless type of treatment, completed a videofluoroscopic examination of their swallowing structure and physiology. They also completed the MDADI (M.D. Anderson Dysphagia Inventory) questionnaire. Pharyngeal retention and penetration/aspiration events were analyzed from videofluoroscopic recordings and correlated with the MDADI scores.

Result(s): Total MDADI average was 61.8 (median limitation). Statistical significant association was observed between total and emotional domain of MDADI and tumor size and radiotherapy. The functional domain of MDADI was significantly related to vallecular retention and aspiration after swallowing. Total MDADI was related to residue in base of tongue, vallecula and to aspiration during swallowing ($p < 0, 05$).

Conclusions (including clinical relevance): Association between MDADI domains and videofluoroscopy was found in head and neck cancer patients primarily on patients with advanced tumors, treated with radiotherapy and with pharyngeal residue and aspiration on videofluoroscopy. The use of health related questionnaires after head and neck cancer treatment can be sensitive to changes on swallowing function, although it is not widely used as a complement to clinical evaluations.

Disclosures: Margareth Andrade: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Aline Gonçalves: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Renata Guedes: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Camila Barcelos: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Luciana Siqueira: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Ana Francisco: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Simone Silva: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Dannyelle Sardinha: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Douglas Barbosa: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Elisabete Carrara-de Angelis: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

ADDITION OF SUPPLEMENT TO DIFFERENT BRANDS OF NECTAR CONSISTENCY THICKENED WATER AND THEIR EFFECT ON VISCOSITY OVER TIME: AN OVERVIEW

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Purpose: To determine the changes that occur upon adding supplements (Ensure, Similac, Benefiber, Osteo Bi-flex with Glucosamine, and Probiotics) to nectar consistency thickened water of different brands (Thick It® AquaCareH2O®, Hormel® Thick and Easy, Nestle® Resource Thicken Up, NUTRA balance®) and how they affect the viscosity of each product over time.

Method(s): Following the directions provided on the container of each product, powdered products were mixed to obtain a nectar consistency and pre-mixed products were taken from the container as provided by the manufacturer. Following the directions provided on each supplement container, supplements were then added to the prepared post-mixed and pre-mixed nectar consistency thickened water. Using Brookfield DV-II + Programmable Viscometer Model HBDVII +CP, viscosities were measured and recorded at time intervals 1, 10, 40 min, 1 and 24 h.

Result(s): According to the National Dysphagia Diet Guidelines, nectar consistency falls into a centipoise range of 51–350 cP. Viscosity above 350 cP was recorded with different brands upon the addition of supplements to nectar consistency thickened water at different time intervals.

Conclusions (including clinical relevance): In order for the safety of dysphagia patients on different thickened protocols to be observed, manufactures of thickened water may need to indicate on their labels the time interval that a patient will need to consume the thickened product upon the addition of a certain supplements for viscosity guidelines to be adhered to.

Disclosures: Jacinta Kemboi: *Financial Disclosure:* Salary: Kent Precision Foods Group; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Chinnadurai Karunanithy: *Financial Disclosure:* Salary: University of Wisconsin-Stout; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

CLINICAL PREDICTORS OF OROPHARYNGEAL DYSPHAGIA FOLLOWING ACUTE STROKE

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Purpose: To find the incidence of oropharyngeal dysphagia and determine the clinical predictors in acute stroke.

Method(s): The study was conducted between April 2012 and August 2013 in the Emergency Unit of a tertiary hospital in Brazil. We included first stroke patients, evaluated for swallowing up to 72 h after the onset of the stroke symptoms. Data was gathered from the socio-demographic factors, type of stroke, neurological severity (NIHSS), and screening tool. The screening tool includes behavioral variables, oral motor tasks, and observation during swallowing 3 and 7 ml of water.

Result(s): A hundred patients were screened. Fifty-three were male, mean age 64 years (SD = 15). Eighty-seven patients presented ischemic stroke and 13 had hemorrhage stroke. Median NIHSS score was 8 (IQR = 11). Fifty-four patients presented dysphagia. The 6 best simple predictors of the presence of dysphagia were delayed pharyngeal swallow, cervical auscultation, NIHSS >7, gurgly voice, orientation, and dysarthria. Two variables—NIHSS and dysarthria—were found to relate to oropharyngeal dysphagia, with accuracy of 78 %, sensitivity of 79 % and a specificity of 76 %.

Conclusions (including clinical relevance): The study confirms the high incidence of dysphagia in acute phase of stroke. The identification of the clinical predictors is important for specific therapies and management strategies.

Disclosures: Mariana Bahia: *Financial Disclosure:* Scholarship: Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Lucia Mourão: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Fabricio Lima: *Financial Disclosure:* Scholarship: Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Li Li: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

SHIFTS IN PRACTICE: EVALUATING THE IMPACT OF FIBEROPTIC ENDOSCOPIC EVALUATION OF SWALLOWING (FEES) IN A CANADIAN ACUTE TERTIARY-CARE SETTING

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Purpose: Videofluoroscopic Swallowing Study (VFSS) and Fiberoptic Endoscopic Evaluation of Swallowing (FEES) have been compared in the dysphagia literature but their relative merits regarding clinical outcomes and health-care costs remain unclear. This study examined the impact of FEES in an acute, tertiary-care setting. Outcomes were assessed at three levels: the patient, the Speech-Language Pathology (S-LP) service and the institution.

Method(s): VFSS was the exclusive method of instrumental assessment at London Health Sciences Centre (LHSC) until 2012 when FEES was adopted as its first-line method of instrumental assessment with patients. These parameters were compared retrospectively 6 months pre- and post-implementation: the total number of instrumental assessments completed, the relative numbers of FEES and VFSS completed, the number of swallowing referrals by service, and radiology costs.

Result(s): Post FEES implementation, a 102 % increase in the total number of instrumental assessments performed was found. For inpatients, the proportion of instrumental swallowing assessments increased from 1:10 to 1:5 while among outpatients, it remained 1:3. Also noted was a 2:1 ratio of FEES to VFSS performed for inpatients and a 1:1 ratio for outpatients. Other findings included a referral increase of 18 % post-FEES, a \$20 K reduction in Radiology costs

and a 52 % reduction in the number of VFSSs performed. Concomitantly, the latency of return to oral intake was reduced.

Conclusions (including clinical relevance): FEES is effective as a first-line swallowing assessment and its applicability in other service delivery settings merits future research.

Disclosures: Emily Barrett: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Donna Bandur: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

EFFECT OF MUCOCILIARY TRANSPORT FUNCTION ON INCIDENCE OF ASPIRATION PNEUMONIA IN ELDERLY ASPIRATORS

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Purpose: It is essential to prevent aspiration pneumonia in the clinical treatment of dysphagia. For the prevention of aspiration pneumonia, it is important to not only reduce the incidence of aspiration, but also clear aspirated matter from the bronchi by cough-up and mucociliary transport. In the last meeting, we reported that the elderly showed a decreased mucociliary transport function in comparison with healthy individuals. The purpose of this study was to clarify whether the decreased mucociliary function leads to an increased risk of aspiration pneumonia in the elderly aspirators selected from nursing home residents.

Method(s): Subjects were 15 residents with liquid aspiration detected by videoendoscopy using foods they normally eat. The mucociliary transport function was evaluated by measuring the saccharin time (ST), which reflects the mucociliary function of the bronchi. The examiner attached 5 mg of saccharin granules to examinees' nasal septum mucosa, and measured the time until they stated that they perceived sweetness. The subjects were divided into two groups based on whether they had developed aspiration pneumonia (group A n = 9) or not (group B n = 6) over the past one year.

Result(s): The mean ST of all subjects was 51.8 ± 50.7 min. The ST of group A was 75.9 ± 53.8 min, and that of group B was 17.2 ± 12.8. Group A showed a significantly longer ST than group B ($p < 0.05$). Five subjects of group A demonstrated a markedly-prolonged ST of more than 120 min.

Conclusions (including clinical relevance): These results suggest that a deteriorated mucociliary transport function indicate an increased risk of aspiration pneumonia on consuming liquid.

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EXPIRATORY MUSCLE STRENGTH TRAINING (EMST) TO IMPROVE AIRWAY PROTECTION IN POST-STROKE PATIENTS

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Purpose: Expiratory muscle strength training (EMST) is an exercise-based rehabilitation tool which has been found to improve airway protective functions Parkinson's disease, Multiple sclerosis, and amyotrophic lateral sclerosis. The goal of this study was to determine the treatment effect for EMST on mechanisms of airway protection in post stroke patients.

Method(s): Eight patients who had a stroke in the past 2 years were recruited for study participation. Baseline measures of maximum expiratory pressure (MEP), reflex and voluntary cough, urge-to-cough, and swallowing were completed during the first study visit. Participants then completed 4 weeks of at-home EMST set at 60 % MEP with weekly visits by a study clinician to adjust the device. All baseline measures were then repeated post-training.

Result(s): Maximum expiratory pressure increased from a mean of 50 to 95 cm H₂O pre-post training. The median penetration-aspiration score improved from 4 pre-training to 3 post-training. Peak voluntary cough airflow also increased post-training, indicating improved cough effectiveness.

Conclusions (including clinical relevance): Specific improvements in swallowing and cough function may be related to overall increased MEP, which is an indirect measure of expiratory muscle strength. These results are promising in terms of the applicability of EMST as an exercise-based rehabilitation option for improving airway protection in patients who have had a stroke.

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PREDICTORS OF POSTOPERATIVE DYSPHAGIA AFTER ANTERIOR CERVICAL SPINE SURGERY

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Purpose: Postoperative dysphagia is a common complication (<79%) after anterior cervical spine surgery (ACSS). This retrospective study examines factors associated with postoperative dysphagia.

Method(s): Patient parameters (sex, age, smoking status, operation level, number of surgeries, operated segments) were collected from 19 patients (10 women/9 men, mean age 58 ± 14) in clinical routine. Pre versus post-surgical videofluoroscopy (VF) were conducted using Penetration-Aspiration Scale (PAS) and residue score for 4 boluses per video (tsp liquid, sip liquid, paste, solids). In-house questionnaire was used to collect self-reported difficulties.

Result(s): PAS: Statistical analysis revealed no significant differences for pre vs post-surgical PAS scores. Residue: More residue was only observed for post-surgical residue with tsp liquid ($p = .034$) and solids ($p = .018$). Patient parameters: More than one surgery ($p = .036$) was associated with greater postoperative residues for liquids by tsp. Smokers demonstrated more postoperative residue with solids ($p = .049$). Patients with multilevel surgery showed more penetration of liquids (PAS > 1) ($p = .017$) although PAS scores were largely within functional levels. Questionnaire: The results confirmed the VF-outcome, but contrary to VF female and younger patients tend to show more self-reported difficulties.

Conclusions (including clinical relevance): ACSS patients demonstrated increased residue post-surgery. Smoking-status, multiple surgeries and surgical segments appear to increase symptoms of dysphagia. The results also indicate that self-reported measurements are not sensitive enough to identify postoperative dysphagia.

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CLINICAL SWALLOWING ASSESSMENT IN NEONATES HOSPITALIZED IN THE NICU: A PRELIMINARY RETROSPECTIVE STUDY

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Purpose: To describe swallowing disorders in neonates with various comorbidities hospitalized in the NICU at Hospital de Clínicas de Porto Alegre, southern Brazil.

Method(s): This is a retrospective study conducted in a hospital from July to October 2013. The sample consisted of 19 infants with multiple medical diagnoses and also complaints of swallowing difficulties. The neonates were submitted to a clinical sucking-swallowing evaluation and a readiness to oral feed check list. Estatistical analysis used frequency, Mann Whitney and Wilcoxon Test as well as Pearson Chi-Square, level of significance used was 0.05.

Result(s): During the period of two months, 19 infant newborns were referred to sucking-swallowing assessment and were evaluated. The median age was 1.2 months gestational age. 17 neonates were submitted to some kind of oxygen support, 7 of them were submitted to invasive ventilation. The most common clinical finding was the lack of suck-swallow-breathe coordination in 14 (74 %) infants. There was significant correlation between anterior spillage and lack of sucking-swallowing-breathing coordination ($p = 0.045$) and between aspiration signs and lack of sucking-swallowing-breathing coordination ($p = 0.045$).

Conclusions (including clinical relevance): Incoordination of sucking-swallowing and breathing occurs frequently in neonates with multiple medical diagnoses and it is correlated with oral motor disorders and pharyngeal signs. The association of a clinical swallowing assessment and the oral readiness checklist could alert the dysphagia team for swallowing disorders in this population.

Disclosures: Deborah Levy: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Karine Pereira: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

SCIENTIFIC EVIDENCE IN SWALLOWING REHABILITATION TECHNIQUES IN NEONATES: A SYSTEMATIC REVIEW

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Purpose: To conduct a systematic review of scientific evidence of the therapeutic techniques used in the neonatal dysphagia rehabilitation.

Method(s): Were investigated papers published from 2000 to 2013 in Portuguese and English, who reported scientific evidence of non-invasive techniques for the neonatal dysphagia treatment. The databases searched were Embase, LILACS/BVS, Periódicos CAPES, PubMed and SciELO. Articles were selected by two researchers for the title and summary and the included articles were reviewed by two other researchers. The relevance was verified by PeDRO-P scale.

Result(s): A total of 3836 publications were identified. Only 4 studies met the inclusion criteria. Included articles addressed the effects of sensory-motor-oral stimulation (2 studies), synthetic orocutaneous stimulation and cheek and jaw support to improve feeding performance.

Conclusions (including clinical relevance): Although some articles of dysphagia rehabilitation show promise for enhancing feeding/swallowing in neonates, methodological limitations and variations in results across studies warrant careful consideration of their clinical use.

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COORDINATION OF SWALLOWING AND BREATHING IN PATIENT WITH AMYOTROPHIC LATERAL SCLEROSIS (ALS)

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Purpose: The aim of the study was to analyze coordination of swallowing and breathing in ALS patients with mild or no dysphagia.

Method(s): Combined Fiberoptic Endoscopic Evaluation of Swallowing, respiratory phase and submental S-EMG recordings were analyzed in 13 ALS patients with mild or no dysphagia. Spontaneous swallows during a 5 minutes recording with and without endoscopic control, voluntary dry swallows, single and sequential deglutitions with thin liquid (5, 10, 50 mL) and semisolid bolus (5, 10 mL) were considered. For each swallow respiratory phases surrounding each swallow, duration of swallowing apnea and number of swallows/bolus were measured. For each patient, respiratory parameters were collected and different Scale such as the Amyotrophic Lateral Sclerosis Functional Rating Scale-Revised, Penetration Aspiration Scale and Dysphagia Outcome and Severity Scale were completed.

Result(s): No differences were found in apnea duration and number of swallows measured with and without endoscopic control ($p = 0.281$ / $p = 0.769$). In 50.1 % of patients deglutition was followed by exhalation phase. Percentage of inhalation-deglutition-inhalation pattern depended on viscosity and decreased with semisolid bolus. Mean swallowing apnea duration was 1.7 s and depended on bolus viscosity and size. Mean number of swallow/bolus was 2.06. A strong correlation between SpO₂ and swallowing apnea duration was found ($r = 0.8$).

Conclusions (including clinical relevance): Many parameters of coordination of swallowing and breathing in ALS patient with mild or no dysphagia are modified compared to healthy adults.

Disclosures: Federica Bianchi: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Antonio Schindler: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Christian Lunetta: *Financial and Nonfinancial Disclosures:* *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Massimo Corbo: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Gabriele Mora: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Daniela Ginocchio: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

ARE NATURAL THICKENERS BETTER THAN COMMERCIAL THICKENERS OF LIQUID?

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Purpose: Dysphagia patients, who can only drink liquids safely when thickened, depend on the use of commercial thickeners. An alternative is the use of a natural thickener, for example applesauce to thicken juice. However little is known about the usefulness and taste preference of patients. The aim of this study was to compare the use of natural vs. commercial thickeners regarding satisfaction in taste preference, daily fluid intake, feasibility for nursing staff and costs, in nursing home residents with severe dysphagia.

Method(s): Eight swallow therapy-resistant nursing home residents received, according to an A-B-A-B design, commercial thickened

beverages (A) and natural thickened beverages (B) for 1 month in total. Daily fluid intake was determined by trained co-workers. Satisfaction about taste preference was determined with the Discomfort Scale-Dementia of Alzheimer Type (DS-DAT) and video recordings. The feasibility of both thickeners was investigated by a questionnaire and costs were calculated.

Result(s): Five (62.5 %) patients showed a higher score on the DS-DAT in the two weeks were natural thickeners were used. In those weeks patients had a higher daily fluid intake (78 vs. 88 % of the offered quantity; $p = 0.043$). The feasibility of the natural thickeners was judged higher, but the costs of the thickeners were equal.

Conclusions (including clinical relevance): While costs remained equal, nursing home residents and staff seem to prefer natural thickened beverages compared to commercial thickened beverages. Further investigation in other and larger patient group seems justified.

Disclosures: Selma De Wit: *Financial Disclosure:* Salary: Liemerij Zevenaar; Grant: Liemerij Zevenaar; *Nonfinancial Disclosure:* Society Member: Nederlandse Vereniging voor Logopedie en Foniatrie (NVLF) | Johanna Kalf: *Financial Disclosure:* Salary: Radboud University Medical Center Nijmegen; Royalty: Bohn Stafleu Van Loghum; *Nonfinancial Disclosure:* Society Member: Nederlandse Vereniging voor Logopedie en Foniatrie (NVLF); Volunteer Advisory Committee or Review Panel Member: Evidence-based practice' committee of NVLF; Volunteer Consultant: Parkinson Vereniging.

