# CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

## Rehabilitation, Recovery and Community Participation Following Stroke

## Part Two: Delivery of Stroke Rehabilitation to Optimize Functional Recovery Evidence Tables

## 7th edition, update 2025

## *Management of Dysphagia*

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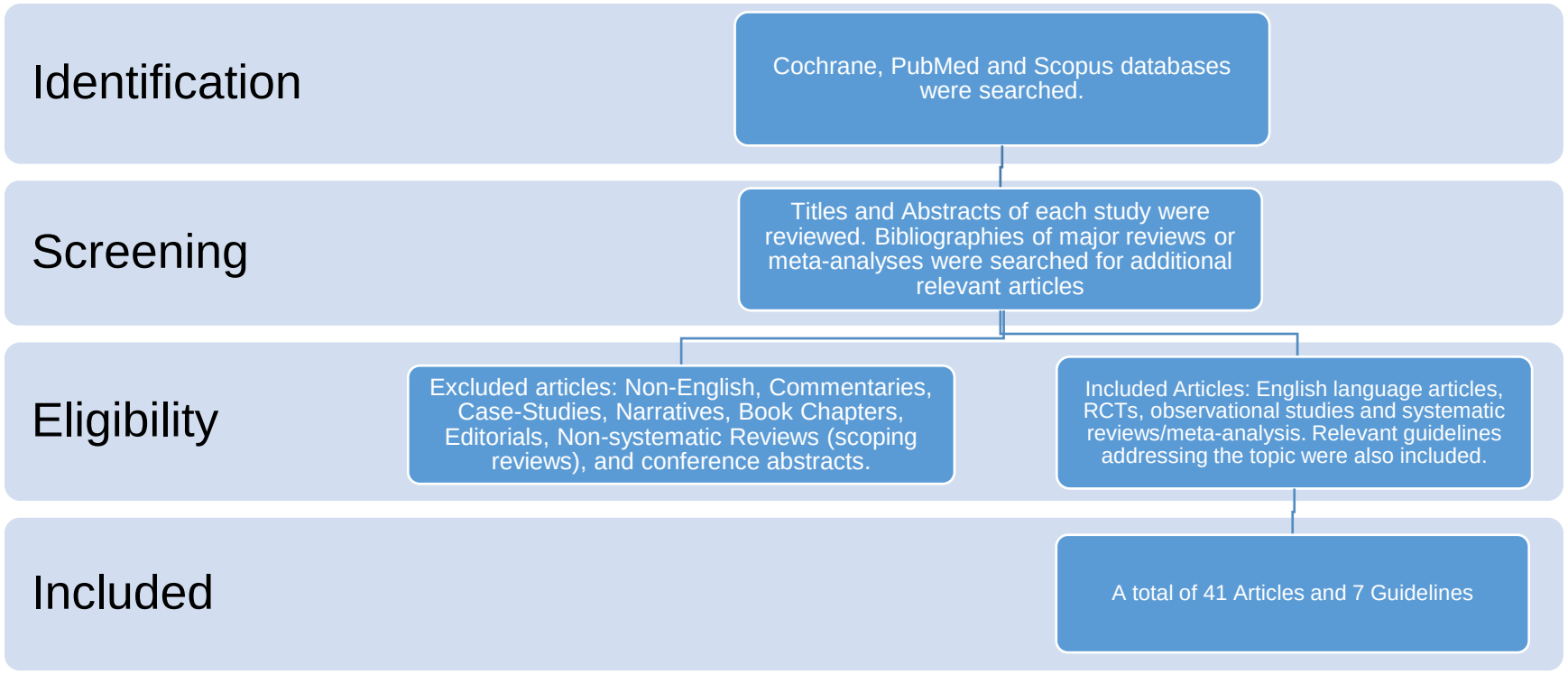
## Search Strategy




Cochrane, PubMed, and Scopus databases were search using terms such as stroke and (swallowing or dysphagia) and (screening or assessment or intervention or treatment); stroke and (malnutrition or nutrition or enteral feeding or gastrostomy tube); stroke and (oral hygiene or oral care or mouth care). Titles and abstract of each article were reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. A total of 41 articles and 7 guidelines were included and separated into categories designed to answer specific questions.

# Published Guidelines

| Guideline | Recommendations |
|---|---|
| **Management of Stroke Rehabilitation Working Group. VA/DoD clinical practice guideline for the management of stroke rehabilitation. Washington (DC): Veterans Health Administration, Department of Defense; Version 5.0 – 2024.**<br><br>**Available at:** https://www.healthquality.va.gov/guidelines/Rehab/stroke/ | 28. We suggest chin tuck against resistance exercises for patients with dysphagia. Weak (for)<br><br>29. We suggest respiratory muscle strength training for dysphagia in patients without a tracheostomy. Weak (for)<br><br>30. There is insufficient evidence to recommend for or against tongue pressure resistance training for dysphagia. Neither for nor against<br><br>31. There is insufficient evidence to recommend for or against neuromuscular electrical stimulation and pharyngeal electrical stimulation for dysphagia. Neither for nor against<br><br>32. There is insufficient evidence to recommend for or against surface electromyography for dysphagia. Neither for nor against |
| **National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4.**<br><br>**Available at:** www.strokeguideline.org.<br><br>**(selected)** | *Dysphagia*<br>Patients with acute stroke should have their swallowing screened, using a validated screening tool, by a trained healthcare professional within four hours of arrival at hospital and before being given any oral food, fluid or medication.<br><br>People with stroke who require modified food or fluid consistency should have these provided in line with internationally agreed descriptors e.g. International Dysphagia Diet Standardisation Initiative (IDDSI).<br><br>Patients with stroke with suspected aspiration or who require tube feeding or dietary modification should be considered for instrumental assessment (videofluoroscopy or fibre-optic endoscopic evaluation of swallowing [FEES]).<br><br>People with swallowing difficulty after stroke should be considered for swallowing rehabilitation by a specialist in dysphagia management. This should be based on a thorough assessment of dysphagia, such as by a speech and language therapist, to decide on the most appropriate behavioural intervention, and may include a variety of muscle strengthening and/or skill training exercises.<br><br>People with dysphagia after stroke may be considered for neuromuscular electrical stimulation as an adjunct to behavioural rehabilitation where the device is available and it can be delivered by a trained healthcare professional.<br><br>Patients with tracheostomy and severe dysphagia after stroke may be considered for pharyngeal electrical stimulation to aid decannulation where the device is available and it can be delivered by a trained healthcare professional.<br><br>People with stroke should be considered for gastrostomy feeding if they: – need, but are unable to tolerate, nasogastric tube feeding, even after a trial with a nasal bridle if appropriate and other measures such as taping the tube or increased supervision; – are unable to swallow adequate food and fluids orally by four weeks from the onset of stroke and gastrostomy feeding is considered to be required long-term; – reach the point where shared decision making by the person with stroke, their family/carers, and the multidisciplinary team has agreed that artificial nutrition is appropriate due to the high long-term risk of malnutrition. |