EFFECTS OF AGE AND SENSATION ON THE ANTICIPATORY STAGE OF SWALLOWING

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Purpose: Despite the implication of increased safety associated with feeding assistance, the influence and potential risk of absent pre-oral cues are unclear. This study investigated the cooperative relationships between the sequential motor acts involved in deglutition, focusing on the anticipatory stage, under various sensory-loss conditions.

Method(s): Kinematic data from the lips, jaw, and hand were obtained from 24 healthy younger adults (ages 18–30) and 24 healthy older adults (ages 70–85) under four different conditions: typical self-feeding, typical assisted feeding, sensory loss self-feeding, and sensory loss assisted feeding.

Result(s): During typical self-feeding, all participants began the mouth opening gesture shortly after the onset of hand movement and prior to the onset of oral sensation. While older adults began this anticipatory movement significantly earlier than younger adults ($p < .05$), both groups began the offset of this gesture at approximately the same time. Similar age-related patterns were observed under the sensory-loss conditions. Further, the degradation of sensory cues resulted in a delay in both the onset and offset of mouth opening, with the extent of the delay varying based on the type of sensory loss present (e.g., loss of proprioceptive versus visual cues).

Conclusions (including clinical relevance): Deglutition should be considered as beginning prior to the onset of oral sensation. The differences observed between older and younger adults, particularly under conditions of sensory loss, may be further exacerbated in a taxed system, potentially increasing risk for various patient populations.

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ASYMMETRICAL MUSCLE ACTIVITY IN PATIENTS WITH WALLEBERG SYNDROME: A PRELIMINARY STUDY USING 3D DYNAMIC CT

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Purpose: Upper esophageal sphincter (UES) dysfunction is common in patients suffering from dysphagia associated with Wallenberg syndrome (WS). However, very few studies have reported the bilateral functional difference in swallowing. In this study, we analyzed the bilateral differences of UES and pharyngeal muscle activities with WS. **Method(s):** Using a 320-row area detector CT, three patients with dysphagia associated with WS was evaluated while swallowing a bolus. For each patient, laryngopharyngeal area was scanned twice at before and after conventional dysphagia rehabilitation period (first and second evaluation, respectively). The following parameters were analyzed: (1) origins and insertions of six hyoid and five pharyngeal muscles; (2) changes in the opening of UES; and (3) movements of the hyoid bone and laryngeal prominence. **Result(s):** In all patients, hyoid and laryngeal trajectories during swallowing reflex and the area of UES at its maximal opening improved at the second evaluation. Opening duration of UES in the ipsilateral side was significantly low (0.45 ± 0.15 s vs 0.65 ± 0.16 s, $p < 0.01$), but improved at the second evaluation. Furthermore, muscle lengths of ipsilateral stylopharyngeus, palatopharyngeus, and tensor veli palatini were longer at rest with poorer shortening ratios during swallowing.

Conclusions (including clinical relevance): Lateral medullary lesion appears to impair the ipsilateral muscle function principally. UES opening is predominantly impaired in the ipsilateral side possibly due to the impaired hyoid and laryngeal movements. UES opening can improve spontaneously with time or with dysphagia rehabilitation.

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FACTORS INFLUENCING STROKE-ASSOCIATED PNEUMONIA IN ELDERLY POST-STROKE PATIENTS WITH DYSPHAGIA

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Purpose: Elderly post-stroke patients with dysphagia are particularly vulnerable to stroke-associated pneumonia (SAP). A evaluation was undertaken to explore risk factors of SAP.

Table 1 Effect estimates of variables retained in the final multivariable logistic regression analysis model. Abbreviations: CI, confidence interval; OR, odds ratio *Denotes statistical significance $p < 0.05$

	p value	OR	95 % CI	
			Lower	Upper
Female	0.009*	5.942	1.557	22.674
Age ≥ 75 years	0.010*	5.348	1.484	19.269
Diabetes	0.012*	5.277	1.436	19.396
Atrial fibrillation	0.014*	5.682	1.416	22.805
Water test	0.000*	9.597	3.888	23.688
Lymphocyte counts	0.004*	0.169	0.050	0.575

Method(s): We retrospectively reviewed database from rehabilitation department to identify ischemic stroke patients within 1 year who developed dysphagia after stroke, but were free of other confounding conditions affecting swallowing. Of the 297 screened, 148 met the study criteria. We assessed the effects of age, sex, dysarthria, nasogastric feeding, aspiration, pneumonia, stroke subtype, diabetes, atrial fibrillation (AF), modified Barthel index and lymphocyte counts (LC) in a logistic regression analysis (Table 1).

Result(s): In a multivariate analysis, aspiration detected on a clinical water swallowing evaluation(odds ration[OR]9.597 confidence interval [95 % CI 3.888–23.688] $p = 0.000$), male (OR = 5.942 95 % CI 1.557–22.674 $p = 0.009$), age ≥ 75 years (OR = 5.348 95 % CI 1.484–19.269 $p = 0.010$), diabetes(OR = 5.277 95 % CI 1.436–19.396 $p = 0.012$), AF (OR 5.682 95 % CI 1.416–22.805; $p = 0.014$),LC (OR = 0.169 95 % CI 0.050–0.575 $p = 0.004$) were significant independent risk factors of SAP. Further, but not independent risk factors were: dysarthria, nasogastric feeding.

Conclusions (including clinical relevance): Risk factors influencing SAP identified in this study can help advance screening methodologies and the prevention of SAP in elderly post-stroke patients with dysphagia.

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PHARYNGEAL ACIDITY, STROKE SEVERITY, DYSPHAGIA, AND ORAL INTAKE

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Purpose: To examine relationships among pharyngeal pH, stroke severity, dysphagia and oral intake.

Method(s): 21 acute stroke patients were assessed for stroke severity [NIH Stroke Scale (NIHSS)], dysphagia [Mann Assessment of Swallowing Ability (MASA)], oral intake [Functional Oral Intake Scale (FOIS)], and pharyngeal pH. Pharyngeal pH measures, percent time pH <5.0, number of acid events, and longest duration pH <5.0, were aggregated as a RYAN score assessing abnormal pharyngeal acidity. Spearman correlations and Fisher's exact tests examined relationships.

Result(s): 62 % of patients presented with moderate to severe stroke (NIHSS > 4); 38 % with dysphagia (MASA ≤ 178); 43 % on modified diets (FOIS < 6); and 33 % with abnormal pharyngeal acidity (RYAN score > 6.8). Higher NIHSS scores correlated with abnormal pharyngeal acidity ($r = .44, p = .047$). Lower FOIS scores correlated with greater percent time pH < 5.0 ($r = -.50, p = .02$); number of acid events ($r = -.48, p = .03$); longest duration pH <5.0 ($r = -.50, p = .02$); and RYAN score ($r = -.49, p = .02$). Patients on modified diets had significantly greater prevalence of abnormal pharyngeal acidity than those on regular diets (67 vs. 8 %, $p = .02$).

Conclusions (including clinical relevance): These data suggest abnormal swallowing function is related to increased pharyngeal acidity in stroke patients. Pharyngeal clearance mechanisms may be implicated in this relationship.

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EVALUATION OF SCREENING SYSTEM FOR DEPENDENT ELDERLY WITH DYSPHAGIA

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Purpose: The Mann Assessment of Swallowing Ability (MASA) is used to determine the severity of dysphagia for acute-stage stroke patients. We previously reported that MASA can be used to evaluate swallowing functions of the dependent elderly. The purpose of this study was to review setting of cutoff values and to consider usefulness of evaluation items in the case of the dependent elderly by comparing MASA with the results of VE testing.

Method(s): A total of 50 elderly patients (82.5 ± 7.8 years) were studied. An ROC curve was created based on the total score of MASA and VE results. The difference between two groups was statistically reviewed in regards to scores for each evaluation item of MASA by classifying into "aspiration" or "non-aspiration" and "pharyngeal retention" or "non-pharyngeal retention" based on VE results.

Result(s): The optimal cutoff value of the MASA score for aspiration was 122 and for pharyngeal retention was 151. The scores of evaluation item of MASA for the aspiration group and pharyngeal retention group decreased in 8 items (cooperation, tongue strength, tongue coordination, oral preparation, oral transit, cough reflex, pharyngeal Phase and pharyngeal response) and have a significant difference between two groups.

Conclusions (including clinical relevance): We suggest using the adequate cutoff values and usefulness of 8 evaluation items in the case of the dependent elderly.

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USING PATIENT SIMULATION (HPS) FOR DEVELOPMENT OF TECHNICAL AND NON-TECHNICAL SKILLS FOR DYSPHAGIA MANAGEMENT

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Purpose: Human Patient Simulation (HPS) utilizes human mannequins to develop clinical skills within authentic clinical scenarios. The study examined the comparative benefits of adding HPS into a university dysphagia curriculum by contrasting student's perceptions of (a) completing only the academic curriculum, with (b) completing both academic curriculum and HPS.

Method(s): 22 students completed their dysphagia curriculum, then attended 2, 2 h HPS tutorials. The HPS scenarios related to (a) pediatric feeding and (b) dysphagia assessment for a patient with a tracheostomy, and required practicing technical (eg., cuff deflation) and non-technical skills (eg. communication). Students completed surveys of perceived knowledge, skills, confidence and levels of anxiety relating to aspects of dysphagia management at (a) pre-lectures, (b) post-lectures but pre HPS, and (c) post HPS.

Result(s): Significant ($p > 0.05$) increases in clinical confidence, knowledge, skills and reasoning were observed (a) post lectures and (b) post HPS. Student anxiety re: managing clients with dysphagia did not change post lectures however reduced significantly ($p < 0.05$) post HPS. Over 98 % rated HPS as extremely or very useful for clinical learning.

Conclusions (including clinical relevance): HPS was beneficial for preparing students for the technical and non-technical skills required for dysphagia management.

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Hill: *Financial Disclosure*: Salary: The University of Queensland; *Nonfinancial Disclosure*: Society Member: Speech Pathology Australia, Health Workforce Australia Expert Reference Group on Simulation | Rebecca Nund: *Financial Disclosure*: Salary: The University of Queensland, Australian Post-Graduate Award; *Nonfinancial Disclosure*: Society Member: Speech Pathology Australia; AN-ZHNCS | Pamela Dodrill: *Financial Disclosure*: Salary: Royal Children's Hospital; *Nonfinancial Disclosure*: Society Member: Speech Pathology Australia, Dysphagia Research Society | Katie Walker-Smith: *Financial Disclosure*: Salary: Royal Children's Hospital; Queensland Health; *Nonfinancial Disclosure*: Society Member: Speech Pathology Australia, American Cleft Palate and Craniofacial Association, Australasian Cleft Lip and Palate Association; Volunteer Employee: Operation Smile, Trinh Foundation | Anna Rumbach: *Financial Disclosure*: Salary: The University of Queensland; *Nonfinancial Disclosure*: Society Member: Speech Pathology Australia | Sarah Wright: *Financial Disclosure*: Salary: Royal Children's Hospital; Queensland Health; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Kristine Kelly: *Financial Disclosure*: Salary: Royal Children's Hospital; Queensland Health; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist.

RHYTHM TREATMENT WITH A METRONOME AND RESPIRATORY-SWALLOWING COORDINATION IN PATIENTS WITH PARKINSON'S DISEASE

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Purpose: We reported previously that rhythm treatment for dysphagia with a metronome improves swallowing function in Parkinson's disease (PD) (Deglutition 2012; 1: 400–412). This study evaluated whether this treatment changes respiratory-swallowing coordination in PD.

Method(s): Ten PD patients and 10 control subjects participated. A pneumogram was conducted by recording the cervical swallowing sound in 3 ml of water. A throat microphone and a respiration transducer were used. We evaluated the inspiratory events before and after swallowing apnea and measured apnea duration. Three people independently measured results. Rhythm treatment involved swallowing water on the sixth beat of the metronome with a pace optimal for each participant (range 0.6–1 Hz). They were instructed to listen to the beat and were given the cue to swallow on the signal sixth beat.

Result(s): There was no difference in the occurrence of inspiratory events before apnea and apnea duration between PD and controls. However, in PD, the occurrence of inspiratory events after apnea (39 %) was more frequent than that in controls (31 %). With metronome treatment, the occurrence of inspiratory events after apnea decreased from 39 to 27 % in PD.

Conclusions (including clinical relevance): In PD, treatment with a metronome contributed to a decrease in the occurrence of inspiratory events after apnea, perhaps due to rhythm adjustment.

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SWALLOWING PERFORMANCE FOLLOWING PAROTID-SPARING IMRT FOR OROPHARYNGEAL CANCER ASSESSED USING THE 100 ML WATER SWALLOW TEST

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Purpose: Studies evaluating the benefit of water swallow tests have focused on their value in identifying patients at risk of aspiration. As well as information on potential aspiration risk, the 100 mL Water Swallow Test (WST) can also be used to measure specific aspects of swallowing performance. The purpose of this study was to understand changes in swallowing capacity and volume in patients recovering from intensity modulated radiotherapy (IMRT) for oropharyngeal cancer.

Method(s): The 100 mL WST was administered to 37 patients with oropharyngeal cancer before commencing a course of IMRT at a tertiary cancer center. Patients were then assessed at 3, 6 and 12 months after treatment.

Result(s): Summary data are in (Table 1). There was a significant reduction in mean swallow volume from baseline to each post-treatment time point: 3 months ($p = 0.001$), 6 months ($p = 0.001$) and 12 months ($p = 0.02$). Equally, significant differences were observed for swallowing capacity from baseline to each timepoint (all $p < 0.001$).

Conclusions (including clinical relevance): There is a significant reduction in swallow volume and capacity from baseline to 3, 6 and 12 months after treatment. Improvements in mean group scores were observed up to 12 months but did not return to baseline. The 100 mL WST is a valuable adjunct to the clinical swallowing evaluation providing quantitative data to document swallowing recovery after treatment.

Disclosures: Justin Roe: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Michael Drinnan: *Financial Disclosure*: Salary: Newcastle Hospitals NHS Foundation Trust; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Paul Carding: *Financial Disclosure*: Salary: Australian Catholic University; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Peter Rhys-Evans: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Shreerang Bhide: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust, Institute for Cancer Research; *Nonfinancial Disclosure*: No relevant

Table 1 Mean (95 % CI) for swallow parameters pre- and post-IMRT

	Swallow volume	Swallow capacity
Baseline (n = 37)	21.2 (18.8–23.6) mL	16.3 (14.9–18.6) mL/s
3 months (n = 29)	15.3 (13.6–17.1) mL	11.1 (9.2–12.9) mL/s
3 months (n = 26)	15.7 (13.4–18.0) mL	11.5 (9.6–14.0) mL/s
12 months (n = 26)	17.6 (15.4–19.8) mL	13.2 (11.4–15.1) mL/s

nonfinancial relationships exist. | Kate Newbold: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Kevin Harrington: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust, Institute for Cancer Research; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Christopher Nutting: *Financial Disclosure*: Salary: Royal Marsden NHS Foundation Trust; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist.

PREDICTING LARYNGEAL MOVEMENT DURING NORMAL SWALLOWING

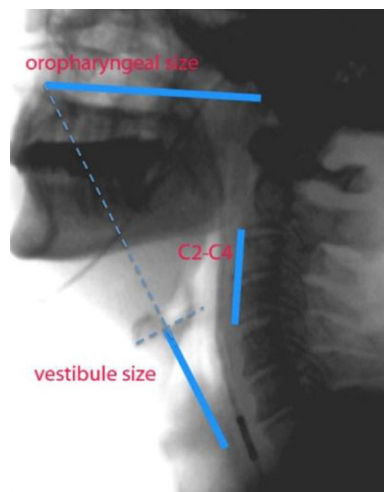
Wong, Seng Mun¹, Ludlow, Christy L¹

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Purpose: Peak laryngeal displacement measures vary widely in normal swallowing (Molfenter and Steele 2011) and have been normalized against cervical spine length. We hypothesized that individual differences in cavity size for the oropharynx and laryngeal vestibule at rest, that will require closure for safe swallowing, may better determine the magnitude of laryngeal elevation during swallowing than anatomical differences in C2 to C4 spine length.

Method(s): Distances (in millimeters) between the anterior floor of the nasal cavity and cervical spine (oropharyngeal size), and from the hyoid to posterior-superior subglottic air column (laryngeal vestibule size), and C2 to C4 length were related to peak superior laryngeal displacement (LarynxY) during 5 ml liquid barium swallows in 5 healthy subjects on videofluoroscopy.

Result(s): Oropharyngeal size, laryngeal vestibule size and C2-C4 length explained 78 %, 78 % and 2 % respectively of variance in LarynxY during swallowing. When normalized by individual cavity size differences, inter-subject variability in LarynxY (coefficient of variation, CV = 0.22) decreased by about half after normalizing by oropharyngeal size (CV = 0.12) and by laryngeal vestibule size (CV = 0.11) but not using C2-C4 length (CV = 0.22).



Conclusions (including clinical relevance): The results demonstrate that individual differences in laryngeal elevation can be accounted for by cavity size requiring closure rather than the anatomy of the spine. Laryngeal vestibule or oropharyngeal cavity size normalization may better distinguish between normal and disordered laryngeal motion during swallowing.

Disclosures: Seng Mun Wong: *Financial Disclosure*: Salary: Singapore General Hospital; Scholarship: Singapore General Hospital, American Speech-Language-Hearing Foundation Graduate Student Scholarship 2013; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. | Christy Ludlow: *Financial Disclosure*: Salary: James Madison University; Grant: National Institutes Health Research; *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society.

PHYSIOLOGICAL FACTORS RELATED TO ASPIRATION RISK: A SYSTEMATIC REVIEW

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Purpose: Penetration-aspiration is considered the most serious component of oropharyngeal dysphagia. Clinicians regularly evaluate the pathophysiology of swallowing and postulate reasons or mechanisms behind penetration-aspiration. We conducted a systematic review to elucidate the association between abnormalities in physiological measures of respiratory, tongue, hyoid and laryngeal function in swallowing and penetration-aspiration.

Method(s): A multi-engine literature search identified 144 non-duplicate articles of which 37 were judged to be relevant. These

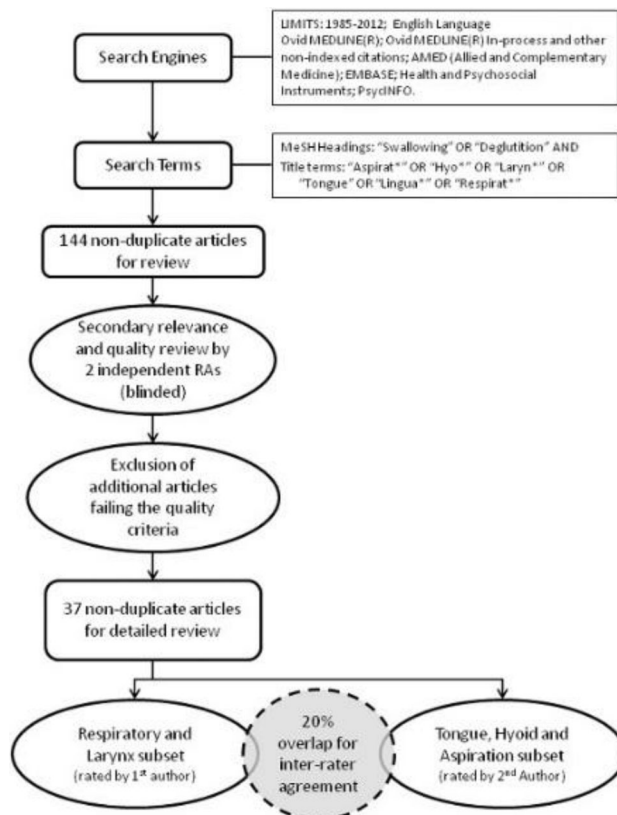


Fig. 1 Process used for Systematic review exploring physiological factors associated with aspiration

underwent detailed review for study quality, rating for level of evidence, and data extraction (Fig. 1).

Result(s): Overall, the literature on physiological factors related to penetration-aspiration shows a paucity of high-quality evidence. In the articles reviewed, links with penetration-aspiration were found for reduced tongue strength, reduced hyoid movement, bolus presence in the pharynx while the larynx remains open, increased respiratory rate, and post-swallow-apnea inspiration.

Conclusions (including clinical relevance): The results support measurement of the following factors as relevant for determining penetration-aspiration risk: tongue strength, anatomically-normalized measures of hyoid movement, bolus dwell time in the pharynx while the larynx remains open, respiratory rate, and respiratory swallow phasing.

Disclosures: Catriona Steele: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute, University Health Network; Grant: Nestle Health Science; Other: Travel and Conference Registration from Nestle Health Science; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Julie Cichero: *Financial Disclosure:* Salary: University of Queensland; Grant: Nestle Health Science; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

EFFECT OF ORAL STAGE IMPAIRMENT ON SWALLOWING AMONG PATIENTS WITH PARKINSON'S DISEASE

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Purpose: The impairment of oral stage of swallowing is frequently observed in patients with Parkinson's disease (PD). We investigated the effects of oral stage impairment on swallowing function among patients with PD.

Method(s): The subjects were 110 patients with PD (59 men and 51 women; mean age, 69 ± 9 years; median Hoehn-Yahr Stage, 3). All patients swallowed 10 ml of liquid barium under videofluorography. Their swallowing movements were recorded to measure the oral transit time (OTT). Because 17 healthy controls (mean age, 60 ± 11 years) had a mean OTT +2SD of 1.8 s, the patients were divided: 78 patients with an OTT < 1.8 seconds (normal OTT group) and 32 patients with an OTT ≥ 1.8 s (delayed OTT group). The results of VF in two groups were compared with the χ^2 test.

Result(s): In the normal OTT and delayed OTT groups, the frequency of premature spillage to the pharynx were 12.8 and 31.3 %, oral residue, 13.5 and 20.7 %; pharyngeal residue, 20.0 and 55.2 %; and aspiration, 6.4 % and 21.9 %, respectively. The delayed OTT group had significantly higher overall values ($p < 0.05, 0.01, 0.01, 0.05$).

Conclusions (including clinical relevance): The PD patients with delayed OTT had poor lingual control and backward tongue thrust due to bradykinesia. Such problems affected subsequent pharyngeal stage of swallowing, with premature spillage and inadequate pharyngeal constriction. It is thought, therefore, that the lingual movement in the oral stage plays an important role in the sequential movement of swallowing in PD.

Disclosures: Yoko Wakasugi: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Japanese Society of Dysphagia Rehabilitation, Japan Society of Gerodontology, Japanese Society of Disability and Oral Health, Japanese Society of Respiratory Care and Rehabilitation | Toshiyuki Yamamoto: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Japanese Society of Neurology, Japanese Society of Internal Medicine, Japanese Society of Dysphagia

Rehabilitation, Japan Society of Logopedics and Phoniatrics, Japanese Association of Rehabilitation Medicine, Society of Swallowing and Dysphagia of Japan; Panel Member: Japanese Society of Dysphagia Rehabilitation | Chihiro Oda: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Keigo Nakayama: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Masako Sato: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Miho Murata: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Japanese Society of Neurology, Japanese Society of Internal Medicine, International Parkinson and Movement Disorder Society.

KINEMATIC ANALYSIS OF THE ORAL PROPULSIVE PHASE IN SWALLOWING WITH SOLID FOOD

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Purpose: To examine the oral propulsive phase of swallowing, with special attention to the “squeeze back” movement of the tongue.

Method(s): Videofluoroscopy was performed while 13 participants ate 6 g pieces of banana, cookie and tofu. We evaluated the temporal order of the motion of tongue markers: the anterior tongue marker (ATM) glued on the tip of tongue, the posterior tongue marker (PTM) glued on the dorsum of tongue.

Result(s): The ATM and hyoid bone started moving upward almost simultaneously at the time of mouth closing at the beginning of swallow. The PTM started moving upward immediately afterwards. The ATM always contacted the palate before the PTM. The hyoid bone started moving forward just after the PTM contacted the palate. There were no significant differences among food type, and also no significant interaction effect of the temporal order and food type.

Conclusions (including clinical relevance): There was a significant time lag between the times that the ATM and PTM contacted the palate. During this period, the ATM remained stationary while the PTM moved upward to contact the palate. This sequential tongue-palate contact created the “squeeze back” propulsive mechanism of the tongue.

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TONGUE-JAW LINKAGE IN FEEDING: A COMPUTER MODEL

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Purpose: Tongue-jaw linkages in chewing have been studied with Videofluoroscopy. We hypothesized that tongue motion could be modeled in the form of rotations of the tongue surface about 3 anatomical axes: anterior–posterior (A–P), superior–inferior (S–I), and medio–lateral (M–L) axes, each angle relative to the instantaneous position of the mandible. We developed a tri-axial computer model for jaw and tongue motion and compared the model output to actual measurements from the VF recordings.

Method(s): The simulator was programmed with EXCEL VBA (Microsoft). Radiopaque markers were glued to the tongue surface of a healthy volunteer who consumed a hard biscuit (size 1 × 1 × 0.5 in) during videofluoroscopy in lateral and A-P projections. Motions of tongue markers and lower second molar during chewing were tracked with a motion analysis system. Marker coordinates at minimum and maximum gape were used to approximate 3-dimensional (3D) coordinates (3DC) of tongue markers relative to the mandible. The simulator's genetic algorithm (an iterative process), compiled 3DC and axis and angle of rotation of the tongue surface relative to the mandible at maximum gape in A–P, M–L, and S–I axes. Twenty results were computed and median values calculated for each of these axes and angles of rotation.

Result(s): The model outputs closely approximated actual measurements. The median of modeled tongue rotation was -7.9° (A–P), 3.4° (S–I) and 6.4° (M–L).

Conclusions (including clinical relevance): The tri-axial computer model provided good predictions of actual tongue surface angles relative to the mandible. This suggests that the tri-axial model deserves further study.

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PHARYNGEAL TACTILE STIMULATION USING A NYLON THREAD FOR ENHANCING PHARYNGEAL SENSORY PERCEPTION

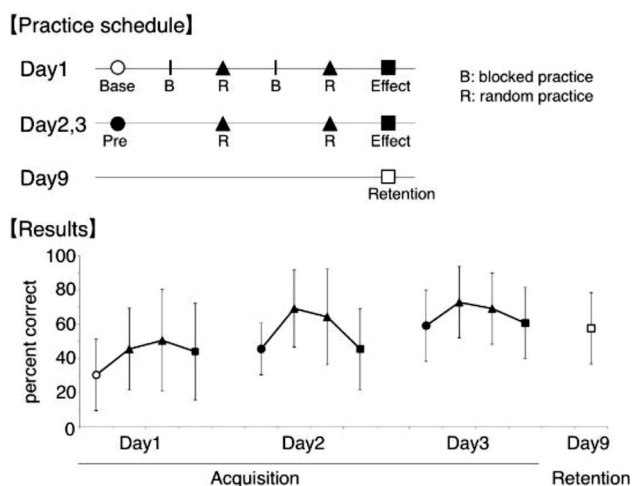
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Purpose: Swallowing is initiated and regulated by neural afferents in the oropharyngeal and laryngeal mucosa. Our goal was to determine whether training using a nylon thread can enhance pharyngeal sensory perception.

Method(s): Eleven healthy men (mean age 26 years) underwent 3-days of nasoendoscopic training using a 0.4 mm nylon monofilament inserted through the internal port of the flexible fiberoptic. Five areas were stimulated: (1) left, (2) center, and (3) right of vallecula and (4) left and (5) right pyriform sinus. Subjects were asked to report the location where the thread touched. Stimulation was provided day 1 in the order specified above followed by random presentation requiring subjects to identify the location. Feedback was provided for incorrect responses. Learning effects during each day and long term (Day 9) were analyzed.

Result(s): At baseline, subject responses were correct 30.3 % of the time compared to 43.9, 45.5, 60.6, 57.6 % during days 1, 2, 3, and 9 respectively. Compared to baseline, the results of Days 3 and 9 were significantly different ($p < 0.05$).



Conclusions (including clinical relevance): In healthy subjects, it was possible to train recognition of sensory stimuli to different pharyngeal locations. Feedback was beneficial to improve stimulus location recognition. Since stimulus location was learned, it is possible that this method can be used to enhance bolus formation during chewing.

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VIDEOFLUOROSCOPIC EVALUATION OF ESOPHAGEAL CLEARANCE IN NORMAL ADULTS

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Purpose: Previous reports showed that esophageal residues were recognized even in healthy humans. In this study, status of bolus transport and residues in the pharynx and esophagus was evaluated using videofluorographic examination in young and elderly subjects.

Method(s): Young (n = 12) and elderly (n = 12) male adults were instructed to drink 3 ml of both liquid and thickened one, and eat 5 g of rice gruel. They were all mixed with barium sulfate. Pharyngeal and esophageal residues were recorded as well as the location of leading edge of bolus at the time of swallow onset.

Result(s): There was a significant difference in the pharyngeal residues and location at the time of swallow onset of all boluses between young and elderly subjects. This was also the case of pharyngeal residues of thickened pate and rice gruel. We also found relationship

between pharyngeal and esophageal residues and between esophageal residues and the location of bolus at the time of swallow onset.

Conclusions (including clinical relevance): Occurrence of esophageal and pharyngeal residues is dependent on aging and oral, pharyngeal and esophageal functions are deeply related to each other.

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A COMPARISON OF THE MAXIMUM HYOID VELOCITY IN HEALTHY YOUNGER AND OLDER WOMEN

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Purpose: Previous research indicated that dysphagia development with aging was caused not only by increased disease prevalence but also healthy aging. The progression of age-related changes contributes to alterations in swallowing in healthy older adults, and is termed presbyphagia, a diminishing functional reserve. As the velocity of muscle contraction decreases with aging, the velocity of hyoid movement may also decrease. The aim of this study was to compare the maximum hyoid velocity in healthy younger women with that in older women.

Method(s): The subjects were 10 healthy younger and 10 older women. Lateral projection videofluorography was recorded twice while each subject swallowed thin liquid barium in one gulp. We previously reported that, in normal younger, a larger bolus volume required a greater maximum hyoid velocity, so the volume was set to 20 ml. We evaluated the maximum hyoid displacement and velocity during swallowing.

Result(s): The velocity in younger women was significantly higher than that in older women ($p < 0.05$). There was no difference in the vertical velocity between the two groups, but the horizontal velocity in young women was significantly higher than that in older women ($p < 0.01$). On the other hand, the vertical displacement in older women was significantly greater than that in younger women ($p < 0.05$).

Conclusions (including clinical relevance): This study shows that the maximum hyoid velocity in older women is lower than that in younger women. It is possible that the decreasing maximum velocity may be a symptom of presbyphagia.

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TIMING OF BETA POWER INCREASE IN MIO AT TRANSITIONS FROM RHYTHMIC CHEWS TO SWALLOWS

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Purpose: Previously we showed that the beta frequency range of local field potentials (LFPs) in the orofacial part of primary motor cortex (MIO) increases its power around transitions from rhythmic chews to swallows. In order to assess if the timing of the power increase can be used reliably to predict occurrence of the transition, we computed the power onset around the time of the transition.

Method(s): Two macaque monkeys were trained to feed with their right hand while restrained. We used a motion capture system to record 3D jaw kinematics and 2D videofluoroscopy to record tongue marker kinematics. Jaw movement cycles were defined by two consecutive maximum gaps. We recorded 96 channels of LFPs from a chronically implanted Utah array in MIO. We then identified the peak of the β oscillation frequency, bandpass filtered each channel of LFP over β peak \pm 3 Hz, then computed the amplitude of the Hilbert transform of the filtered LFPs.

Result(s): Most of the channels (81/96 and 62/96 channels in each monkey) showed systematic increases, on average, slightly before one jaw movement cycle (-36 ms \pm 15 ms std) prior to the transition from chew to swallow.

Conclusions (including clinical relevance): Our results indicate that the magnitude of β oscillations recorded from MIO can be used to predict the occurrence of transition from a rhythmic chew to a swallow at least one chewing cycle prior to the start of the swallow cycle. Such a signal may be useful to trigger a device to assist reflexive swallowing safely.

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FIBEROPTIC ENDOSCOPIC EVALUATION SWALLOWING IN NEURODEGENERATIVE DISEASE

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Purpose: To compare the Fiberoptic Endoscopic Evaluation Swallowing (FEES) findings in Parkinson's disease (PD) and Amyotrophic Lateral Sclerosis (ALS).

Method(s): A cross-sectional clinical retrospective case series, by collecting the database of a Dysphagia Center. The study included 10 individuals. These were divided into two groups. Group I consisted of five individuals with PD and Group II of five individuals with ALS, presenting variations on the stage of the disease within and between groups, seven females and three males, age range 26-77 years old. The FEES was performed using puree and liquid, 5 ml each one.

Result(s): It was found that the GI of 5 (100 %) patients, 4 (80 %) had posterior oral spillage, 2 (40 %) pharyngeal residues and the penetration and aspiration were absent. GII was also found posterior oral spillage in 4 (80 %) patients, but was also observed pharyngeal residue 1 (20 %), penetration 2 (40 %) and one aspiration (20 %).

Conclusions (including clinical relevance): There was no difference in the frequency of posterior oral spillage and pharyngeal residue, however individuals with ALS showed signs of aspiration, which did not occur in individuals with Parkinson's disease in this sample.

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MORPHOMETRIC ANALYSIS OF HYOLARYNGEAL MECHANICS

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Purpose: Morphometric analysis was used to document the covariant function of the hyolaryngeal mechanism associated with age, gender, and bolus viscosity in a large cohort of healthy, non-dysphagic adults.

Method(s): Coordinate data mapping hyolaryngeal mechanics were extracted from 132 MBSS using ImageJ. A canonical variate analysis of coordinates was executed using MorphoJ to determine variance proportions (eigenvalues) and shape changes (eigenvectors) associated with

these categorical variables: hyolaryngeal excursion, age (< 40 [range = 21–39, mean = 28.8, n = 63], ≥40 [range = 40–86, mean = 51.5, n = 69]), bolus type (5-mL thin liquid, 5-mL pudding), and gender.

Result(s): Eigenvalues associated with each canonical variate (CV): CV1 (hyolaryngeal excursion) = 83.4 % (D = 5.41, $p < .0001$), CV2 (gender) = 10.9 % (D = 2.11, $p < .0001$), and CV3 (age) = 2.8 % (D = 0.96, $p < .0001$). No significant differences were associated with bolus viscosity (D = 0.35). Eigenvectors of coordinates associated with CV3 indicate a shortened pharynx and extended head and neck in ≥40 age group.

Conclusions (including clinical relevance): Biomechanical analysis of hyolaryngeal mechanics using multivariate morphometric analysis is a new method of determining structural changes associated with categorical variables such as age group, gender, or bolus type. Implications of bolus type finding will be discussed. Future studies will include test groups of age-matched dysphagic patients to identify specific impairments in the hyolaryngeal mechanism.