| Guideline | Recommendations |
|---|---|
| | *Mouth Care*<br>People with stroke, especially those who have difficulty swallowing or who are tube fed, should have mouth care at least three times a day (particularly after mealtimes), which includes removal of food debris and excess secretions, and application of lip balm.<br><br>People with stroke, including those who have full or partial dentition and/or wear dentures and especially those who have difficulty swallowing or who are tube fed, should have mechanical removal of plaque at least twice a day by the brushing of teeth and cleaning of gums and tongue with a low foaming, fluoride-containing toothpaste. Chlorhexidine dental gel may be prescribed short term and requires regular review. A powered toothbrush should be considered |
| **Dziewas R, Michou E, Trapl-Grundschober M, Lal A, Arsava EM, Bath PM et al.**<br><br>**European Stroke Organisation and European Society for Swallowing Disorders guideline for the diagnosis and treatment of post-stroke dysphagia.**<br><br>***Eur Stroke J*. 2021 Sep;6(3):LXXXIX-CXV.** | *Dysphagia and nutritional screening*<br>In all patients with acute stroke, we recommend a formal dysphagia screening test to prevent post-stroke pneumonia and decrease risk of early mortality. We recommend to screen the patients as fast as possible after admission. For screening, either water-swallow-tests or multiple-consistency tests may be used. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Strong for intervention ↑↑<br><br>In patients with acute stroke, we recommend no administration of any food or liquid items, including oral medication, until a dysphagia screening has been done and swallowing was judged to be safe. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Strong for intervention ↑↑<br><br>*Dysphagia Assessment*<br>We suggest a dysphagia assessment in all stroke patients failing a dysphagia screen and/or showing other clinical predictors of post-stroke dysphagia, in particular a severe facial palsy, severe dysarthria, severe aphasia or an overall severe neurological deficit (NIH-SS ≥ 10 points). Dysphagia assessment should be done as soon as possible. In addition to the clinical swallow examination, VFSS or, preferentially, FEES should be available. Quality of evidence: Low ⌖⌖ Strength of recommendation: Weak for intervention ↑?<br><br>We suggest that in acute stroke patients swallowing of tablets should routinely be evaluated as part of dysphagia assessment in addition to assessing the swallowing of liquid and different food consistencies and quantities. Quality of evidence: Low ⌖⌖ Strength of recommendation: Weak for intervention ↑<br><br>*Dietary Interventions*<br>In patients with post-stroke dysphagia, we suggest that texture modified diets and/or thickened liquids may be used to reduce the risk of pneumonia. Quality of evidence Low ⌖⌖ Strength of recommendation: Weak for intervention ↑?<br><br>In patients with post-stroke dysphagia, we recommend that texture modified diets and/or thickened liquids are prescribed only based on an appropriate assessment of swallowing. Quality of evidence: Low ⌖⌖ Strength of recommendation: Strong for intervention ↑↑<br><br>In stroke patients put on texture modified diet and/or thickened liquids we recommend to monitor fluid balance and nutritional intake. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Strong for intervention ↑↑ |

| Guideline | Recommendations |
|---|---|
| | *Behavioural interventions*<br>In patients with post-stroke dysphagia, we suggest behavioural swallowing exercises to rehabilitate swallowing function. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Weak for intervention ↑?<br><br>In patients with post-stroke dysphagia, we suggest that behavioural interventions should not be limited to one specific manoeuvre or training, but the treatment should be tailored to the specific swallowing impairment of the individual patient based on a careful assessment of dysphagia. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Weak for intervention ↑?<br><br>*Other treatments*<br>In patients with post-stroke dysphagia, we recommend that treatment with neurostimulation techniques should preferably be conducted within a clinical trial setting. Quality of evidence: low ⌖⌖ Strength of recommendation: Strong for intervention ↑↑<br><br>In patients with post-stroke dysphagia, we suggest treatment with rTMS, TES, tDCS and PES as adjunct to conventional dysphagia treatments to improve swallowing function. Quality of evidence: Moderate ⌖⌖⌖ Strength of recommendation: Weak for intervention ↑?<br><br>*Oral Care*<br>In stroke patients we suggest to implement oral health care interventions to reduce the risk of pneumonia. Quality of evidence: Low ⌖⌖ Strength of recommendation: Weak for intervention ↑? |
| **Burgos R, Bretón I, Cereda E, Desport JC, Dziewas R, Genton L et al.**<br><br>**ESPEN guideline clinical nutrition in Neurology.**<br><br>***Clin Nutr.* 2018 Feb;37(1):354-396.**<br><br>**(selected)** | *Dysphagia screening*<br>Recommendation 52: A formalized screening for dysphagia should be performed in all stroke patients as early as possible and before oral intake. Grade of recommendation B strong consensus (95% agreement)<br><br>Recommendation 53: All stroke patients failing the dysphagia screening or demonstrating symptoms of or risk factors for dysphagia should be evaluated with a more thorough assessment of swallowing function as early as possible. Grade of recommendation B strong consensus (100% agreement).<br><br>Recommendation 58: Texture modified diets and thickened liquids may reduce the incidence of aspiration pneumonia in stroke patients with dysphagia. Data on the effect of modified diets and thickened liquids on mortality of stroke patients is insufficient. Texture modified diets and thickened liquids should be ordered only following an assessment of swallowing function including assessment of the risk of aspiration according to a standardized protocol (clinical and, if feasible, instrumental) by professionals trained and experienced in the assessment and treatment of dysphagia. This assessment should be repeated at regular intervals until normal swallowing function is regained. Grade of recommendation: GPP e strong consensus (95% agreement)<br><br>*Enteral Feeding*<br>Recommendation 63: Patients with prolonged severe dysphagia after stroke that presumably last for more than 7 days should receive early (not more than 72 h) enteral tube feeding. Grade of recommendation: GPP strong consensus (100% agreement. |