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COMPARISON BETWEEN PHARYNGEAL RESIDUE AND LARYNGEAL SENSITIVITY IN STROKE

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Purpose: The aim of the present study was to compare the pharynx residues with laryngeal sensitivity in post-stroke and ischemic individuals.

Method(s): A cross-sectional clinical study was performed with 82 individuals, with mean age 67 years old and average time since injury of 24 months. All underwent the fiberoptic endoscopic evaluation of swallowing and evaluated the laryngeal sensitivity. The residues in the pharynx was observed after three food consistencies (puree, thickened liquid and water) and dyed with blue color. The Mann Whitney U test was used to compare the incidence of residues in the pharynx and presence or absence of laryngeal sensitivity. A p value < 0.05 was considered statistically significant.

Result(s): The pharyngeal residue was noted 21/71 (29.6 %) in individuals with presence of laryngeal sensitivity and 7/11 (63.6 %) with absence using consistency ($z = 2.2$ and $p = 0.02$). In the thickened liquid consistence was observed pharyngeal residues in 21/71 (29.6 %) individuals with presence of laryngeal sensitivity and 7/11 (63.6 %) with absence ($z = 2.2$ and $p = 0.02$). With water occurred 21/71 (29.6 %) in individuals with presence of laryngeal sensitivity and 8/11 (72.7 %) with absence of laryngeal sensitivity ($z = 2.8$ and $p = 0.005$).

Conclusions (including clinical relevance): Our findings showed that stroke patients present more pharyngeal residues among individuals with absence of laryngeal sensitivity independent of food consistence.

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A MACRO-ENABLED EXCEL WORKBOOK FOR MBS MEASUREMENTS USING IMAGEJ

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Purpose: A macro-enabled Excel workbook was developed as a companion tool to ImageJ that facilitates the collection and calculation of displacement, timing, and area measurements from MBS video files.

Method(s): Using Visual Basic for Applications, an initialization macro was written supporting scalar and variable selection that generates a customized protocol sheet for ImageJ data collection. A data capture function imports ImageJ data and calculates variables of interest. To demonstrate the usefulness of this workbook, data were extracted from 40 MBS video files from a study investigating swallowing impairment among wounded warriors.

Result(s): Of the 32 potential variables encoded in the workbook, 12 were reported for this study with results as follows: hyoid excursion (1.34 ± 0.68 cm), hyolaryngeal approximation (1.04 ± 0.70 cm), laryngeal elevation (1.86 ± 0.90 cm), pharyngeal shortening (0.99 ± 0.61 cm), base of tongue retraction ratio ($0.81 \pm .12$), UES distension (1.09 ± 0.41 cm), oral transit time (0.66 ± 0.51 s), stage transition duration (0.35 ± 0.49 s), pharyngeal transit time (0.78 ± 0.64 s), pharyngeal constriction ratio ($.09 \pm .06$), and normalized residue ratio scale (valleculae = $.15 \pm .22$; piriform recesses = $.03 \pm .08$).

Conclusions (including clinical relevance): ImageJ is open source image-processing software. This MBS macro-enabled workbook organizes ImageJ data collection from MBS videos and calculates multiple displacement, timing, and area measurements. This tool will be made freely available for dysphagia research.

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ACCURACY OF CERVICAL AUSCULTATION FOR IDENTIFY PENETRATION OR ASPIRATION IN CEREBRAL PALSY

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Purpose: This study aimed to compare the accuracy of cervical auscultation in cerebral palsy between two specialized Dysphagia Centers in Brazil.

Method(s): Clinical cross-section study, transversal and retrospective. The study included 145 patients with different types of cerebral palsy, 86 males and 59 females, age range 1–19 years old. Of these, 44 individuals were from the Center I and 101 from the Center II. Performed cervical auscultation and swallowing videofluoroscopy, for liquid and puree, both performed by dysphagia specialist. The presence of changes in cervical auscultation and videofluoroscopic evidence of penetration and / or aspiration were compared and analyzed in the same consistency of food. Values were calculated sensitivity and specificity for the two centers and these were compared by means of the 95 % confidence interval.

Result(s): The Center I had a sensitivity of 85.7 % CI (75.4, 96.0) and specificity of 62.5 % CI (48.2, 76.8). In the Center II sensitivity was 62.5 % CI (53.1, 71.9) and a specificity of 72.3 % CI (63.6, 81.0).

Conclusions (including clinical relevance): There was a difference between the two centers for sensitivity, which was higher in the Center I, but there was no difference in specificity.

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CORRELATION BETWEEN NATIONAL INSTITUTES OF HEALTH STROKE SCALE (NIHSS) AND LARYNGEAL PENETRATION AND TRACHEAL ASPIRATION IN ISCHEMIC STROKE

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Purpose: To correlate NIHSS score and laryngeal penetration and aspiration in stroke. Seventy-four stroke individuals were evaluated.

Method(s): Seventy-four stroke individuals were evaluated. They were divided into four groups, G1 (0–4 points), G2 (5–10 points), G3 (11–20 points) and G4 (≥20 points). Two of these individuals were excluded because they have severe neurological impairment by NIHSS. Seventy

two subjects were submitted to videofluoroscopy evaluation, performed on the same day, using puree and liquid consistencies, observing the presence of laryngeal penetration and aspiration

Result(s): The laryngeal penetration occurred in 06 (8.33 %) individuals with puree, distributed in G1 (04–66.6 %) and G2 (02–33.3 %). With liquid, laryngeal penetration was observed in 41 (56.9 %) individuals, distributed in G1 (21–51.2 %), G2 (12–29.2 %) and G3 (08–19.5 %). There was not statistically significant correlation between the NIHSS and the presence of laryngeal penetration with thin pasty ($p = 0.3270$) and liquid ($p = 0.8138$). Regarding the presence of tracheal aspiration only 01 (1.3 %) individual had this sign with puree in G1 (100 %) of the NIHSS. The aspiration with liquid occurred in 09 (12.5 %) individuals, distributed in NIHSS groups G1 (04–44, 4 %), G2 (03–33, 3 %) and G3 (02–22, 2 %). There was no correlation between the NIHSS and the presence of aspiration with puree ($p = 0.3714$) and liquid ($p = 0.6292$).

Conclusions (including clinical relevance): There was no correlation between the NIHSS and the laryngeal penetration and aspiration in stroke.

Disclosures: Priscila Ribeiro: *Financial and Nonfinancial Disclosures:* No relevant relationship exists | Paula Cola: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Ana Rita Gatto: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Roberta Silva: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Arthur Schelp: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Rodrigo Bazan: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Maria Aparecida Arruda: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

RELATIONSHIPS BETWEEN SALIVARY FLOW, SWALLOWING FREQUENCY, AND GERD SYMPTOMS

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Purpose: GERD can cause dysphagia in the esophageal phase. GERD-induced acid reflux presents various symptoms such as heartburn and difficulty in swallowing. Esophagus acid clearance ameliorates these symptoms, and the quantity of salivation and swallowing frequency are presumed to play an important role in this defense mechanism; however, this has not yet been confirmed. This study examined the relationships between salivary flow, swallowing frequency, and GERD symptoms.

Question	Mark this section				
	NEVER	SOME TIMES	OFTEN	ALWAYS	
1 Do you get heartburn?	0	1	2	3	4
2 Does your stomach get bloated?	0	1	2	3	4
3 Does your stomach ever feel heavy after meals?	0	1	2	3	4
4 Do you sometimes subconsciously rub your chest with your hand?	0	1	2	3	4
5 Do you ever feel sick after meals?	0	1	2	3	4
6 Do you get heartburn after meals?	0	1	2	3	4
7 Do you have an unusual (e.g. burning) sensation in your throat?	0	1	2	3	4
8 Do you feel full while eating meals?	0	1	2	3	4
9 Do some things get stuck when you swallow?	0	1	2	3	4
10 Do you get bitter liquid (acid) coming up into your throat?	0	1	2	3	4
11 Do you burp a lot?	0	1	2	3	4
12 Do you get heartburn if you bend over?	0	1	2	3	4

Please describe any other symptoms you experience. + + + =

Acid reflux-related symptoms = POINTS
Dyspeptic (dysmotility) symptoms = POINTS

Frequency Scale for the Symptomes of GRED

Method(s): Subjects comprised 48 patients who visited our department with a chief complaint of oral dryness. To evaluate GERD symptoms, subjects were assessed with the frequency scale for the symptoms of GERD (FSSG), then divided into two groups according to the quantity of salivation (Group A: salivary flow for 15 min < 1.5 ml, and group B: >1.5 ml). Study 1: We compared FSSG scores between the two groups. Study 2: We examined correlations between the swallowing frequency and FSSG scores in each group.

Result(s): Study 1: The average FSSG score in group A was 10.5 ± 6.1 and that in group B was 7.4 ± 8.0 . A significant difference was observed in FSSG scores between the two groups ($p < 0.01$). Study 2: A significant correlation was found between the swallowing frequency and FSSG score in group A ($p < 0.05$), but not in group B.

Conclusions (including clinical relevance): These results indicate that: (1) saliva flow is one of the factors regulating GERD symptoms, and (2) swallowing frequency may be increased in response to GERD-induced acid reflux to compensate for decreased salivary flow.

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CLINICAL PREDICTORS OF ASPIRATION IN INDIVIDUALS WITH AMYOTROPHIC LATERAL SCLEROSIS

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Purpose: Identify clinical predictors of penetration/aspiration in individuals with Amyotrophic Lateral Sclerosis (ALS).

Method(s): 40 ALS patients underwent a videofluoroscopic evaluation of swallowing. The Penetration Aspiration Scale and validated objective measures of swallowing were completed by a blinded rater. T-tests between non-penetrator/aspirators (Non-PA:PAS < 2) versus penetrator/aspirators (PA:PAS > 3); Spearman's Rho correlations between PAS scores and objective swallow parameters; and a multiple linear regression were conducted.

Result(s): ALS patients in the PA group demonstrated significantly higher pharyngeal constriction ratios (PCR) (.22 vs .09, $p < .01$); longer oropharyngeal transit time (OTT) (.37 vs .24, $p < .01$); longer hypopharyngeal transit time (HTT) (1.32 vs. 0.77, $p < .02$); longer PES opening duration (.70 vs .59, $p < .03$); and reduced hyoid displacement (1.2 vs. 1.7, $p < .05$). Significant positive correlations were revealed between PAS scores and PCRs ($r = .53$, $p = .001$); OTT ($r = .52$, $p = .002$) and HTT ($r = .58$, $p = .000$). A significant linear regression [$F(3,29) = 10.44$, $R^2 = 0.52$, $p = .000$] revealed that PCR, OTT and HTT were significant predictors for aspiration.

Conclusions (including clinical relevance): ALS individuals who penetrated/aspirated demonstrated: (1) longer oropharyngeal and hypopharyngeal transit times; (2) longer PES opening durations; (3) reduced pharyngeal strength; and (4) reduced hyoid displacements. Decreased pharyngeal strength and longer oropharyngeal and hypopharyngeal transit times were associated with poorer airway protection and identified as significant predictors of aspiration in this cohort of ALS patients.

Disclosures: Emily Plowman: *Financial Disclosure:* Grant: National Institute of Child Health Development (NICHD) 1R21 HDO75327-01; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society, ASHA, SFN; Society Board Member: Dysphagia Research Society; Society Committee Member: DRS Rules of Conduct Committee (Chair); DRS Junior Springer Travel Scholarship Committee (Chair); DRS Bylaws committee; DRS Ad Hoc Public Relations and Communications Committee | Amanda Domer: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society; Society Board Member: Dysphagia Research Society; Society Committee Member: DRS Student Committee | Stephanie Watts: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Joy Gaziano: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Lauren Tabor: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

POSTER PRESENTATION AWARD WINNER: THIRD PLACE

SWALLOWING OUTCOMES FOLLOWING UNILATERAL STN VS. GPI SURGERY: A RETROSPECTIVE ANALYSIS

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Purpose: The adverse effects of deep brain stimulation (DBS) surgery on swallowing could potentially exacerbate the natural deterioration of airway protection associated with Parkinson's disease (PD). There are no studies comparing swallowing outcomes associated with subthalamic nucleus (STN) versus globus pallidus interna (GPI) DBS surgery. We completed a retrospective study comparing swallowing outcomes in a cohort of patients with PD who underwent unilateral DBS surgery.

Method(s): A chart review was completed to identify all participants with diagnoses of PD who received videofluoroscopic swallowing evaluations pre and post-unilateral DBS in the STN or GPi at the University of Florida Center for Movement Disorders and Neurorestoration.

Result(s): The retrospective search yielded 33 patients (STN = 14, GPi = 19) with idiopathic PD who met inclusion criteria. Mean penetration/aspiration (PA) scores did not change significantly for participants who received GPi surgery ($p = .857$), but mean PA scores significantly worsened for participants who received STN DBS ($p = .007$). There was a significant improvement in UPDRS scores off medication pre-surgery, to off medication and on stimulation post-surgery for both groups ($p < .001$).

Conclusions (including clinical relevance): Despite the limitations of a retrospective analysis, this preliminary pre/post-DBS study suggests that STN DBS may have an adverse effect on swallowing function, while GPi DBS does not appear to have a similar deleterious effect. This study and other future studies should help to elucidate the mechanisms underpinning the effects of DBS on swallowing function.

Disclosures: Michelle Troche: *Financial Disclosure:* Salary: University of Florida; Grant: NIH (NCATS) CTSA awards to the University of Florida UL1TR000064 and KL2TR000065; *Nonfinancial Disclosure:* Society Member: ASHA, International Society for

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RESPIRATORY-SWALLOW COORDINATION IN INDIVIDUALS WITH AMYOTROPHIC LATERAL SCLEROSIS

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Purpose: Aims: In patients with ALS: (1) Delineate pre- and post-apnea respiratory events (RE); (2) Determine if RE and apnea duration differ in penetrator/aspirators versus non-penetrator/aspirators; and (3) Examine associations between RE, swallowing apnea duration and Penetration-Aspiration Scale (PAS) scores.

Method(s): Methods: Twenty patients (61 % males, mean age 63.5 ± 7.1) diagnosed with ALS (el Escorial criteria) participated in this study. Simultaneous videofluoroscopy and nasal respiratory flow were recorded and coupled with a swallow signals lab while patients swallowed trials of: 1, 3, 20, and 90 cc thin barium. A blinded rater judged airway safety using the PAS, apnea duration (ms) and defined RE expiration/inspiration pre and post swallow apnea. ALS patients were divided into two groups: Non-PA (PAS < 2) or PA (PAS > 3). Descriptives, a t-test and Spearman's-Rho correlation analyses were performed on the 3 cc swallow trials.

Result(s): Results: Expiration was identified as the predominant RE pre and post-swallow apnea for 3 cc swallow trials. Although no significant differences were noted in RE for PA versus non-PA ALS patients ($p > 0.05$), a higher percentage of PAs inspired pre-swallow apnea compared to non-PAs (44.4 vs. 28.6 %). Apnea duration was significantly longer in the PA group of ALS patients (264 vs. 143 ms), [$t(21) = -2.40, p = 0.026$] and a significant positive correlation was revealed between apnea duration and PAS score ($r = 0.51, p = 0.014$).

Conclusions (including clinical relevance): In this cohort of ALS patients, longer apnea durations were associated with poorer airway protection during swallowing.

Disclosures: Stephanie Watts: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Lauren Tabor: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Amanda Domer: *Financial Disclosure*: No relevant financial relationships exist. *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society; Society Board Member: Dysphagia Research Society; Society Committee Member | Joy Gaziano: *Financial Disclosure*: No relevant financial relationships exist. *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society | Emily Plowman: *Financial Disclosure*: Grant: National Institute of Child Health Development (NICHD) 1R21

HDO75327-01; *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society, ASHA, SFN; Society Board Member: Dysphagia Research Society; Society Committee Member: DRS Rules of Conduct Committee (Chair); DRS Junior Springer Travel Scholarship Committee (Chair); DRS Bylaws committee; DRS Ad Hoc Public Relations and Communications Committee.

PREDICTION OF ASPIRATION BY PERCEPTUAL EVALUATION OF PRE-SWALLOW WET VOICE AND WET EXPIRATORY SOUND

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Purpose: The aim of this study was to investigate the relationships between perceptual evaluation of pre-swallow wet voice and expiratory sound and videofluoroscopic swallowing study (VFSS) findings. **Method(s):** Fifty-one head and neck cancer patients served as subjects. Pre-swallow phonation of the vowel “a” and expiratory sounds were recorded immediately before VFSS. During VFSS subjects were requested to swallow a 3 ml bolus of jelly. A total of 61 samples of “a” and a total of 61 samples of expiratory sound were obtained. These sound samples were randomized and presented to 12 examiners, 10 dentists and 2 speech therapists with varying years of experience in dysphagia management. The examiners performed a perceptual evaluation of the wetness of phonation of “a” and expiratory sounds using a five point “wetness” scale (0: no findings to 4: very severe). VFSS findings were evaluated using the penetration-aspiration (PA) scale. The relationships between sound samples and VFSS findings were analyzed (Fig. 1).

Result(s): Differences of experience among clinicians did not affect the wetness scores. Subjects with high PA scale scores, especially score 8 (silent aspiration), showed higher wetness scores in phonation of “a” and expiratory sounds.

Conclusions (including clinical relevance): The results suggest that pre-swallow wet voice and expiratory sound can be a predictor of aspiration.

Disclosures: Michiyo Yamakawa: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Kaoru Yokoyama: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Koji Takahashi: *Financial Disclosure*: No relevant financial relationships exist. *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society | Michael Groher: *Financial Disclosure*: No relevant nonfinancial relationships exist. *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society.

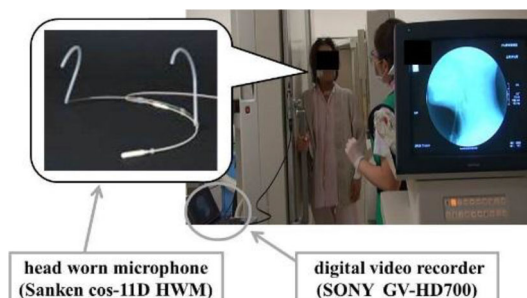


Fig. 1 Recording system of phonation and expiration

THE RISK OF DYSPHAGIA AFTER PROLONGED OROTRACHEAL INTUBATION: PRESENTATION OF CLINICAL PREDICTORS

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Purpose: Purpose: to elucidated independent factors that predict the risk of dysphagia after prolonged orotracheal intubation.

Method(s): Methods: Participants were 148 consecutive patients who underwent a clinical bedside swallowing assessment. All patients presented a history of prolonged orotracheal intubation and were admitted in one of the several Intensive Care Units (ICUs) of a large Brazilian school hospital. The statistical analysis included the correlation of the results obtained on a water swallow test and the risk level for dysphagia.

Result(s): Results: The results of the univariate analysis indicated that the variables extra oral loss, multiple swallows, cervical auscultation, vocal quality, cough, choking and other signs were possible significant indicators of high risk for dysphagia. The results of the multivariate analysis indicated that cervical auscultation and cough were independent predictor variables of high risk of dysphagia.

Conclusions (including clinical relevance): Conclusion: Patients showing the above characteristics should be benefit from early swallowing evaluation. Early recognition of post-extubation dysfunction is paramount in reducing the rate of morbidity in this high risk population.

Disclosures: Danielle Moraes: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Gisele Medeiros: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Fernanda Sassi: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Laura Mangilli: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Claudia Andrade: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

DOES MEASUREMENT OF FLUID INTAKE PROVIDE AN ACCURATE INDICATION OF HYDRATION FOR STROKE REHABILITATION INPATIENTS?

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Purpose: Individuals with dysphagia post-stroke are considered at risk of inadequate oral fluid intake. Recent evidence demonstrates they are also at higher risk of dehydration than their non-dysphagic peers in acute settings. This study examined the oral fluid intake and hydration of individuals without dysphagia post-stroke to determine whether they too are at risk of dehydration and whether measurement of fluid intake is a strong predictor of dehydration.

Method(s): This prospective study was conducted in three rehabilitation centres to measure the oral beverage intake and hydration of 86 inpatients without dysphagia post stroke. Average beverage intake was calculated from 7 days of fluid balance charts, with biochemical

measures of blood urea nitrogen/creatinine ratio (BUN/Cr) taken at the beginning and end of this period.

Result(s): The participants drank on average 1,504 ml per day (SD 359 ml). The mean BUN/Cr ratio at entry to the study was 19.79 (SD = 5.33) and remained stable at day 7 (19.97, SD = 5.55). At these two time points 40 and 44 % of the participants in the sample were dehydrated based on BUN/Cr ratio > 20:1. Fluid intake was not correlated with measures of hydration at entry to the study ($r = -0.122$, $p = 0.265$) or day 7 ($r = -0.1$, $p = 0.379$).

Conclusions (including clinical relevance): Measurement of oral fluid intake alone is not adequate in detecting individuals who are dehydrated following stroke. Individuals without dysphagia are also at risk of dehydration in rehabilitation settings therefore all patients hospitalized due to stroke should have their hydration monitored routinely through objective measures.

Disclosures: Joanne Murray: *Financial Disclosure:* Salary: Hampstead Rehabilitation Centre, South Australia; Grant: National Stroke Foundation Clinical Research Development Award Grant of \$30,000 (Australia); *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Sebastian Doeltgen: *Financial Disclosure:* Salary: Flinders University, South Australia; Intellectual Property Rights: Flinders University; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Michelle Miller: *Financial Disclosure:* Salary: Flinders University, South Australia; Intellectual Property Rights: Flinders University; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Ingrid Scholten: *Financial Disclosure:* Salary: Flinders University, South Australia; Intellectual Property Rights: Flinders University, South Australia; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society.

EXAMINATION OF SWALLOWING SOUND BY THE SIMULTANEOUS RECORDING OF VIDEOFLUOROSCOPY AND HIGH-RESOLUTION MANOMETRY

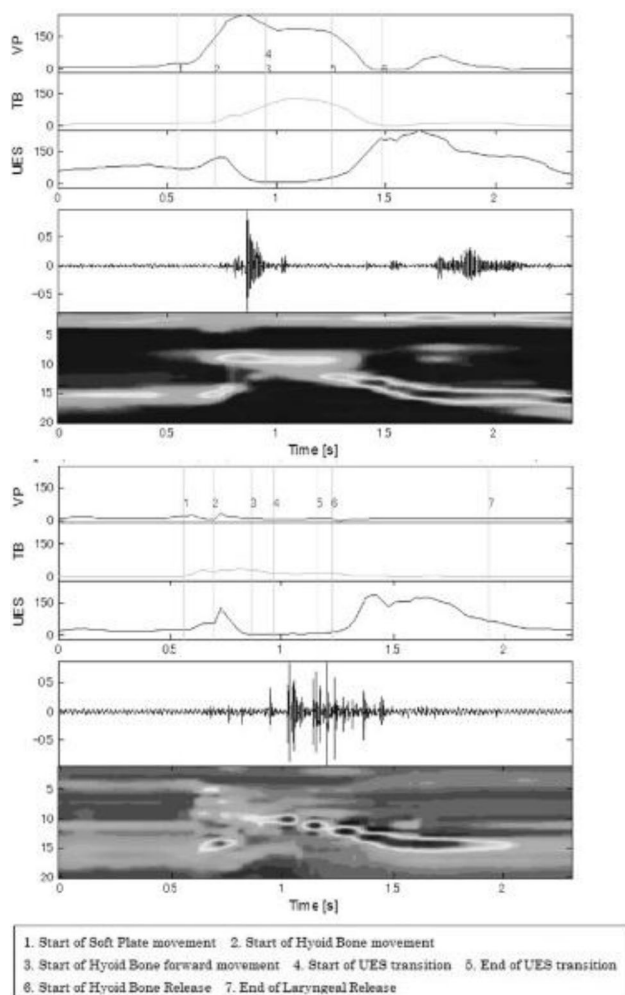
Teramoto, Yohei¹, Ueno, Tomoyuki¹, Jayatilake, Dushyantha¹, Suzuki, Kenji¹, Nakai, Kei¹, Hidaka, Kikue¹, Ayuzawa, Satoshi², Eguchi, Kiyoshi¹, Matsumura, Akira¹

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Purpose: Videofluoroscopic swallow study (VFSS) is usual in the diagnosis of dysphagia, but this method has restrictions such as exposure to radiation. And high-resolution manometry (HRM) is useful, but it is painful. Swallowing sound, on the other hand is easy to record, and can be performed anywhere. We aim to explore a way to understand the swallowing dynamics by the sound.

Method(s): We obtained 33 number of 3 ml water swallows from 11 subjects with dysphagia (5 males, mean age = 62.5), while simultaneously recording HRM, swallowing sound and VF. We used makers for the synchronization of audio, VFSS, and HRM. While carefully checking the VF images for the sensor numbers corresponding to the three regions of interest: velopharynx (VP), tongue base (TB) and UES, we calculated the pressure values from HRM.

Result(s): Subjects who produced a clear sound when bolus is moving to pharyngeal cavity while VP and hyoid bone are moving, appeared to have a higher VP pressure (21 swallows, maximum mean = 168 mmHg) than others (12 swallows, 36 mmHg) (p -value < 0.001). Further, subjects who produced a continuous sound during UES transition of the bolus, appeared to have a lower VP pressure (21 swallows, mean = 54 mmHg vs. 12 swallows, 104 mmHg, p -value < 0.05), together with a smaller UES opening diameter (mean = 6.29 vs. 8.49 mm, p -value < 0.05).



Conclusions (including clinical relevance): The swallowing sound reflected the differences observed in swallowing pressure of VP region. A lengthier evaluation is required to confirm this. Swallowing sound is unique to the individual, and our findings could help the development of a sound-based screening test at the bedside.

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Nakai: *Financial Disclosure:* Salary: University of Tsukuba Hospital; Grant: Ministry of Health, Labour and Welfare, Japan; Intellectual Property Rights: University of Tsukuba; Investigative device or drug to be discussed in presentation: High-resolution Manometry; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Kikue Hidaka: *Financial Disclosure:* Salary: University of Tsukuba Hospital; Grant: Ministry of Health, Labour and Welfare, Japan; Intellectual Property Rights: University of Tsukuba; Investigative device or drug to be discussed in presentation: High-resolution Manometry; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Satoshi Ayuzawa: *Financial Disclosure:* Salary: Tsukuba University of Technology; Grant: Ministry of Health, Labour and Welfare, Japan; Intellectual Property Rights: University of Tsukuba; Investigative Device or Drug to be discussed in presentation: High-resolution Manometry; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Kiyoshi Eguchi: *Financial Disclosure:* Salary: University of Tsukuba Hospital; Grant: Ministry of Health, Labour and Welfare, Japan; Intellectual Property Rights: University of Tsukuba; Investigative Device or Drug to be discussed in presentation: High-resolution Manometry; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist. | Akira Matsumura: *Financial Disclosure:* Salary: University of Tsukuba Hospital; Grant: Ministry of Health, Labour and Welfare, Japan; Intellectual Property Rights: University of Tsukuba; Investigative device or drug to be discussed in presentation: High-resolution Manometry; *Nonfinancial Disclosure:* No relevant nonfinancial relationships exist.

A COMPARATIVE STUDY BETWEEN MODIFIED STARCH AND XANTHAN GUM THICKENERS IN POST-STROKE OROPHARYNGEAL DYSPHAGIA

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Purpose: To compare the therapeutic effects of modified starch (MS) and xanthan gum (XG) thickeners in post-stroke oropharyngeal dysphagia (PSOD).

Method(s): Videofluoroscopic (VFS) study with 3 volumes (5, 10, 20 ml) and 3 viscosities (liquid, nectar, spoon thick) comparing MS and XG thickeners. VFS signs of efficacy and safety of swallow and swallow physiology were assessed in each patient.

Result(s): We studied 161 PSOD patients (75.1 ± 10.7 years, 59.4 % men), 84 with MS and 76 with XG thickeners. (a) MS: 24.5 % patients had safe swallow at liquid, 61.9 % at nectar, and 89.5 % at spoon-thick viscosity. Residue prevalence was 40, 49.2 and 58.9 %, respectively. (b) XG: 29.1 % patients had safe swallow at liquid, 71.3 % at nectar ($p < 0.05$ vs MS) and 89.9 % at spoon-thick viscosity. Residue prevalence was 17.6, 19.3 and 24.1 % ($p < 0.05$ vs XG for all three consistencies). Increasing bolus viscosity did not affect timing of swallow response but reduced bolus velocity at spoon-thick viscosity by 14.3 % in MS and 10.0 % in XG (vs liquid).

Conclusions (including clinical relevance): Increasing bolus viscosity with either MS or XG thickeners improved safety of swallow. Significant therapeutic effect was detected at nectar viscosity with XG. Moreover, MS thickeners significantly enhanced oropharyngeal residue.

Disclosures: Natalia Vilardell: *Financial Disclosure:* Salary: Fundació Consorci Sanitari del Maresme; Grant: Fundació La Marató de TV3; *Nonfinancial Disclosure:* Society Member: European Society for Swallowing Disorders (ESSD) | Laia Rofes: *Financial Disclosure:*

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PREVALENCE, RISK FACTORS AND MID-TERM CLINICAL OUTCOMES OF POST-STROKE OROPHARYNGEAL DYSPHAGIA

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Purpose: To assess the prevalence, risk factors and mid-term clinical outcomes of oropharyngeal dysphagia (OD) in post-stroke patients (PSP).

Method(s): A prospective study on PSP was performed over 16 months at a general hospital. Demographic, neurological and clinical data were collected and OD was assessed on admission, before discharge and at 3 months with EAT-10, V-VST and videofluoroscopy.

Result(s): A total of 229 PSP were studied (73.7 ± 12.4 years, 52.4 % men): (a) Before admission, Barthel Index (BI) was 90.3 ± 18.6, only 3.0 % presented swallowing difficulties (EAT-10 ≥ 3), and 1.5 %, BMI < 18.5. During hospital stay, 19.2 % patients presented a severe stroke; 6.6 %, respiratory infections (RI) and mortality was 3.9 %. BI fell to 75.6 ± 30.9 ($p < 0.05$ vs before admission BI). OD prevalence was 54.6 % (impaired safety, 39.6 %). OD was associated with age >70 OR 2.5 (1.2–5.1), stroke severity OR 4.1 (1.2–10.0), total anterior circulation infarction OR 3.4 (1.2–11.2), right lateralization OR 2.6 (1.4–5.1), RI OR 17.9(2.3–141.8), prolonged hospitalization ($p < 0.05$), higher mortality OR 9.04 (1.1–76.8) and institutionalization after discharge (30.6 %) OR 3.4 (1.8–6.8). At 3-months follow up, BI recovered to 91.0 ± 16.0; OD prevalence remained high, 43.3 % (23.1 % PSP impaired safety) and 18.2 % presented complications including RI 3.9 % and BMI <18.5, 4.4 %.

Conclusions (including clinical relevance): Prevalence of post-stroke OD is very high during hospital stay and at 3-month follow up and is associated with clinical and neurotopographical factors, high prevalence of complications, poor clinical outcomes and institutionalization.

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THE STANDARDIZED METHOD FOR HAND-CARRIED ULTRASONOGRAPHY (HCUS) IMAGING OF TONGUE ON SWALLOWING

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Purpose: B-mode ultrasound imaging has been used primarily to detect temporal and spatial movements of the tongue preparatory and oral stage of swallowing. The purpose was to develop a standardized method for ultrasound imaging of the tongue shapes and movements during water swallowing by the hand-carried ultrasonography (HCUS) devices.

Method(s): The HCUS was performed in 10 healthy adult men (range 22–33 years). The sector probe was positioned at the median sagittal plane, and it was inclining for mandibular inferior. Each subject was instructed to swallow 5 mL of water. The most suitable depth and scanning angle of probe for clear and wide visualization of tongue shapes and movements in the sagittal plane were sought. We studied the quantitative features of grooving depth and grooving width during water swallowing.

Result(s): HCUS imaging of tongue shapes and movements was standardized when the probe location was 10° from sagittal plane, and the depth was 6 cm. The depth and width of grooving of the tongue during water swallowing agreed with past findings.

Conclusions (including clinical relevance): It was possible to objectively and non-invasively measure the tongue movement by the ultrasonography with hand-carried devices. A larger patient trial using HCUS will help establish the future clinical utility of this novel diagnostic tool.

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l Kazuharu Nakagawa: *Financial Disclosure*: Salary: Fujita Health University; Grant: Grant-in-Aid for Young Scientists (B); *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist. l Shouji Hironaka: *Financial Disclosure*: Salary: Showa University; *Nonfinancial Disclosure*: No relevant nonfinancial relationships exist.

A PRELIMINARY STUDY OF HOW THE VISCOSITY OF DIETARY FLUIDS AND VIDEOFLUOROSCOPY FLUIDS CAN BE MATCHED

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Purpose: Some studies pointed out the fact that there was poor correlation between the viscosity of dietary fluids and their videofluoroscopy counterparts. The present study aims to examine the method by which the viscosity of mealtime and videofluoroscopy fluid can be matched through adjustment of the amount of thickener added to them (Fig. 1).

Method(s): Two types of samples were prepared. One consisted of 87.0 ml water and 58.7 g barium sulfate (total volume of 100 ml), with 0.5–8.0 g of xanthan-gum based thickener. The other consisted of 100.0 ml water and 1.0–12.0 g thickener. Viscosity measurements were made with a cone-plate viscometer and a water bath. Samples were tested at $25 \pm 0.1^\circ\text{C}$ and a shear rate of 50 s^{-1} , according to National Dysphagia Diet guidelines.

Result(s): The sample with barium sulfate was more viscous than the sample without it at any concentration of thickener agent. The exponential regression equations showed a good fit for each sample ($R^2 > 0.99$). The fitted equation is $y = 100.05x^{1.4248}$ ($R^2 = 0.9978$) for the sample with barium, and $y = 71.819x^{1.3761}$ ($R^2 = 0.9973$) for the sample without barium (x : amount of thickener [g/100 ml], y : apparent viscosity [mPa s]).

Conclusions (including clinical relevance): Our results showed that the amount of thickener should be reduced by 20–30 % when barium sulfate is mixed in the sample. Further studies are needed as to the combination of the barium sulfate and thickener agent and the temperature adapted to obtain a closer rheological match between dietary fluids and the fluids given to patients during videofluoroscopy.

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NO EVIDENCE FOR TONGUE FATIGUE INDUCED BY CONSUMPTION OF A CHALLENGING MEAL IN HEALTHY YOUNG AND OLD ADULTS

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Purpose: The effect of eating on tongue strength is understudied, and its potential for inducing fatigue remains unanswered (Kays, 2010). This study aimed to quantify the effects of consuming a challenging meal on tongue strength in a large group of healthy adults.