| Guideline | Recommendations |
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| | Recommendation 66: If enteral feeding is likely necessary for a longer period of time (>28 days), a PEG should be chosen and placed in a stable clinical phase (after 14-28 days). Grade of recommendation: A strong consensus (95% agreement)<br><br>*Dysphagia Therapy*<br>Recommendation 79: There is strong evidence that the Shaker head lift, a combination of an isometric and an isokinetic exercise, has favorable long-term effects by improving the strength of the suprahyoid muscles over time, and increasing the opening of the upper esophageal sphincter. We recommend the Shaker head lift for the treatment of upper esophageal sphincter dysfunction. Grade of recommendation: A strong consensus (100% agreement)<br><br>Recommendation 81: The chin-down maneuver is recommended in patients with premature spillage and predeglutitive aspiration. Grade of recommendation: B strong consensus (94% agreement)<br><br>Recommendation 82: Systematic and sufficiently frequent swallowing therapy making individualized use of the different exercises available is recommended in patients suffering from OD. Grade of recommendation: B strong consensus (100% agreement) |
| **Clinical Guidelines for Stroke Management 2022. Melbourne (Australia): National Stroke Foundation.**<br>**Chapter 3. Acute medical and surgical management** | *Dysphagia Screening/Assessment*<br>People with acute stroke should have their swallowing screened within four hours of arrival at hospital and before being given any oral food, fluid or medication. Practice statement.<br><br>People with acute stroke should have their swallowing screened, using a validated screening tool, by a trained healthcare professional. Weak recommendation<br><br>All stroke patients who have failed swallow screening or who deteriorate should have a comprehensive assessment of swallowing performed by a speech pathologist. Weak recommendation<br><br>*Dysphagia Treatment*<br>For stroke survivors with swallowing difficulties, behavioural approaches such as swallowing exercises, environmental modifications, safe swallowing advice, and appropriate dietary modifications should be used early. Strong recommendation.<br><br>For stroke survivors with dysphagia, non-invasive brain stimulation should only be provided within a research framework. Weak recommendation (against).<br><br>For patients with stroke, acupuncture should not be used for treatment of dysphagia in routine practice other than as part of a research study. Weak recommendation (against).<br><br>For stroke survivors with dysphagia, surface neuromuscular electrical stimulation should only be delivered by clinicians experienced in this intervention and be applied according to published parameters in a research framework. Weak recommendation (against).<br><br>For stroke survivors with dysphagia, pharyngeal electrical stimulation is not routinely recommended. Weak recommendation |

| Guideline | Recommendations |
|---|---|
| | (against).<br><br>*Nutrition*<br>For stroke patients who do not recover a functional swallow, nasogastric tube feeding is the preferred method of feeding in the short term. Weak recommendation<br><br>For stroke patients, there is no preference with regard to continuous pump (meaning using a pump for greater than or equal to 16hrs out of 24hrs for less than or equal to 80ml/hr) feeding versus intermittent bolus feeding (meaning 250-400mls/hr for 4- 5times/day) therefore practical issues, cost and patient preferences should guide practice. Weak recommendation<br><br>*Oral hygiene*<br>All stroke patients, particularly those with swallowing difficulties, should have assistance and/or education to maintain good oral and dental (including dentures) hygiene. Strong recommendation<br><br>Staff and carers of stroke patients (in hospital, in residential care and home settings) should be trained in assessment and management of oral hygiene. Strong recommendation<br><br>For stroke patients, chlorhexidine in combination with oral hygiene instruction, and/or assisted brushing may be used to decrease dental plaque and gingiva bleeding. Caution should be taken, however, for patients with dysphagia. Weak recommendation |
| **Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K et al; on behalf of the American Heart Association Stroke Council.**<br><br>**2018 Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.**<br><br>***Stroke.* 2018; Mar;49(3):e46-e110** | *4.6. Dysphagia Screening*<br>Dysphagia screening before the patient begins eating, drinking, or receiving oral medications is reasonable to identify patients at increased risk for aspiration. Class IIa; LOE C-LD.<br><br>It is reasonable for dysphagia screening to be performed by a speech-language pathologist or other trained healthcare provider. Class IIa; C-LD.<br><br>An instrumental evaluation is reasonable for those patients suspected of aspiration to verify the presence/absence of aspiration and to determine the physiological reasons for the dysphagia to guide the treatment plan. Class IIa; LOE B-NR.<br><br>It is not well-established which instrument to choose for evaluation of swallowing with sensory testing, but the choice may be based on instrument availability or other considerations (ie, fiberoptic endoscopic evaluation of swallowing, videofluoroscopy, fiberoptic endoscopic evaluation). Class IIb; LOE C-LD.<br><br>For patients with dysphagia, it is reasonable to initially use nasogastric tubes for feeding in the early phase of stroke (starting within the first 7 days) and to place percutaneous gastrostomy tubes in patients with longer anticipated persistent inability to swallow safely (>2–3 weeks). Class IIa; LOE C-EO.<br><br>Implementing oral hygiene protocols to reduce the risk of pneumonia after stroke may be reasonable. Class IIb; LOE B-NR |
| **Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC et al; on behalf of** | *Dysphagia*<br>Early dysphagia screening is recommended for acute stroke patients to identify dysphagia or aspiration, which can lead to |

| Guideline | Recommendations |
|---|---|
| **the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research.**<br><br>**Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.**<br><br>***Stroke* 2016;47:e98–e169** | pneumonia, malnutrition, dehydration, and other complications. Class I, LOE B<br><br>Dysphagia screening is reasonable by a speech-language pathologist or other trained healthcare provider. Class IIa, LOE C<br><br>Assessment of swallowing before the patient begins eating, drinking, or receiving oral medications is recommended. Class I, LOE B<br><br>An instrumental evaluation is probably indicated for those patients suspected of aspiration to verify the presence/absence of aspiration and to determine the physiological reasons for the dysphagia to guide the treatment plan. Class IIa, LOE B<br><br>Selection of instrumental study (fiberoptic endoscopic evaluation of swallowing, videofluoroscopy, fiberoptic endoscopic evaluation of swallowing with sensory testing) may be based on availability or other considerations. Class IIb, LOE C<br><br>Incorporating principles of neuroplasticity into dysphagia rehabilitation strategies/interventions is reasonable. Class IIa, LOE C<br><br>Behavioral interventions may be considered as a component of dysphagia treatment. Class IIb LOE A<br><br>Acupuncture may be considered as an adjunctive treatment for dysphagia. Class IIb, LOE B<br><br>Drug therapy, NMES, pharyngeal electrical stimulation, physical stimulation, tDCS, and transcranial magnetic stimulation are of uncertain benefit and not currently recommended. Class III, LOE A<br><br>*Nutrition*<br>Enteral feedings (tube feedings) should be initiated within 7 days after stroke for patients who cannot safely swallow. Class I, LOE A<br><br>Nasogastric tube feeding should be used for short term (2–3 weeks) nutritional support for patients who cannot swallow safely. Class I, LOE B<br><br>Percutaneous gastrostomy tubes should be placed in patients with chronic inability to swallow safely. Class I, LOE B<br><br>*Oral Hygiene*<br>Oral hygiene protocols should be implemented to reduce the risk of aspiration pneumonia after stroke. Class I; LOE B. |