Method(s): 160 adults participated in the study, evenly distributed among 4 age categories (20–60, 61–70, 71–80 and 80+ years old). They had no symptoms of swallowing difficulty or history of any medical condition potentially associated with dysphagia. All participants passed the 3 fl. oz. swallowing screening. Tongue strength measures were assessed using the IOPI at the anterior and posterior tongue. Two maximal isometric pressures (MIP) were obtained, at baseline and after the challenge. The standardized meal required 52 swallows, evenly distributed between water, yoghurt and puree, volumes of 5 and 10 ml, effortful and habitual swallowing, including 4 dry effortful swallows. Post-meal measures of tongue strength were performed immediately after completing the meal. Data were analyzed using paired sample T-tests.

Result(s): At the group level a significant increase in anterior MIP was found post-meal compared with pre-meal; no significant differences were present at the posterior location. Subsequent analyses revealed that the training effect was only present in females of 80+ years old, both anterior and posterior. All other subgroups did not show fatigue post-meal.

Conclusions (including clinical relevance): This large dataset with a well-balanced design demonstrates no induction of fatigue on MIP post-meal; an unexpected training effect was present in the subgroup of oldest (80+) females.

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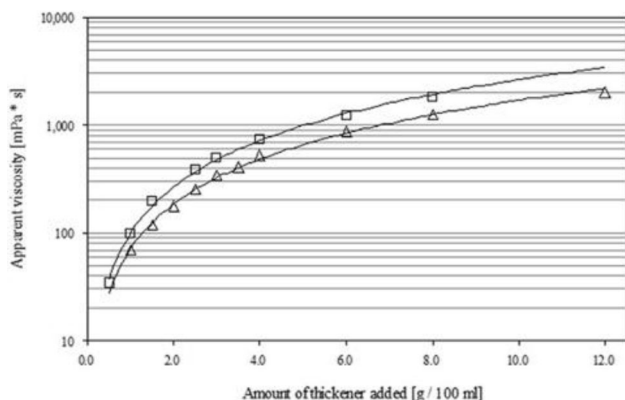


Fig. 1 Square sample with barium; triangular sample without barium

Member: BSSD | Cindy Guns: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Rik Elen: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Gilbert Chantratin: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Marc De Bodt: *Financial and Nonfinancial Disclosures*: No relevant relationships exist.

RELATIONSHIP BETWEEN SWALLOWING FUNCTION AND MAXIMUM TONGUE PRESSURE IN ALS PATIENTS

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Purpose: To clarify the relationship between the characteristics of swallowing disorders in ALS and the significance of measuring tongue pressure as a simple and less-invasive assessment for ALS progress.

Method(s): 10 ALS patients were evaluated by ALSFRS-R and videofluoroscopy. Maximum tongue pressure and tongue thickness by tongue sonography were also measured.

Result(s): As bulbar syndrome scores in ALSFRS-R decreased, tongue pressures became lower. In addition, the patients who have much oral and pharyngeal residues indicated significantly lower pressure than who have less oral and pharyngeal residues ($p < 0.05$).

Conclusions (including clinical relevance): It was suggested that decreased tongue pressure indicated increased risk of aspiration. Tongue pressure measurement could be a useful and regular assessment for swallowing disorders in ALS.

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ORAL FEEDING DIFFICULTIES AND GROWTH FAILURE IN INFANTS AND YOUNG CHILDREN WITH CONGENITAL HEART DISEASE

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Purpose: Oral feeding difficulties, poor weight gain and growth restriction are commonly reported in children with congenital heart disease CHD, however limited data exists on clinically assessed oral feeding skills and aspiration-risk. The aim of this study was to systematically assess oral feeding skills, growth and nutritional status of young children admitted to the Queensland Paediatric Cardiac Service for cardiac surgery.

Method(s): Prospective, observational study of all children, aged 0-36 months, admitted to a tertiary hospital for cardiac surgery over a 12 month period. Data on feeding and swallowing difficulties were obtained through parent questionnaire, clinical feeding evaluation and nutritional assessment/anthropometry (height, cm; weight, kg).

Result(s): Eighty-five children were included (58 % male), median age 4 months with a median hospital length of stay (LOS) of 11 days (range 4-50 days). On admission, 13 children (15 %) were nil by mouth, and 21 (25 %) had a nasogastric tube in situ. Forty-five (53 %) had oral feeding difficulties pre/during admission and 26(31 %) on discharge. Presence of a feeding difficulties was significantly associated with increased LOS ($p = 0.017$) and growth restriction ($p = 0.017$). Types of feeding difficulties included: oral phase ($n = 23, 32 %$); pharyngeal phase ($n = 14, 19 %$) and suck-swallow-breath incoordination ($n = 21, 29 %$).

Conclusions (including clinical relevance): Oral feeding difficulties were common with associated increased LOS and growth restriction. Close surveillance of oral feeding skills and nutrition in all young children with CHD is suggested.

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PSYCHOMETRIC CHARACTERISTICS OF QUESTIONNAIRES ON FUNCTIONAL HEALTH STATUS IN OROPHARYNGEAL DYSPHAGIA: A SYSTEMATIC LITERATURE REVIEW

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Purpose: The use of symptom questionnaires to describe a patient's functional health status (FHS) is common practice in the assessment of oropharyngeal dysphagia in adults. This systematic review aims to provide an overview of FHS questionnaires and their corresponding psychometric characteristics.

Method(s): A systematic search of literature was performed using two electronic databases: Pubmed and Embase. All research papers published before June 2013 were included. Key words (mesh and thesaurus terms) were supplemented by using free text words. All publications related to the development and validation of FHS questionnaires were retrieved. Terwee's quality criteria for health status questionnaires were used to evaluate the psychometric characteristics of the FHS questionnaires.

Result(s): Four questionnaires met the inclusion criteria: the Eating Assessment Tool (EAT-10), the Swallowing Outcome After Laryngectomy (SOAL), the Self-report Symptom Inventory and the Sydney Swallow Questionnaire (SSQ). The psychometric properties of all four FHS questionnaires were evaluated. All four FHS questionnaires received poor or moderate psychometric ratings due to inadequate reporting of psychometric properties.

Conclusions (including clinical relevance): Further research is needed to determine the psychometric characteristics of FHS questionnaires in adults with oropharyngeal dysphagia. Moreover, a more comprehensive approach is required when developing and validating FHS questionnaires.

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COMPARING PHYSIOLOGICAL SWALLOW MEASURES CAPTURED ON VIDEOFLUOROSCOPY AT DIFFERENT FRAME RATES: A PRELIMINARY ANALYSIS

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Purpose: Videofluoroscopic assessment of swallow (VFS) physiology is considered a gold standard. Research standards require a capture rate of 30 frames per second (fps). However, in clinical practice 15 fps is increasingly used. This study reports our preliminary findings comparing VFS readings at these capture rates.

Method(s): Patients from a larger RCT study comparing two treatment strategies for locally advanced squamous cell carcinoma in the head and neck were consecutively assessed with VFS at baseline, 4-months and 12-months post treatment. VFS assessments were simultaneously captured for each patient at 15 and 30 fps. Two blinded trained raters using the MBSImp protocol analyzed each VFS. Ratings were compared using Spearman's rank correlation coefficient statistic. Poor correlation was $\rho < .60$ and good correlation was $\rho > .70$.

Result(s): A random selection of 22 VFSs captured at both 15 and 30 fps were selected for preliminary analysis: 12 at baseline, 10 at 4-months. Across all textures, correlations were good for 2 (22 %) sagittal ratings (i.e. epiglottic movement and laryngeal vestibular closure) and both A-P ratings. Regardless of texture, correlations were poor for the remaining 7 (88 %) sagittal readings including laryngeal elevation, PES opening and the penetration aspiration scale.

Conclusions (including clinical relevance): Overall, these preliminary findings suggest that VFSs captured at 15 fps correlate poorly with 30 fps in the sagittal plane for measures critical to assess airway safety and bolus flow. These preliminary findings will be a first step toward informing VFS clinical practice.

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SWALLOWING AND SPEECH IN ELDERLY WITH CHRONIC STROKE

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Purpose: The purpose was to study the functions of swallowing and voice as well as the relationship between them to individuals affected by stroke.

Method(s): We analyzed the medical charts of 30 patients averaging 72 years of age. Were performed: perceptual evaluation of voice through GRBASI scale; videoendoscopy of swallowing; videoendoscopy of phonation.

Result(s): In GRBASI scale, most individuals showed grade and roughness moderate for spontaneous conversation and the grade and instability moderate for the vowel / a / sustained. With respect to

morphology, was observed laryngeal asymmetry (73 %), bilateral bowing of the membranous portion of the vocal fold (77 %) and bilateral protrusion of the vocal process (77 %). Regarding to the functional aspects, it was observed slit (57 %), supraglottic antero-posterior constriction (57 %) and median constriction (80 %). Most individuals (83 %) had rating 6 in DOSS scale, level 1 for liquid (57 %) and level 0 to paste (57 %) and solid (63 %) in The Secretion Severity Rating scale. It was observed that there was a correlation between stasis in the vallecula to solid and the vocal characteristics of breathiness ($p = 0.01$), and asthenia ($p = 0.02$), the relationship between the severity of the signs of swallowing disorders with laryngeal configuration.

Conclusions (including clinical relevance): It was concluded that the characteristics of voice and swallowing presented by this study were similar to those often found in the elderly and that there were relations between the functions of swallowing and voice.

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COMPREHENSIVE ANALYSIS OF PHARYNGEAL PRESSURE TRACE FROM HIGH-RESOLUTION MANOMETRY

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Purpose: Together with Videofluoroscopic swallow study (VFSS), high-resolution manometry (HRM) and swallowing sound can produce valuable information to assess the swallowing function. However, it is not easy to identify the activities of three areas of interests: velopharynx (VP), tongue base (TB) and UES from the pressure values because the sensor location of HRM changes during the swallowing due to external pressure in the pharynx and UES. This study focuses on the manometric information on the pharyngeal swallow and also the development of a framework to combine these different measuring systems accurately (Fig. 1).

Method(s): The 33 swallowing data from 11 patients with dysphagia were studied to clarify the relationship between the pressure traces and sensor locations in areas of interest during the pharyngeal swallow, which is observed from VF image sequence. An audio event was triggered inside the VF environment for the synchronization of sound and VF.

Result(s): We obtained the sensor numbers corresponding to VP, TB and UES from the VF images and adjusted the manometer sensor pressure trace in the HRM spatiotemporal plots to align estimated pressure profiles with the VF evidence.

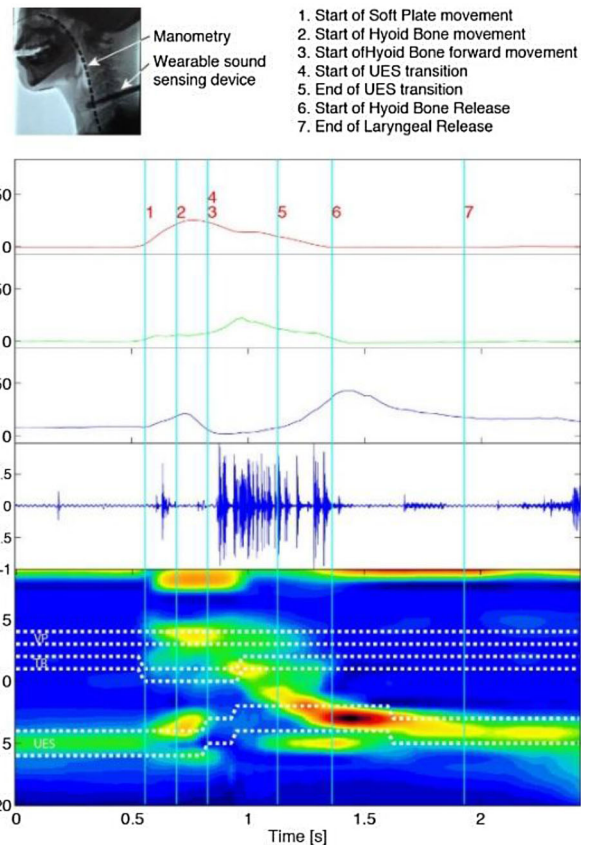


Fig. 1 HRM spatiotemporal plots and estimated pressure profiles

Conclusions (including clinical relevance): We developed a MATLAB-based application to synchronize and visualize the pressure trace in areas of interest (VP, TB, and UES). Timing data were correlated for different data source such as swallowing sound and VF, and confirmed the proposed approach with the user studies.

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VIDEOFLUOROSCOPIC CHARACTERIZATION OF DYSPHAGIA IN MOUSE MODELS OF ALS AND PRESBYPHAGIA

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Purpose: The aim of this study was to establish a videofluoroscopic swallow study (VFSS) for mice that permits identification of robust translational biomarkers of dysphagia in mouse models of amyotrophic lateral sclerosis (ALS) and presbyphagia.

Method(s): A VFSS protocol was established using 59 male & female mice from two colonies (C57 model of presbyphagia & SOD1-G93A model of ALS), divided into two age groups: 3–8 months (20 C57, 9 end-stage SOD1 transgenic, & 10 SOD1 nontransgenic) & >17 months (20 C57). A site-built observation tube maintained freely-behaving mice in the lateral plane within the fluoroscopic field of view while drinking flavor-enhanced iohexol. Videos (30 fps) were analyzed to quantify five swallow parameters: swallow rate, lick rate, number of licks per swallow, pharyngeal transit time, & inter-swallow interval.

Result(s): Inter-swallow interval (time between two successive, uninterrupted swallows) was significantly longer for elderly C57 mice ($p < .05$), compared to young C57 mice, end-stage SOD1 mice, & age-matched nontransgenic controls (see Fig. 1). The other 4 swallow parameters were unable to be quantified due to suboptimal spatial resolution.

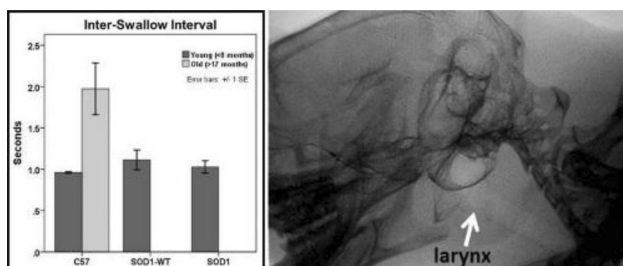


Fig. 1 Inter-swallow interval

Conclusions (including clinical relevance): This study provides novel videofluoroscopic evidence that elderly C57 mice swallow slower than young mice, further validating this strain as a model of presbyphagia. Additionally, we have obtained a new small animal fluoroscope which will provide optimal spatial resolution (see image) to revolutionize our search for robust biomarkers of dysphagia in various mouse models, including the parameters we were unable to quantify.

Disclosures: Ryan Brooks: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Loren Littrell: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Rebecca Harris: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Mollie Ulsas: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Danarae Aleman: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Sabrina Braun: *Financial and Nonfinancial Disclosures*: No relevant relationships exist. | Teresa Lever: *Financial Disclosure*: Salary: University of Missouri; Grant: NIH/NIDCD RO3:DC010895; *Nonfinancial Disclosure*: Society Member: Dysphagia Research Society

HEAD & NECK CANCER ALLIANCE AWARD

EFFECT OF PROPHYLACTIC PEG TUBE PLACEMENT ON SWALLOW PHYSIOLOGY IN PATIENTS UNDERGOING RADIOTHERAPY FOR HEAD AND NECK CANCER: A SYSTEMATIC REVIEW

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Purpose: Patients undergoing radiotherapy for head and neck cancer (HNC) often experience malnutrition and dehydration during treatment; as a result, many patients require tube feeding to maintain nutrition. Although, some centers place PEG tubes prophylactically (pPEG) to prevent malnutrition, recent research has suggested that pPEG use may negatively affect swallow physiology, especially in the long term. The purpose of this study was to systematically review the literature on pPEG use in HNC patients undergoing radiotherapy and to determine its impact on swallow status.

Method(s): Electronic databases were searched for all relevant primary research published through October 21, 2013 using the following databases: AMED, CINAHL, the Cochrane Library, Embase, Healthstar, Medline, and PsycINFO. Main search terms included head and neck cancer, radiotherapy, deglutition disorders, feeding tube(s), and prophylactic/elective.

Result(s): The search retrieved 161 unique citations, of which 16 met our inclusion criteria. Quality assessment was conducted using Cochrane's Risk of Bias tool and revealed that all studies were at risk for bias due to factors such as non-randomized sampling, unreported or inadequate blinding, and incomplete reporting of outcomes. Most studies demonstrated selection bias with significant differences between pPEG patients and controls with respect to tumor severity, tumor location, chemotherapy use, age, follow-up time, and/or baseline weight/BMI.

Conclusions (including clinical relevance): Well-controlled, randomized trials are needed to determine if pPEG use places patients at greater risk for developing long-term dysphagia.

Disclosures: Stephanie Shaw: *Financial Disclosure:* Scholarship: University of Toronto, Connaught Scholarship; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society, ASHA; Society Board Member Dysphagia Research Society, Ad Hoc Student Co-Councilor; Society Committee Member: Dysphagia Research Society Ad Hoc Student Committee | Rosemary Martino: *Financial Disclosure:* Salary: University of Toronto; Grant: Canadian Institutes of Health Research, Canadian Cancer Society Research Institute; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Andrew Hope: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Brian O'Sullivan: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

DEVELOPING A PROTOTYPE SYSTEM TO INVESTIGATE THE LARYNGEAL ADDUCTOR REFLEX IN MICE

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Purpose: The laryngeal adductor reflex (LAR) entails brief closure of the vocal folds to prevent foreign material from entering the airway. In neurologic diseases, the LAR becomes impaired and contributes to dysphagia. Studying the LAR in mouse models of neurologic diseases may lead to novel therapeutic approaches for dysphagia. The purpose of this study was to develop a nonsurgical approach for longitudinal investigation of the LAR in mice.

Method(s): Fifty-two healthy C57BL/6 mice (8–14 months of age) were used during the design and construction of a prototype LAR system consisting of an air pulse delivery device, respiratory strain gauge, multi-adjusting test platform, endoscope micromanipulator, speculum, and speculum micromanipulator. Air pulses of calibrated, adjustable pressures and durations were delivered via luer lock tubing through the working channel of a 1.9 mm diameter endoscope (Storz). Micromanipulators permitted precise control of the anatomical location for delivery of each air pulse at the laryngeal entrance. Air pulses were synchronized with rate and phase of the respiratory cycle.

Result(s): We have successfully used our prototype system to evoke and record LAR responses in healthy C57BL/6 mice under light anesthesia (see Fig. 1). Unilateral or bilateral responses were consistently observed, depending on where each air pulse was aimed along the laryngeal entrance.

Conclusions (including clinical relevance): This study provides novel evidence that mice have an LAR similar to humans. We are currently using our prototype system to establish translational biomarkers of LAR pathology in mouse models of human neurological diseases.



Fig. 1 Successful use of our prototype system to evoke and record LAR responses in healthy C57BL/6 mice under light anesthesia

Disclosures: Leslie Farmer-Shock: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Brandon Gallemore: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Elizabeth Bearce: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Sydney Parriott: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Teresa Lever: *Financial Disclosure:* Salary: University of Missouri; Grant: NIH/NIDCD RO3:DC010895; *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society.

DYSPHAGIA RISK IN COPD PATIENTS WITH PSYCHOLOGICAL COMORBIDITIES

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Purpose: Chronic obstructive pulmonary disease (COPD) is an aversive respiratory disease associated with significantly impaired health related quality of life (HRQoL). COPD patients are at risk for dysphagia due to potentially excruciating apneic pause. DDS Health Standard 007-1 outlines medications that pose a risk for dysphagia. The purpose of this study is to identify patients at risk for dysphagia related to their treatment plan.

Method(s): A retrospective chart review was conducted on all patients with PFT-confirmed diagnosed COPD (ICD 496). Patient demographics, FEV-1 scores, comorbidities, psychological illness (depression, anxiety, PTSD, schizophrenia, alcohol abuse), medication treatment, medical history were recorded.

Result(s): Of 172 patients evaluated, those with psychological comorbidities (67 %) were significantly more likely ($p < .05$) to be treated with medications with dysphagia risk. Of these medications, those causing xerostomia, CNS depressants, and antipsychotic medications were most prevalent, followed by anti-cholinergic or anti-muscarinic medications. However, only one patient was identified as being at risk for dysphagia, and none were further assessed for difficulties in swallow.

Conclusions (including clinical relevance): This research identifies a significant gap in the treatment of COPD patients with psychological comorbidities and at risk for disease and medication-associated dysphagia. Further quantification of this risk will direct an appropriate future treatment plan. The authors discuss clinical considerations for use with this population and present a theoretical framework for enhanced standard-of-care practices.

Disclosures: Sarah Miller: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Erin Silverman: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

THE IMPACT OF BOLUS VISCOSITY ON HEALTHY SWALLOWING KINEMATICS AND TIMING

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Variable	Thin (20cP@ 50/s,40 %w/v)		Nectar (236 cP@ 50/s,40 %w/v)		<i>p</i> -value	Effect size (Cohen's <i>d</i>)
	Mean	95 % CI	Mean	95 % CI		
Maximal XY Hyoid Position (%C2–4)	154.4	148.1–160.6	159.5	153.2–165.7	0.004	0.34
Anterior Hyoid Displacement (%C2–4)	37.5	33.9–41.1	41.6	38.0–45.2	0.002	0.40
Hypotenuse Hyoid Displacement (%C2–4)	57.2	56.3–62.6	61.7	56.3–67.1	0.011	0.39
UES Opening Duration (ms)	380.4	345.8–415.0	399.8	365.2–434.4	0.041	0.22

Purpose: Thickened liquids are used to improve swallowing safety, yet little is known about variations in swallowing physiology in response to higher viscosity stimuli. Our goal was to identify physiological differences in swallowing between thin and nectar-thick healthy swallows.

Method(s): 20 healthy adults (10 women; mean age 31), each swallowed three 5 ml thin and three 5 ml nectar-thick liquid boluses under videofluoroscopy. Mixed model repeated measures ANOVAs (within-subject factor of viscosity, between-subject factor of sex) were run for measures of hyoid excursion (maximal XY position; anterior, superior and hypotenuse displacements), and timing measures (UES opening, laryngeal closure (LC), hyoid movement, pharyngeal transit time, stage transition duration and LC-to-UES-opening).

Result(s): A significant main effect of viscosity was observed for 3 of 4 hyoid measures with nectar-thick stimuli. UES opening duration was also significantly longer for nectar. A main effect of sex was observed for anterior hyoid excursion: women displayed greater excursion measured in cervical spine units (mean 43.1 %C2–4, 95 % CI 38.3–47.9) than men (mean 36.0 %C2–4, 95 % CI 31.2–40.8).

Conclusions (including clinical relevance): Bolus viscosity appears to influence hyoid excursion and UES opening in healthy swallowing. Given that hyoid movement duration was not influenced by viscosity while hyoid displacement measures were, future work should investigate differences in hyoid velocity by viscosity.

Descriptive statistics (means and 95 % confidence intervals for measures of hyoid displacement and UES opening for thin and nectar-thick barium

Disclosures: Sonja Molfenter: *Financial Disclosure:* Salary: New York University; Scholarship: NSERC Create Care Doctoral Scholarship; TRI OSOTF Scholarship; Ontario Graduate Scholarship; Other: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosures:* Society Member: Dysphagia Research Society | Chelsea Leigh: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; *Nonfinancial Disclosures:* No relevant nonfinancial relationships exist. | Catriona Steele: *Financial Disclosure:* Salary: Toronto Rehabilitation Institute - University Health Network; Grant: National Institutes of Deafness and Other Communication Disorders; Other: University of Toronto; Bloorview Research Institute; *Nonfinancial Disclosures:* Society Member: Dysphagia Research Society.

ASSOCIATION BETWEEN THE ELECTROGLOTTOGRAPHIC WAVEFORM AND THE TEMPORAL ASPECTS OF THE PHARYNGEAL SWALLOW

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Purpose: The purpose of this study was to identify and compare the capture duration of the swallow of different viscosities as represented by the electroglottographic (EGG) waveform and attempt to validate the application of the EGG as a possible biofeedback tool for use in behavioral dysphagia therapy.

Method(s): Each participant (30) performed a total of ten swallows: 5 swallows with 10 mL of water and 5 swallows with 10 mL of applesauce. Following visual inspection of the EGG waveform signal, the onset and offset of the swallow was identified. A segmentation of the EGG cycle was then viewed. Duration measures of the swallow were obtained between the onset and offset markings.

Result(s): A paired t-test performed on 30 participants between the mean durational values of thin liquid and puree swallows revealed a statistically significant difference beyond the .05 level: $t(29) = -2.608, p = 0.014$ (two-tailed). A one-way, within-subjects ANOVA was performed on swallow duration as a function of swallow trial. There was not a significant difference on swallow duration depending on swallow trial of thin liquid or puree consistencies, $F(3.606, 104.586) = 0.898, p = .460$ and $F(2.573, 74.624) = .702, p = .533$, respectively.

Conclusions (including clinical relevance): Preliminary data supports the use of EGG as a potential method to measure progress of a patient receiving behavioral dysphagia therapy.

Disclosures: Hope Baylow: *Financial Disclosure:* No relevant financial relationships exist. *Nonfinancial Disclosure:* Society Member: Dysphagia Research Society | Aaron Ziegler: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Christine Ciorciari: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Lisa Marie Ricigliano: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

THE IMPACT OF IMAGE TRANSFER ON IMAGE QUALITY IN VIDEOFLUOROSCOPIC SWALLOW STUDIES

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Purpose: High quality images are essential for accurate real-time decision making during videofluoroscopic swallow studies (VFSS). This study examines the change in fluoroscopic image quality during online transmission from image acquisition to the final viewing monitor.

Method(s): Evaluation of image quality from acquisition using a digital fluoroscopy system (Siemens Artis Zee MP) was compared to

a Digital Swallowing Workstation (DSW) (KayPentax) and a range and combination of telehealth units (Cisco Telepresence System C20 & C60) over different network speeds (2,4,6 Mbits/s). Images were evaluated using a variety of software tools, the NEMA XR 21 Cardiovascular Fluoroscopy Benchmarking Phantom and clinical imaging assessments.

Result(s): Compared to the acquired image, all transferred images demonstrated a loss of image quality.

Displayed images on the DSW and telehealth systems were modified from the source data through the image transfer processes (e.g. changes in image and display matrix sizes, video frame-rate). Phantom assessments demonstrated losses in the areas of spatial, temporal and low contrast resolution, however clinical evaluations were inconclusive.

Conclusions (including clinical relevance): Clinical and telehealth systems alter the image quality of the original fluoroscopic image. Findings highlight important considerations for fluoroscopy imaging solutions used by VFSS clinical services, researchers and telehealth services.

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HIGH-FLOW OXYGEN VIA NASAL CONTINUOUS POSITIVE AIRWAY PRESSURE (HFO2-NCPAP) HAS NO EFFECT ON ORAL FEEDING IN NEONATAL & ADULT/GERIATRIC POPULATIONS

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Purpose: HFO₂-NCPAP is increasingly common in intensive care units. Despite the critical interface between respiration & swallowing the impact of HFO₂-NCPAP on deglutition is unknown. It was hypothesized that HFO₂-NCPAP would not impede successful oral feeding in neonatal & adult/geriatric populations.

Method(s): Age, sex, O₂ flow rates/min, O₂ requirements, O₂ saturation levels (SpO₂), & feeding status (see Table 1) were recorded from 100 consecutive patients (50 neonatal & 50 adult/geriatric) requiring HFO₂-NCPAP. Feeding status was determined by

Table 1

	Neonates (n = 50)	Adults/Geriatics (n = 50)
Chronologic age (CA)	Mean 28.5 days (range 1–119 days)	Mean 70 years (range 27–96 years)
Completed gestational age	Mean 31 weeks 3 days (range 22 weeks 6 days - 40 weeks 2 days)	N/A
Sex	24 M; 26F	16 M; 34F
O ₂ flow rates: mean (range)	1.8 l/m(1–3 l/m)F	26.6 l/m (10–50 l/m)
O ₂ requirements: mean (range)	23.1 % (21–45 %)	65.9 % (30–100 %)
SpO ₂	94 % (range 86–100 %)	93 % (range 90–100 %)
Oral feeding tolerated	n = 18* CA: 37.9 days (range 1 - 199 days)	n = 39** (34 per MD & 5 per FEES)

institutional protocol: neonates & adults/geriatrics deemed safe to feed by their physicians or adults/geriatrics after passing FEES.

Result(s): As shown in the table: *All 18 neonates deemed appropriate by the neonatologist for oral alimentation tolerated oral feedings. **All 39 adults/geriatrics deemed appropriate by the intensivist for oral alimentation or who passed FEES tolerated oral feedings.

Conclusions (including clinical relevance): HFO₂-NCPAP did not affect successful feeding in neonatal or adult/geriatric populations. Patients requiring HFO₂-NCPAP should be referred for swallowing evaluations using the same criteria as patients who do not require HFO₂-NCPAP. It is not the use of HFO₂-NCPAP but rather population specific determinates of feeding readiness & the underlying medical conditions that impact oral feeding status.

Disclosures: Steven Leder: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Jonathan Siner: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Matthew Bizzarro: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Maureen Lefton-Greif: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

RISK ASSESSMENT FOLLOWING CARDIAC SURGERY

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Purpose: The Society for Thoracic Surgery benchmark for nosocomial pneumonia following coronary artery bypass graft (CABG) is 3.0 %. Postoperative pneumonia was encountered in 20/187 patients (10.7 %) undergoing CABG in 2011.

Method(s): Quality improvement interventions were instituted. Efforts were made to extubate all patients after surgery before leaving the operating room. Patients requiring overnight intubation were evaluated as a subgroup. Grip strength was measured. Patients deemed frail underwent modified barium swallow.

Result(s): CABG was performed in 187 patients in 2011. Pneumonia developed in 20 (10.7 %). Eighteen of these 20 patients (90 %) had been intubated over 24 h. Following institution of interventions, nosocomial pneumonia was encountered in 3/155 patients (1.94 %). Nine of 13 (69 %) patients able to participate in the grip assessment were deemed frail, of whom 6 (66 %) had deep laryngeal penetration or aspiration. All were intubated over 24 h.

Conclusions (including clinical relevance): Overnight intubation is high risk clinical indication for aspiration. Weak grip strength has limited sensitivity. All patients intubated overnight may be at risk for aspiration, and active screening is indicated.

Disclosures: Sara Byers: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Brooke Baumann: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Tamara Wasserman-Wincko: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Bridget Hathaway: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Vinay Badhwar: *Financial and Nonfinancial Disclosures:* No relevant relationships exist. | Jonas Johnson: *Financial and Nonfinancial Disclosures:* No relevant relationships exist.

ORAL PHASE SWALLOWING EFFICIENCY IN PARKINSON'S DISEASE: ON AND OFF DRUG EFFECTS

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	Measure	Mean	<i>p</i> value	95 % CI
TOMASS	Discrete bites	.18	.27	-.52 to .15
	Masticatory cycles	.87	.53	-3.65 to 1.91
	Swallows	.37	.1	-.81 to .08
	Total time (s)	1.69	.75	-8.86 to 12.23
TWST	Swallows	.46	.62	-2.32 to 1.41
	Volume (ml)	.99	.8	-8.9S to 6.99
	Total time (s)	3.21	.26	-8.87 to 2.45

Purpose: This study evaluated the influence of drug state on swallowing efficiency of liquids and solid textures in patients with Parkinson's disease

Method(s): 38 patients with Parkinson's disease (19 male) were evaluated twice using the Test of Mastication and Swallowing of Solids [TOMASS: ingestion of dry Salada™ cracker] and the Timed Water Swallow Test [TWST: ingestion of 150 ml water]. 'On' drug testing was completed in the morning; 'off' drug testing was completed at the same time of day, 48 h after the last drug dose.

Result(s): No significant differences were detected for any measure of swallowing efficiency as an effect of drug state.

Conclusions (including clinical relevance): These normed and validated measures identify no influence of pharmacological management on swallowing efficiency in PD. Correlation with other measures of motor change would improve the study.

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RELATIONSHIP AMONG RADIATION DOSE, ASPIRATION, AND SWALLOWING KINEMATICS

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Purpose: The goal of this investigation was to determine whether swallowing temporal kinematics are affected by radiation dose.

Method(s): Videofluoroscopic swallowing studies of 41 patients following radiation therapy for oropharyngeal cancer were analyzed for 5 cc and cup sip thin liquid boluses. Measures included duration of laryngeal vestibule closure (LVC), duration to maximum hyoid elevation (DTMHE), duration to cricopharyngeal opening (DTCPO), and pharyngeal transit time (PTT). Penetration Aspiration Scores (PAS) were extracted for each swallow and were considered normal if ≤ 2 . Abnormal PAS was noted in 23 % of swallows and patients were grouped according to PAS category.

Result(s): Mean LVC and DTCPO varied according to PAS group (LVC: Normal PAS mean = 0.67 s, Abnormal PAS mean = 0.13 s; $p < 0.0001$), (DTCPO: Normal PAS mean = 0.22 s, Abnormal PAS mean = 0.37 s, $p = 0.016$). Higher PAS was most strongly correlated with minimum radiation dose received by geniohyoid ($r = 0.45$, $p < 0.0001$). As PAS increased, DTCPO and PTT increased ($r = 0.21$, $p = 0.04$; $r = 0.20$, $p = 0.04$). A negative correlation was noted between PAS and LVC ($r = -0.38$, $p = 0.001$). As minimum and mean dose to the geniohyoid increased, DTMHE, DTCPO, and PTT increased.

Conclusions (including clinical relevance): Higher radiation doses to the geniohyoid are associated with increased severity of dysphagia as measured through kinematics and PAS. Consideration of dose to the geniohyoid should be considered when planning radiation.

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THE EFFECTS OF FOOD CONSISTENCY IN PHARYNGEAL RESPONSE TIME AFTER STROKE

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Purpose: This study aimed to analyze the influence of consistency food on pharyngeal response time after stroke.

Method(s): A clinical retrospective cross study. It was analyzed 50 swallowing barium study of stroke, independent from the site of injury. It was included only the framework that allowed the parameters and food consistencies studied. Therefore, it was analyzed 14 exams, 11 females and 3 males, with ages ranging between 40 and 101 years (mean 66 years). The time between the date of stroke and their inclusion in this study ranged from 2 to 30 days (average 13 days).

Result(s): It was found that puree consistency and liquid, respectively, the average time was 2806 milliseconds and 1015 milliseconds for the pharyngeal response. Thus, there is a statistically significant difference in response time pharyngeal between paste and liquid in oropharyngeal dysphagia after stroke p - level: 0.012.

Conclusions (including clinical relevance): There is a difference in pharyngeal response time after stroke according to the consistency of the food offered.

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ACCURACY OF CLINICAL SWALLOWING EVALUATION FOR OROPHARYNGEAL DYSPHAGIA IN STROKE COMPARING BOTH NECTAR AND LIQUID CONSISTENCIES

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Purpose: Verify the accuracy of the bedside screening for oropharyngeal dysphagia to identify laryngeal penetration and laryngotracheal aspiration in stroke using the liquid and nectar consistencies.