# Evidence Tables

## Accuracy & Validity of Dysphagia Screening Tools

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Boaden et al. 2021**<br><br>**UK**<br><br>**Cochrane review** | Using the QUADAS-2 tool, the quality of the studies was generally considered to be of poor quality – only 6 studies were at low risk across all 4 risk of bias domains, and 2 studies were at low risk of bias for 3 domains | 25 studies including 3,953 participants with acute stroke. 4 included studies did not contain quantitative data and were excluded from analyses. | The test characteristics of 37 screening tests were evaluated. The reference criterion included the results from the Mann Assessment of Swallowing Ability (MASA, n=20) fibreoptic endoscopic evaluation of swallowing (FEES, n=6), and videofluoroscopy (VF, n=11).<br><br>24 (65%) tests used water only, 6 (16%) used a combination of water and other consistencies, and 7 (19%) used other methods | **Primary outcomes:** Diagnostic accuracy, sensitivity, specificity | Statistical pooling of diagnostic accuracy data was not possible.<br><br>The best performing swallow screening tools were the combined water swallow tests and Oxygen Saturation Test, Gugging Swallowing Screen (GUSS), and Toronto Bedside Swallowing Screening Test (TOR-BSST).<br><br>The best performing test using water only was the TOR-BSST with a sensitivity of 1.00 (95% CI, 0.75–1.00) and specificity of 0.64 (95% CI, 0.31–0.89).<br><br>The best performing test that used water, semisolids, and solid trials and management plan was the GUSS with a sensitivity of 1.00 (95% CI, 0.77–1.00) and specificity of 0.69 (95% CI, 0.41–0.89).<br><br>The best performing test that combined water swallow test with an instrumental assessment was the Bedside Aspiration Test (combined) with a sensitivity of 1.00 (95% CI, 0.87–1.00) and specificity of 0.71 (95% CI, 0.49–0.87).<br><br>Screening tools that used a combination of water and other consistencies as testing materials were more accurate than screening tests that used only water.<br><br>Tests that used methods other than water only and water and other consistencies had mixed results; some performed as well as the water-only tests, while others performed worse. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| | | | | | Screening tests with dysphagia as the primary outcome generally performed better than screening tests for which the primary outcome was aspiration.<br><br>Screening tools carried out by nurses performed consistently better than those carried out by other healthcare providers.<br><br>The authors concluded that they were unable to identify a single screening tool with high and precisely estimated sensitivity and specificity due to lack of high-quality studies. |

## Improved Outcome Associated with Dysphagia Screening & Assessment

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Sherman et al. 2021**<br><br>**Canada**<br><br>**Systematic review & meta-analysis** | Among the 17 domains assessed, overall, those with highest risk of bias (>50% of studies) were for blinding of patients and/or outcome assessors, and lack of reporting sufficient details for the screening protocols | 30 studies (6 RCTs) including patients with swallowing problems following stroke. Mean age ranged from 55 to 75 years. The percentage of men ranged from 39.5% to 100%. | Studies compared the outcomes of patients who received no screening vs, screening, (n=9), late vs. early screening (n=5), informal vs. formal screening (n=2), pre- vs post screening (n=10) and pre- vs. poststroke guideline that included screening (n=7).<br><br>Of the studies that used published screening tools, 6 used the Acute Screening of Swallow in Stroke/TIA (Middleton et al. 2011), 4 used the Gugging Swallowing Screen, one used the Three-Step Swallowing Screen | **Primary outcomes:** Pneumonia, mortality, dependency, hospital LOS<br><br>Pneumonia was assessed during hospital stay (n=16 studies). Mortality was assessed during hospital stay (n=13 studies). In the remaining studies, outcome was assessed at 30 days, 90 days, 6 months and at 3-5 years post stroke. Dependency was assessed at discharge | Overall, screening was associated with reduced odds of pneumonia (OR=0.57, 95% CI, 0.45–0.72, n=20), mortality (OR=0.52, 95% CI 95% CI, 0.35–0.77, n=18), dependency (OR=0.54, 95% CI, 0.35-0.85, n=13) and reduced LOS (SMD= −0.62, 95% CI, −1.05 to −0.20, n=13).<br><br>There was variability among the subgroups of comparisons with some statistically significant, and others, not. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| | | | protocol and one used the MetroHealth Dysphagia Screen | (n=6) and 90 days (n=8). | |
| **Smith et al. 2018**<br><br>**Canada/US/UK**<br><br>**Systematic review** | NA | 3 RCTs including persons ≥18 years, hospitalized for stroke (ischemic or hemorrhagic) | Trials compared dysphagia screening protocols or quality improvement interventions designed to improve screening rates vs. no screening, alternative screening, usual care or gold standard | **Primary outcomes:** ≥1 of death, dependency, or pneumonia | 3 trials (Rai et al. 2016, Miles et al. 2013 and Middleton et al. 2011), are all described below.<br><br>The percentage of patients who received dysphagia screening and developed pneumonia was not significantly lower, compared with patients in a control group, in any of the trials.<br><br>The authors highlight the lack of evidence from RCTs and state that *"no conclusions can be drawn about the clinical effectiveness of dysphagia screening protocols."* |
| **Bray et al. 2017**<br><br>**UK**<br><br>**Retrospective study** | NA | 63,650 patients included in a nation register, ≥16 years admitted to 199 hospitals, following an acute ischaemic stroke or primary intracerebral haemorrhage, between 2013 and 2014. Median age was 77 years, 50.4% were female, 88.2% of strokes were ischemic | The risk of stroke-associated pneumonia in relation to timing of dysphagia screening and comprehensive assessment was examined using multivariable models adjusted for age, sex, stroke subtype, pre-stroke functional level (mRS), place of stroke (out of hospital vs. inpatient), vascular comorbidity and either NIHSS score or level of consciousness on admission. Timing of screening and assessment was arranged into quartiles. | **Primary outcome:** Stroke-associated pneumonia (SAP)<br><br>**Secondary outcome:** 30-day mortality | 55, 838 (87.7%) patients had a dysphagia screen, of which 24,542 (38.6%) proceeded to a comprehensive assessment by a SLP.<br><br>The overall incidence of SAP was 8.7% (13.8% for patients not screened, 8.0% for patients who were screened and 14.7% for patients who received a comprehensive assessment).<br><br>The median time from admission to dysphagia screening was 2.9 hours.<br><br>The median time from admission to dysphagia assessment was 22.9 hours.<br><br>The odds of SAP associated with timing of screening including data from 55,838 patients were:<br>Q1 (0-79 min): OR=1.00 (ref)<br>Q2 (80-176 min): OR=0.92, 95% CI 0.83-1.01, p=0.08<br>Q3 (177-344 min): OR=0.89, 95% CI 0.81-0.99, p=0.03<br>Q4 (≥345 min): OR=1.14, 95% CI 1.03-1.24, p=0.008 |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| | | | | | The odds of SAP associated with timing of dysphagia assessment including data from 24,542 patients were:<br>Q1 (0-369 min): OR=1.00 (ref)<br>Q2 (370-1371 min): OR=1.40, 95% CI 1.22-1.06, p<0.0001<br>Q3 (1372-2961 min): OR=1.60, 95% CI 1.41-1.84, p<0.0001<br>Q4 (≥2962 min): OR=2.01, 95% CI 1.76-2.30, p<0.0001<br><br>The odds of 30-day mortality, excluding patients dying or who started palliative care in the first 72 hours after admission, were associated with increased delays in dysphagia assessment (Q1: ref, Q2 OR= 1.31, Q3 OR= 1.54, Q4OR=1.39, all p<0.0001). |
| **Joundi et al. 2017**<br><br>**Canada**<br><br>**Retrospective study** | NA | 6,677 patients ≥18 years, included in the Canadian Stroke Registry from 2010-2013 who were eligible for dysphagia screening within 72 hours of admission following acute ischemic stroke. 78.7% of patients suffered a mild stroke (CNS score >7), 9.5% had moderately severe stroke (CNS 5-7) and 6.3% had a severe stroke (CNS <5) | The association between formal dysphagia outcome and stroke outcomes was examined. | **Primary outcome:**<br>In-hospital pneumonia within 30 days of admission, severe disability (mRS 4-5) and all-cause mortality at 1 year | 19.2% of patients did not receive a dysphagia screen within 72 hours of admission.<br><br>Independent predictors of receiving a dysphagia screen included older age, admission to specialized units, the presence of weakness, speech difficulties and treatment with thrombolysis.<br><br>Patients with mild strokes were less likely to be screened compared with those with moderate strokes (adj OR=0.51, 95% CI 0.41-0.64).<br><br>Of the patients who were screened, 47.8% failed. Compared with patients who passed the screen, those who failed were at significantly higher risk of pneumonia (adj OR=4.71, 95% CI 3.43-6.47), severe disability (adj OR=5.19, 95% CI 4.48-6.02) and death (adj OR=2.42, 95% CI 2.09-2.80) |
| **Al-Khaled et al. 2016**<br><br>**Germany** | NA | 12,276 patients, ≥18 years recruited from 15 hospitals from 2007-2012 following admission for acute ischemic stroke. Mean age | The association between dysphagia, assessed shortly after admission to hospital, and clinical outcomes was examined. | **Primary outcomes:**<br>Stroke-related pneumonia during hospitalization | 9,164 patients were screened for dysphagia. 94% of patients were screened within 24 hours of admission. 3,083 patients had dysphagia.<br><br>Mean LOS was 9 days. During this time, 1,271 |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Retrospective study** | | was 73 years, 49% were women. | | **Secondary outcomes:** 30-day mortality, disability (mRS ≥2) at discharge and 30 days | patients (10.3%) developed pneumonia.<br><br>Pneumonia incidence was significantly higher in patients with dysphagia (29.7% vs. 3.75, p<0.001).<br><br>Dysphagia was an independent predictor of pneumonia (OR=3.4, 95% CI 2.8-4.2). Early dysphagia screening within 24 hours was protective (OR=0.68, 95% CI 0.52-0.89).<br><br>Dysphagia was also a significant, independent predictor of case fatality (OR=2.8, 95% CI 2.1-3.7), disability at discharge (OR=2.0, 95% CI 1.6-2.3), 3-month mortality (OR=3.2, 95% CI 2.4-4.2) and 3-month disability (OR=2.3, 95% CI 1.8-3.0) |
| **Rai et al. 2016**<br><br>**India**<br><br>**Cluster RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☒<br><br>ITT: ☒ | 162 patients, ≥18 years admitted to 2 wards within 72 hours of stroke onset. Mean age was 55.7 years, 73.5% were men. Median NIHSS score was 6 | Patients were randomized by ward to an intervention (n=77) or control group (n=85). Patients in the intervention group were managed by a stroke care pathway consisting of nurse education, care checklist, swallow assessment flowchart, swallow screen conducted by a physician, and patient and caregiver education. Patients in the control group were treated with conventional care. There was no dysphagia assessment, and feeding was started by the resident doctor based on clinical judgment. | **Primary outcome:** Aspiration pneumonia<br><br>**Secondary outcomes:** 3-month mortality, BI and mRS at 3 months | Non-significantly fewer patients in the intervention group developed aspiration pneumonia during hospitalization (6.5% vs. 15.3%, RR = 0.42, 95% CI 0.16-1.14, *p*= 0.062).<br><br>Fewer patients in the intervention group required mechanical ventilation during hospital stay (7.8% vs. 17.6%, p=0.05).<br><br>There were significantly fewer deaths in the intervention group at 90 days (7.8% vs. 20%, p=0.02).<br><br>There were no significant differences between groups in median mRS or BI scores at discharge or 3 months. |
| **Bax et al. 2014**<br><br>**New Zealand**<br><br>**Retrospective study** | NA | 440 patients admitted to a stroke unit and referred for an SLP assessment. Mean age was 76 years, 43% were men. Mean NIHSS score was 8. | The incidence of pneumonia before and after the implementation of a SLP-led FEES service was compared.<br><br>In the pre-FEES group, access to VFSS was available | **Primary outcome:** Pneumonia<br><br>**Secondary outcomes:** Mortality, diet on discharge, | The number of patients who received a FEES examination increased post FEES implementation (6.4% to 38.2%, p=0.008).<br><br>The percentage of patients developing pneumonia was significantly lower after the implementation of FEES (5% vs. 12%, p=0.37). |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | in the radiology department. In the FEES group, the stroke unit had access to a ward-based FEES service and VFSS, with SLPs qualified to perform FEES independently. | discharge destination, duration nil-by-mouth, incidence of nonoral feeding, and length of stay (LOS) | Mean LOS increased significantly post FEES implementation (23.7 vs. 17.3 days, p<0.001).<br><br>The percentage of patients requiring NG or PEG feeding did not change from pre to post implementation, nor did the mean number of nil by mouth days.<br><br>If a patient left hospital on an oral diet, they were significantly more likely to leave hospital on a standard rather than a modified diet post FEES implementation (66% vs. 51%, p=0.005).<br><br>The mean duration of NG feeding days was significantly longer post FEES implementation (13.5 vs. 7.6, p=0.013).<br><br>There was no significant change in mortality or discharge destination post FEES implementation. |
| **Masrur et al. 2013**<br><br>**USA & Canada**<br><br>**Retrospective study** | NA | Records of 314,007 patients with ischemic stroke admitted to GWTG–Stroke hospitals between April 2003 and March 2009 were reviewed. Median age was 73 years, 48% male. Median NIHSS score was 4. | The outcomes of patients who had received a standardized swallowing screen by any method that was accepted by individual institutions (including bedside or instrumental methods) were compared with those of patients who had not been screened. | **Primary outcome:** The incidence of pneumonia occurring after 48 hours of admission. | 216,372 (68.9%) patients were screened for dysphagia, 97,656 (31.1%) were not screened.<br><br>17,906 patients (5.7%) developed post-stroke pneumonia.<br><br>Patients who were screened for dysphagia were more likely to develop pneumonia compared with those who did not develop pneumonia (7.5% vs. 68.5%, p<0.001).<br><br>Significant predictors of whether a dysphagia screen was completed were increasing age, increasing NIHSS score, admission to an academic hospital, atrial fibrillation and dyslipidemia. |
| **Miles et al. 2013**<br><br>**New Zealand**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☒ | 311 patients, recruited from 4 hospitals who were referred to SLP following stroke for swallowing assessment. Mean age was | Patients were randomized to an experimental (n=149) or control group (n=163). Patients in the control group were assessed using local | **Primary outcome:** Pneumonia at 3 months following recruitment | Within the experimental group, 61% of patients passed the CRT with a strong cough, 21% passed with a weak cough (21%) and 18% failed the test. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | ITT: ☑ | 78 years, 47% were men. | protocols. Patients in the experimental group used a cough reflex test (CFT), using nebulized citric acid, delivered by face mask, prior to the standard assessment | **Secondary outcome:** 3-month mortality | There were no significant differences between groups in the number of patients who developed pneumonia (experimental 26% vs. control 21%, p=0.38), or who were dead at 3 months (experimental 20% vs. control 14%, p=0.23). |
| **Middleton et al. 2011**<br><br>**Australia**<br><br>**Cluster RCT** ***Quality in Acute Stroke Care (QASC)*** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☑ | 19 large tertiary care facilities with acute stroke units.<br><br>Patients were eligible if they had been admitted to one of these facilities with a diagnosis of stroke (ischemic or hemorrhagic) within 48 hours. Age was evenly distributed among 3 groups, age 65 to 85. 60% male. 41% mild stroke. | 4,198 patients were randomized to receive care at institutions that had adopted nursing protocols to identify and manage 3 complications-hyperglycemia, fever and swallowing dysfunction or to a control facility. Clinicians at the participating control institutions received abridged guidelines only.<br><br>The dysphagia component included education and training in the use of the ASSIST screening tool. Nurses were required to pass a clinical competency test prior to conducting swallowing screening. Patients who failed the screen were referred to an SLP for assessment. | **Primary outcome:** Death or dependency at 90 days (mRS score of ≥2), BI, SF-36 (mental component summary score), physical component summary score<br><br>**Secondary outcomes:** Mean temperature for first 72 hours, proportion of swallowing screenings completed within the first 24 hours of admission, pneumonia diagnosis, LOS | Intervention was associated with a decreased frequency of death or dependency at 90 days (42% vs. 58%, p=0.002).<br><br>The % of patients with BI scores ≥95 was non-significantly higher in the intervention group (69% vs. 60%, p=0.07).<br><br>**Dysphagia outcomes:**<br>Swallowing screening was performed more frequently in the intervention group (46% vs. 7%, p<0.0001). There was no difference between groups in the incidence of pneumonia (2% vs. 3%, p=0.82). |
| **Lakshminarayan et al. 2010**<br><br>**USA**<br><br>**Audit of National Stroke Registry** | NA | Records of 18,017 patients admitted and discharged for stroke from 222 hospitals in 6 states from March 1 to Dec 31, 2009, were reviewed. | Patients were identified and classified according to dysphagia screening status:<br>Unscreened<br>Screen/pass<br>Screen/fail.<br>Associations between screening status and incidence of pneumonia were explored using adjusted logistic regression | **Primary outcome:** Pneumonia | Number (%) of patients:<br>Unscreened: 4509 (25%)<br>Screened/pass: 8406 (46.6%)<br>Screened/fail: 5099 (28.3%)<br><br>Adjusting for age, gender, race, weakness, aphasia and altered level of consciousness, unscreened patients were at higher risk of developing pneumonia compared to patients who passed screening (OR=2.2, 95% CI 1.7 to 2.7). |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Hinchey et al. 2005**<br><br>**USA**<br><br>**Uncontrolled study** | NA | 15 institutions in the US (73% with dedicated stroke units) collected data prospectively on patients discharged with a diagnosis of ischemic stroke. | Adherence rates between sites with formal dysphagia screening<br>protocols and those without formal protocols were examined for differences in pneumonia rates | **Outcomes:**<br>Adherence rates to dysphagia screening development of pneumonia, mortality | 6 of the 15 sites had formal dysphagia screening protocols.<br><br>Screens were conducted more frequently at sites with a formal screening protocol (78% vs. 56%, p<0.0001.<br><br>Pneumonia occurred less frequently at sites with formal screening protocols (2.4% vs. 5.4%).<br><br>Mortality was higher among patients who developed pneumonia (21% vs. 4.8%, p<0.0001). |