Method(s): Fifty stroke patients were submitted to bedside screening and videofluoroscopy comparing the nectar and liquid consistencies to detect laryngeal penetration and laryngotracheal aspiration. The cough, wet voice and cervical auscultation alteration was considering clinical signs for penetration and aspiration.

Result(s): The bedside screening showed higher sensibility, specificity and agreement for the nectar (sensibility 85.7 %, specificity 88.3 %, VPP 54.55 %, VPN 94.44 % and Kappa 0.59 %) when compared to the liquid (sensibility 72.7 %, specificity 74.3 %, VPP 44.44 %, VPN 90.63 % and Kappa 0.38 %) for the detection of penetration and aspiration.

Conclusions (including clinical relevance): The accuracy for the detection of aspiration was higher using the nectar consistency in stroke. The bedside screening has no accuracy for detecting laryngeal penetration.

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SWALLOWING DISORDERS IN CHRONIC OBSTRUCTIVE PULMONAR DISEASE (COPD)

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Purpose: To verify the presence of swallowing disorders in medical records of COPD patients in a University Hospital.

Method(s): Research based on secondary data records of COPD patients treated at a University Hospital, presenting changes in texture, volume and route of feeding.

Result(s): Sample of 60 medical records, mostly males, mean age 65.9 years and time of diagnosis between 2 and 29 years. We found 98.3 % Hypertension, 91.7 % smoking, 53.3 % Congestive Heart Failure and 46.7 % Diabetes Mellitus. Those, 48.3 % of patients were receiving O₂ therapy at home, 60 % showed some type of change in consistency, volume and route of feeding. Furthermore, there was a significant relation between disease duration, O₂ home therapy and presence of swallowing disorders and patients with ventilatory support at home are 80 times more likely to have swallowing disorders (OR = 80.5).

Conclusions (including clinical relevance): The changes in the breathing pattern of COPD patient may enhance the appearance of swallowing disorders. Knowing the factors that may cause a worsening of the clinical state in COPD patients allows professionals to adopt preventive and protective health measures to their patients, preventing aspiration episodes and COPD decompensation and decreasing hospital costs with disease management.

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SWALLOWING AFTER BARIATRIC SURGERY

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Purpose: Difficulty in feeding is a frequent symptom following bariatric surgery. Our aim was to compare the swallowing of obese patients before and 90 days after bariatric surgery and non-obese subjects.

Method(s): The study was conducted on 19 patients who underwent bariatric surgery for treatment of class III obesity (BMI >40 kg/m²) and 19 healthy subjects (BMI: 19 ± 4 to 29.7 kg/m²). Videofluoroscopic evaluation was performed with swallowing, in triplicate, of 5 ml liquid and pasty boluses and solid food (a cookie with 2.2 g).

Result(s): Before surgery, obese subjects had, for all consistencies, an increase in the interval between the onset of the movement of the hyoid and the beginning of the pharyngeal phase, and shorter transit through the upper esophageal sphincter. They had greater chances of having premature mouth leakage for liquids and, after surgery, the chances of premature mouth leakage also increased with pasty consistency. The surgery caused an increase in oral preparatory duration, a longer transit through the upper esophageal sphincter with a liquid consistency and a longer duration of the hyoid movement with liquid and paste, and a decrease in the interval between the onset of the movement of the hyoid and the beginning of the pharyngeal phase with a paste consistency and a greater chance of oral residue.

Conclusions (including clinical relevance): We concluded that after 90 days of bariatric surgery, the patients had an increase in the duration of the transit through the upper esophageal sphincter and an increase in the duration of the hyoid movement.

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COST OF PNEUMONIA IN ACUTE STROKE IN BRAZIL

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Purpose: To evaluate the factors associated with pneumonia; to determine the healthcare costs.

Method(s): This is a retrospective study conducted between July–December/2011. We included stroke patients in the Emergency Unit of a public tertiary hospital in Brazil. Data was gathered from the reviewed all medical charts, including socio-demographics factors, neurological severity (NIHSS, CGS), and stroke data. Costs were estimated using expenses covered by the government and informed by the hospital billing database.

Result(s): A hundred and fifty-one patients were included. Fifty-eight percent were male, mean age 63 years (SD = 13). Eighty percent presented ischemic stroke and 20 % had hemorrhagic stroke. The average daily cost for each patient was US\$694. Thirty-four percent presented pneumonia. Pneumonia was more frequent in patients with hemorrhagic stroke (OR = 3.2), higher NIHSS, and lower GCS. Median NIHSS score was 16 (IQR = 11) in patients with pneumonia, and 8 (IQR = 12) without pneumonia. Patients with pneumonia had an average length of stay 2.4 higher, and cost of hospitalization 4.3 higher than patients without pneumonia. The average daily cost per patient with and without pneumonia was US\$1165 and US\$446, respectively. Only one variable—NIHSS—was found to be related to pneumonia.

Conclusions (including clinical relevance): The study indicates high incidence of pneumonia in acute stroke. Pneumonia increases the length of hospitalization and its costs. The severity of stroke as evaluated by the NIHSS was shown to be the only independent risk factor for pneumonia in acute stroke patients.

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HYPOXEMIA IN ADULT PATIENTS WITH DYSPHAGIA: CAN IT BE RELIABLY MEASURED?

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Purpose: Hypoxemia can exacerbate the ill effects of aspiration pneumonia, a serious consequence in patients with dysphagia. Hypoxemia is measurable using arterial oxygenation (SpO₂) or pulse (beats per minute) readings. Our objective was to assess the reliability of these readings in adult patients with dysphagia.

Method(s): Thirty-six clinicians from five disciplines involved with dysphagic patients were trained on proper assessment and interpretation of oxymetry (MIR MiniSpir MR910584). Consecutive adult in- and out-patients with a dysphagia diagnosis were enrolled. Arterial oxygenation and pulse readings were recorded at rest for 2-minutes

followed by a 6-minute eat/drink activity. Inter-rater reliability was assessed using interclass coefficient (ICC) statistics.

Result(s): Fifty patients (mean age = 61.0 SD = 10.8; 28 males; 47 outpatients) with varying dysphagia severity and mixed etiologies were enrolled. Targeted combinations of four clinicians assessed each patient. Overall reliability was excellent for peripheral pulse rate at rest (ICC = 0.80, 95 % CI 0.71, 0.86) and activity (ICC = 0.86, 95 % CI 0.80, 0.91) but poor for SpO₂ both at rest (ICC = 0.56, 95 % CI 0.42,0.67) and activity (ICC = 0.41, 95 % CI 0.26,0.54). There was no effect from sensor site or clinician profession.

Conclusions (including clinical relevance): Interdisciplinary clinicians were trainable on oxymetry testing, but reproducibility was excellent for only peripheral pulse and suboptimal for arterial oxygenation. Clinically, this suggests oxymetry is not suitable as a measure of static values. These findings will guide oxymetry use in adult patients with dysphagia.

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THE INFLUENCE OF LANGUAGE SPOKEN, BOLUS LOCATION, BOLUS TYPE, HEAD POSITION AND EFFORT ON LINGUAL SWALLOWING PRESSURES

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Purpose: Deglutitive tongue pressures are influenced by a number of variables. This research aimed to study the effects of language spoken, bolus location, bolus type, head position and effort on swallowing pressures, since these factors were only explored in a small number of participants in previous research (Hori et al, 2011).

Method(s): 67 adults participated in this study (49 French-speaking, 18 Dutch-speaking) with a mean age of 39 yo (range 22-66). None

had symptoms of dysphagia or a medical condition potentially associated with dysphagia. All participants passed the 3 fl. oz. swallowing screening. Tongue pressures during swallowing were assessed using the Iowa Oral Performance Instrument (IOPI). Within subjects factors were location (anterior or posterior tongue), bolus type (saliva or 5 ml. water swallows), head position (neutral or chin tuck) and effort (normal or effortful swallow); between subjects factor was language spoken. Data were analyzed using a mixed model approach, looking at main and interaction effects.

Result(s): All effects are reported as significant at $p < .05$. The main effect of the between- subjects factor was not significant. Within-subjects factors analysis revealed a significant main effect of effort whereby pressures generated during effortful swallowing were greater than normal swallowing. No significant main effect of bolus type, location or head position was found.

Conclusions (including clinical relevance): This study demonstrates the absence of a significant effect of language spoken (French vs. Dutch) on swallowing pressures. The lack of influence of head position in this study contrasts with previous research.

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SWALLOWING SOUNDS IN CHILDREN: ESTABLISHING NORMATIVE DATA

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Purpose: Limited data on cervical auscultation (CA) sounds in normal swallows of various food and fluid textures during the transitional feeding period of 4-36 months exists. This study documents the acoustic and perceptual parameters of swallowing sounds in healthy children aged 4-36 months over a range of food and fluid consistencies.

Method(s): Prospective cross-sectional study involving 50 healthy children (46 % boys) aged 4-36 months (mean = 16.1 months). Swallow recordings were made with an omnidirectional microphone attached to the child's neck during swallow trials of developmentally appropriate food and fluid consistencies. Descriptive statistics were computed for acoustic parameters of frequency (Hz), duration (secs) and intensity (dB) and number of swallows per presentation; and for perceptual parameters of the swallow, to create a swallowing sound profile across consistencies.

Result(s): Average swallow duration of pure and thin fluids is 0.84 and 0.76 s, respectively. Children take on average between 1 and 2

swallows to clear a puree (1.61 swallows) or thin fluid (1.52 swallows) bolus. Average peak frequency of puree and thin fluids is 3,230 and 3,337 Hz, respectively.

Conclusions (including clinical relevance): Children have higher pitched swallow sounds and longer swallow durations compared to adults on puree and thin fluids. Differences in anatomical size and muscle strength of the cervical region between adults and children may impact on swallowing acoustic differences.

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IS THERE A DIFFERENCE IN SOUND ACOUSTICS BETWEEN ASPIRATING VERSUS NON-ASPIRATING SWALLOWERS IN CHILDREN WITH DYSPHAGIA?

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Purpose: Cervical auscultation (CA) may be used to complement the clinical feeding examination when assessing for oropharyngeal aspiration (OPA). Data exists on the acoustic properties of normal and abnormal swallowing sounds in adults and children. However, there are no published paediatric studies comparing the acoustic properties of sounds comparing OPA with non-OPA swallows. We aimed to determine if there is an acoustic difference between modified barium swallow (MBS)-identified OPA and non-OPA swallow sounds in children.

Method(s): Simultaneous recordings of swallow sounds during MBS studies were obtained. OPA was rated using the Penetration-Aspiration scale. Acoustic data including frequency (Hz) and duration (s) were obtained for both OPA and non-OPA swallows. Data between groups of sounds were compared using independent *t*-tests.

Result(s): To date, 65 children (58 % male), mean age 34.3 months, are enrolled. Twenty-seven (42 %) children had OPA diagnosed on MBS on at least one fluid consistency. Sixteen OPA and 20 non-OPA sounds when swallowing thin and infant-thick feeds were acoustically

analyzed. There was significant difference in duration between OPA (mean = 1.14 s, 95 %CI 0.70-1.58) and non-OPA (mean = .72 s, 95 % CI 0.61–0.91) swallows in children aged ≥ 12 months. There was no difference between groups for frequency.

Conclusions (including clinical relevance): Swallow sounds of infants with OPA are slower (thus less efficient) than those without OPA, but have similar frequencies. Possible reasons for these differences will be discussed.

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SCIENTIFIC EVIDENCE OF THERAPEUTIC REHABILITATION TECHNIQUES IN PEDIATRIC DYSPHAGIA: SYSTEMATIC REVIEW

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Purpose: To conduct a systematic literature review about the pediatric dysphagia rehabilitation and provide an estimate of the effects of dysphagia rehabilitation on feeding/swallowing outcomes in pediatric population.

Method(s): A systematic search of the literature published from 2003 to 2013 was conducted. Abstract and title of articles meeting the selection criteria were selected by two screeners. Full texts of all potentially relevant papers were obtained and examined by two reviewers. The articles relevance was evaluated from the PeDro-P scale.

Result(s): A total of 3,344 publications were identified. Eight studies met our inclusion criteria, only one article presented scientific evidence about therapeutic techniques in the dysphagia rehabilitation. The methodological quality varied greatly in the researches which were selected.

Conclusions (including clinical relevance): The present study confirms that there is little evidence in pediatric dysphagia rehabilitation, however further research based on randomized controlled trials is needed for this population.

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PREVALENCE, AGE AND GENDER CHARACTERISTICS OF AFRICAN AMERICAN NURSING HOME PATIENTS REFERRED FOR MOBILE VIDEOFLUOROSCOPIC SWALLOW STUDIES (VFSS)

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Purpose: It has been reported that African American hospitalized patients are less likely to undergo dysphagia screening and less likely to be recognized with dysphagia impairment in the community. The purpose of this study was to determine the prevalence and characteristics of African American patients in a large metropolitan nursing home population of patients referred for VFSS with signs or symptoms of dysphagia.

Gender Race	Mean Age	Std Deviation	n	CI lower limit	CI upper limit
Female white	82.22	9.265	147	80.485	83.964
Female AA	77.74	10.935	27	73.682	81.799
Female	72.33	15.293	6	63.723	80.943
Female other	80.0	72.11	3	67.824	92.176
Female total	81.20	9.903	183		
Male white	79.65	12.170	88	77.400	81.896
Male AA	71.24	12.311	17	66.120	76.350
Male hispanic	80.0	12.480	9	72.970	87.030
Male other	75.00	5.292	3	62.824	87.176
Male total	78.33	12.346	117		
White total	81.26	10.497	235		
AA total	75.23	11.789	44		

Method(s): A sequential sample of 300 (n) nursing home residents, from 31 facilities in a single metropolitan area, referred for signs and symptoms of dysphagia were evaluated using VFSS. Data was collected during the evaluation on each resident patient. Data points include age, gender, and ethnicity. All studies were performed by the same team of one technician, and one SLP and one supervising physician. Data was analyzed by separate multiple logistic regression models adjusting for confounding variables.

Result(s): The results for age, gender and ethnicity are reported in the accompanying table.

Conclusions (including clinical relevance): In this prospective study of nursing home patients referred for dysphagia evaluation, a prevalence of (14.7 %) 44 (n) African Americans versus (85.3 %) 256 (n) was demonstrated. There was no significant difference in the gender distribution between the groups. There was a significant difference in age at presentation between the African American patients and non-African American patients who were evaluated. This is consistent with other reports in the literature and demonstrates a disparity in the age of diagnosis for dysphagia between African Americans and other ethnicities.

AA DYSPHAGIA NURSING HOME PATIENTS CHARACTERISTICS

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DYSPHAGIA IN HUNTINGTON'S DISEASE: CASE STUDY

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Purpose: To describe dysphagia in patients with Huntington's disease (HD).

Method(s): It is a descriptive study of 8 patients (4 men and 4 women) with HD. The patients underwent Fiberoptic Endoscopic Evaluation of Swallowing, Unified Huntington's Disease Rating Scale (UHRS) and Magnetic Resonance Imaging (MRI). The data analysis was based on averages and absolute values.

Result(s): The average age was 47 (± 6.6) years old. The average disease duration was 9.6 (± 6) years. One patient had aspiration, 6 had penetration and 5 had stasis in vallecula and pyriform sinus. In MRI was observed gliosis on left temporal lobe, gliosis and demyelination on frontal lobe, diffuse cerebral atrophy and atrophy of caudate nucleus. As behavioral alteration they referred irritability, fear, depression and cognitive impairment. In UHRS they classification in independence scale varied between 70 and 10 score, it means since self-care maintained until total bed care. They all had dysarthria, varying between unclear speech and mostly incomprehensible oral communication (1–3 score). The tongue protrusion was between normality (score 0) and completely failed in protrude tongue between the lips (score 4). The chorea in mouth and tongue was classified in normal, mild and moderate intermittent (0–2 score). One patient had rigidity as a main motor alteration.

Conclusions (including clinical relevance): Beside the large variation of age and disease duration the patients had swallowing problems as a consequence of chorea in mouth and tongue and cognitive problems. The case of aspiration was observed in a patient with young onset.

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AGREEMENT BETWEEN PATIENTS WITH PARKINSON'S DISEASE AND THEIR CAREGIVERS ON SUBJECTIVE AND OBJECTIVE MEASURES OF SWALLOWING DISORDERS

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Purpose: The aim of this pilot study was to develop a patient and a family questionnaire to identify the presence and worsening severity of swallowing disorders in patients with Parkinson's disease, and the need for a follow-up Modified Barium Swallow (MBS) study.

Method(s): 11 patients with a diagnosis of Parkinson's disease and their caregiver completed questionnaires that asked various questions related to the patient's eating and swallowing behaviors. After completing the questionnaire, each patient received an MBS study which was reviewed for swallowing disorders. Responses to the questionnaires were tabulated and compared between patient and caregiver, and with the patients' objective swallow data.

Result(s): Overall agreement between patient and caregiver was 67 %. When the patient and caregiver did not agree, most of the time it was the patient who indicated that his or her swallow was worse. Seventy-five percent of the subjects needed multiple swallows to clear residue as seen on MBS. Of these, 83 % of the patient-caregiver pairs answered "yes" or "sometimes" to the questionnaire question relating to the need to swallow multiple times. One patient demonstrated aspiration during the MBS study. Both the patient and caregiver

answered that the patient "sometimes" coughed while eating, indicating that this pair was sensitive to the patient's aspiration.

Conclusions (including clinical relevance): There is potential for development of a reliable and valid questionnaire to identify the presence, severity, and worsening of swallowing disorders in patients with Parkinson's disease.

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