## Dysphagia Treatment (Any)

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Duncan et al. 2020**<br><br>**UK**<br><br>**Systematic review & meta-analysis** | Using the Cochrane RoB tool, all trials were at low or unclear risk of bias of section bias, detection bias, attrition bias and reporting bias, while >50% of trials were at high risk for performance bias (blinding). | 22 RCTs including 1,700 adult patients in acute or critical care settings with dysphagia (19 trials included stroke patients in acute care, 2 included tracheostomized stroke patients in intensive care, and one trial included intubated patients on an intensive care unit). Mean age of patients ranged from 55 to 75 years. | Interventions included noninvasive electrical brain stimulation (transcranial electrical stimulation or transcranial magnetic stimulation, n=5), pharyngeal electrical stimulation (n=5), neuromuscular electrical stimulation (n=4), acupuncture (n=2), behavioral therapy (n=2), chin tuck (n=1), respiratory muscle strength training (n=1), tongue palate resistance training (n=1), and effortful swallow training and traditional swallowing exercises (n=1).<br><br>Control interventions included sham stimulation, swallowing exercises, and no therapy. | **Primary outcomes:**<br>Time taken to return to oral intake, aspiration incidence post-treatment (Penetration Aspiration Score >5)<br><br>**Secondary outcomes:**<br>Incidence of pneumonia, QoL (Swallowing Quality of Life Scale), hospital LOS, nutritional status (albumin level) and intervention-related adverse events. | Swallowing therapy was not associated with a significantly decreased time to resumption of oral intake (MD=4.5 days, 95% CI -10.6 to 1.63, 1 trial, n=33) GRADE: very low, or improvement in albumin level (MD=0.9 g/L, 95% CI -0.99 to 2.79, 1 trial, n=141). GRADE: low<br><br>Swallowing therapy was not associated with a significantly decreased risk of aspiration (RR=0.79, 95% CI 0.44 to 1.45, 4 trials, n=113) GRADE: low<br><br>Swallowing therapy was associated with a significantly lower risk of pneumonia (RR=0.71, 95% CI 0.56 to 0.89, 8 trials, n=719) GRADE: low<br><br>Swallowing therapy was not associated with a significantly decreased LOS (-0.4 days, 95% CI -3.6 to 2.8, 4 trials, n=536). GRADE: very low |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| | | | Frequency and duration of therapy varied widely (maximum duration was 8 weeks). | | Swallowing therapy was associated with a significantly improved QoL (MD=11.38, 95% CI -23.83 to -1.08 lower, 2 trials, n=239) GRADE: very low.<br><br>The risk of intervention-related adverse events was not increased significantly (RR=1.74, 95% CI 0.57 to 5.27, 2 trials, n=109). GRADE: low |
| **Bath et al. 2018**<br><br>**UK**<br><br>**Cochrane review** | ≤25% of trials were at high risk of selection, performance, detection and attrition biases. | 41 RCTs (2,660) including persons with post stroke dysphagia within 6 months of onset. | Treatment interventions included acupuncture (11 studies), behavioural interventions (9 studies), drug therapy (3 studies), neuromuscular electrical stimulation (NMES; 6 studies), pharyngeal electrical stimulation (PES; 4 studies), physical stimulation (3 studies), transcranial direct current stimulation (tDCS; 2 studies), and transcranial magnetic stimulation (TMS; 9 studies). | **Primary outcome:**<br>Death or dependency<br><br>**Secondary outcomes:**<br>Case fatality at the end of the trial, length of inpatient stay (LOS), proportion of participants with dysphagia at the end of the trial, swallowing ability, penetration aspiration score, chest infection or pneumonia, pharyngeal transit time, institutionalization, and nutrition. | Based on the results of a single trial, swallowing therapy (behavioral intervention) did not decrease the odds of the primary outcome (OR=1.05, 95% CI 0.63 to 1.75; 306 participants). GRADE; moderate certainty<br><br>Swallowing therapy (behavioral interventions, drug therapy, PES, physical stimulation, TMS) did not reduce the odds of case fatality at end-of-trial (OR= 1.00; 95% CI, 0.66–1.52; n=766; 14 studies). GRADE: moderate certainty<br><br>Swallowing therapy (behavioral interventions, PES) significantly reduced mean LOS (MD -2.9, 95% CI -5.65 to -0.15; 577 participants; 8 studies). GRADE: moderate certainty<br><br>Swallowing therapy (acupuncture, behavioral interventions, drug therapy, NMES, PES, physical stimulation, tDCS) significantly reduced the proportion of participants with dysphagia at the end of the trial (OR= 0.42, 95% CI 0.32 to 0.55; 1487 participants; 23 studies). GRADE: low certainty<br><br>Swallowing therapy (behavioral intervention, PES, NMES, TMS) did not reduce the mean penetration aspiration score, identified on radiological examination (SMD -0.37, 95% CI -0.74 to -0.00; 303 participants; 11 studies). GRADE: low certainty<br><br>Swallowing therapy (behavioral interventions, |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | | | drug therapy, NMES, PES) significantly reduced the incidence of chest infection or pneumonia (OR 0.36, 95% CI 0.16 to 0.78; 618 participants; 9 studies). GRADE: very low |

## Behavioral intervention

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Wang et al. 2022**<br><br>**China**<br><br>**RCT** | CA: ☒<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☒ | 37 patients recruited from a rehabilitation department with post-stroke dysphagia. Mean age was 61 years, 58% were men. Mean time since stroke was 4.8 months. 13 patients in the experimental and 14 in the control group were fed by nasogastric tubes. | Patients were randomized 1:1 to receive conventional dysphagia rehabilitation training, including orofacial motor control exercises, orofacial muscles sensory stimulation, respiratory training, and airway protection manipulation for 30 mins/day, 5 days a week for 4 weeks + tongue-pressure resistance training (TPRT) using a JMS tongue pressure measurement device for 20 mins/day, 5 days a week for 4 weeks or conventional dysphagia rehabilitation only. | **Primary outcomes:**<br>Functional Communication Measure for swallowing (FCM), Oral Motor Function Scale (OMFS), maximum tongue pressure (MTP), Murray Secretion Scale (MSS), Yale Pharyngeal Residue Severity Rating Scale (YPR-SRS), and Rosenbek Penetration–Aspiration Scale (PAS)<br><br>Assessments were conducted before and after the intervention | After treatment, there were significant improvements from baseline in mean or median scores for all outcomes in the TPRT group.<br><br>In the control group there was significant improvement in mean or median MTP, FCM, OMFS, YPR-SRS (piriform sinus) and PAS scores.<br><br>The difference in mean or median scores between groups was significantly better in the TPRT group for the outcomes of MTP, FCM, OMFS, MSS, YPR-SRS (piriform sinus) and PAS. |
| **Park et al. 2019**<br><br>**South Korea**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☒ | 24 patients recruited from an inpatient rehabilitation unit with post-stroke dysphagia. Mean age was 65 years, 46% were men. Mean time since stroke was 25 weeks. | Patient were randomized 1:1 to an experimental group or a control group. Patients in both groups performed traditional swallowing therapy including compensatory techniques (chin tuck and head tilting and rotation); therapeutic techniques such as orofacial muscle exercises, thermal tactile stimulation using ice sticks, and expiratory training, | **Primary outcome:**<br>Tongue strength, swallowing function (e Videofluoroscopic Dysphagia Scale [VDS])<br><br>Assessments were conducted before and after the intervention | There was significantly greater improvement in anterior and posterior tongue strength in the experimental group.<br><br>There was significantly greater improvement in the mean VDS score when the 7 items form the oral phase were totaled, in the intervention group (17.83 to 11.50 vs. 17.50 to 14.33, p= 0.017).<br><br>There were no significant differences between groups for any individual items associated with the oral or pharyngeal phase, or total VDS scores. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | provided as 30-minute sessions, 5x/week x 4 weeks. Patients in the experimental group also performed effortful swallowing training (EST), 10x per session, 3 sessions per day, 5 days per week. Patients in the control group performed sham EST. | | |
| **Carnaby et al. 2006**<br><br>**USA**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☑ | 306 patients with clinically identified dysphagia admitted to hospital within 7 days of acute stroke, with no previous history of dysphagia. Mean age was 71 years, 58% were men. | Patients were randomly assigned to receive usual care (supervision for feeding and precautions for safe swallowing; n=102), standard low-intensity intervention (composed of environmental modifications, safe swallowing advice and appropriate dietary modifications; n=102), or standard high-intensity intervention and dietary prescription (daily direct swallowing exercises, dietary modification; n=102). Treatment continued for up to a month. | **Primary outcome:**<br>Proportion of patients who had returned to their pre-stroke diet by 6 months.<br><br>**Secondary outcomes:**<br>Time to return to a normal diet, recovery of functional swallowing, number of dysphagia-related medical complications, death, need for institutionalization, dependency in ADL by 6 months after stroke. | Combining high-intensity and low-intensity groups into a single treatment group and comparing with the usual care group:<br><br>Normal diet at 6 months: RR=1.19, 95% CI 0.98 to 1.45, p>0.05<br><br>Return to functional swallow: RR=1.41, 95% CI 1.03 to 1.94, p<0.05.<br><br>Chest infection: RR=0.56, 95% CI 0.41 to 0.76, p<0.05<br><br>Death: RR=0.80, 95% CI 0.49 to 1.3, p>0.05<br><br>Institutionalization: RR=0.69, 95% CI 0.43 to 1.1, p>0.05<br><br>Dependency (Rankin ≥3) RR=1.05, 95% CI 0.82 to 1.3, p>0.05<br><br>Death or institutionalization: RR=0.73 95% CI 0.55 to 0.97, p<0.05<br><br>Dropouts and losses to follow-up: usual care n=23, low-intensity group n=21, high-intensity group n=19 |
| **DePippo et al. 1994**<br><br>**USA** | CA: ☒<br><br>Blinding:<br>Patient ☒<br>Assessor ☑ | 115 patients admitted to an inpatient rehabilitation unit an average of 5.6 weeks following confirmed stroke with | Patients were randomized to receive 1 of 3 treatment protocols: Group 1 (n=38) received one formal dysphagia treatment session and choice of | **Primary outcome:**<br>Pneumonia<br><br>**Secondary outcome:**<br>Dehydration, calorie- | The number of patients meeting a study end point in groups 1, 2 and 3<br><br>Any end point: 6 vs. 7 vs. 5, p>0.05 There was no difference between groups in time to end point. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **RCT** | ITT: ☒ | VMBS evidence of dysphagia and failure on the Burke Dysphagia Screening Test | modified-texture diet recommended by the SLP based on the results of the VMBS study; Group 2 (n=38) also received one dysphagia session, but were prescribed a texture-modified diet by the SLP; Group 3 received the same formal dysphagia treatment session, with an SLP controlled diet. Patients in group 3 were also seen daily by the SLP and received additional instructions in compensatory strategies. | nitrogen deficit, recurrent upper-airway obstruction, death<br><br>Patients were followed for the duration of their inpatient stay and for 1 year. Follow-up data was collected by telephone interview at 3,6 and 12 months | Pneumonia: 1 vs. 5 vs. 2, p>0.05<br><br>Dehydration: 3 vs. 0 vs. 1, p>0.05<br><br>Calorie-nitrogen deficient: 2 vs. 2 vs. 3, p>0.05<br><br>Recurrent upper-airway obstruction: 1 vs. 0 vs. 0, p>0.05<br><br>Death: 0 vs. 0 vs. 0, p>0.05<br><br>Dropouts: n=1 |

## Neuromuscular Electrical Stimulation (NMES)

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Tarihci Cakmak et al. 2023**<br><br>**Turkey**<br><br>**RCT** | CA: ☒<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☒ | 34 patients with post-stroke dysphagia. Mean age was 63 years, 59% were men. Mean time from stroke to enrolment was 50 weeks. | Patients were randomized 1:1 to receive traditional dysphagia therapy (TDT) + NMES with the VitalStim device (45 minutes/session x 5 days/week x3 weeks) or TDT only. Patients in both groups received TDT (45 minutes/sessions, 5 days/week x 3 weeks. TDT included diet modification, oral hygiene education, compensatory methods, and exercises. | **Primary outcomes:**<br>FOIS, Eating Assessment Tool (EAT-10), the Swallowing Quality of Life Questionnaire (SWAL-QOL)<br><br>Assessments were conducted before and after treatment and at 3 moths post intervention. | From baseline to end of treatment to follow-up, there were significant improvements within both groups in mean scores for all outcomes, with no between group differences. |
| **Carnaby et al. 2020**<br><br>**USA** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑ | 53 patients with post-stroke dysphagia (MASA score <178), recruited from a rehabilitation unit. Mean age was 66 years, | Patients were randomized to receive usual care (UC) including behavioral swallowing therapy (1 hour/day for 3 weeks, or until hospital | **Primary outcomes:**<br>MASA, FOIS<br><br>**Secondary outcomes:**<br>Treatment response, | 3-month data were available for 41 patients.<br><br>Post intervention, there was significantly greater improvement in mean MASA scores in the MDTP group + sham stimulation compared with the other |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **RCT** | ITT: ☒ | 47% were men. Mean time since stroke was 8 days. | discharge) or exercise-based swallowing therapy (McNeill Dysphagia Therapy: MDTP) swallowing therapy + active NMES with the VitalStim device or MDTP + sham NMES. | return to pre-stroke diet<br><br>Outcome was assessed at baseline, post treatment and at 3 months | 2 groups (17.6 vs. 15.2 [MDTP + NMES] vs. 13.3 [UC]).<br><br>Post intervention, there was significantly greater improvement in mean FOIS scores in the MDTP group + sham stimulation compared with the other 2 groups (2.1 vs. 1.2 [MDTP + NMES] vs. 0.53 [UC]).<br><br>Post intervention, a significantly higher percentage of patients in the MDTP + sham stimulation group were classified as full responders compared with the other 2 groups (86% vs.70% [MDTP + NMES] vs. 33% [UC]). Response was significantly higher in the MDTP + sham stimulation group vs. UC, but not for the comparison of MDTP + NMES vs. MDTP + sham NMES.<br><br>At 3-month follow-up, 91% of patients in the MDTP + sham group had returned to their pre-stroke diet, compared with 64% of patients in the MDTP + NMES group and 53% of patients in the UC group.<br><br>In adjusted analysis, compared with UC, MDTP + sham NMES was associated with a significantly greater likelihood of return to normal diet (HR=4.32, 95% CI 1.08-17.2). |
| **Chen et al. 2016**<br><br>**Taiwan**<br><br>**Systematic review & meta-analysis** | Jadad scores ranged from 1 to 5. | 8 RCTs including 329 patients with post-stroke dysphagia. Patients were included in the acute (n=2), subacute (n=8) and chronic stages (n=3). | Trials compared NMES +/- dysphagia therapy vs. dysphagia therapy without NMES. NMES was provided for 20 minutes to one hour per session, 10 to 20 sessions for 2 to 4 weeks. | **Primary outcome:** Dysphagia outcome, as reported in each study<br><br>Outcome was assessed at the end of treatment in 7 trials, and at 12 weeks in a trial that provided the intervention for 3 weeks. | NMES was associated with significantly better swallowing function scores (SMD=1.27 (95% CI 0.51-2.02). |
| **Park et al. 2016**<br><br>**South Korea** | CA: ☑<br><br>Blinding: | 61 patients recruited from a rehabilitation hospital with VFS confirmed | Patients were randomized to receive 6 weeks of sham or active NMES using the | **Primary outcomes:** Videofluoroscopy Dysphagia Scale (VDS) | The mean stimulation intensity was 13.2 mA.<br><br>Mean total VDS scores improved significantly over |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **RCT** | Patient ☒<br>Assessor ☑<br><br>ITT: ☒ | dysphagia following a stroke occurring within the previous 6 months, who were able to swallow against the resistance applied by using electrical stimulation. Mean age was 54.5 years, 52% were men. Mean time from stroke onset to randomization was 35.5 weeks. | VitalStim device for 30 minutes, 5x/week. Patients in both groups received conventional dysphagia treatment. In the experimental group, electrical stimulation was applied to induce a strong muscle contraction, while in the control group, the minimum stimulation that was needed for the patient to feel a tingling sensation, was applied. Patients performed an effortful swallow with their saliva or a small bolus during the stimulation to elevate the hyoid bone. | and Penetration–Aspiration Scale (PAS), assessed before and after treatment.<br><br>**Secondary Outcomes:**<br>Hyoid bone movement | the treatment period (active 59.3 to 45.1, p<0.0001 and control 59.5 to 57.4, p=0.02). The improvement was significantly greater in the active group (mean change =14.1 vs. 2.1, p<0.001).<br><br>Mean total PAS scores improved significantly over the treatment period in the active treatment group (4.96 to 3.60, p<0.001) but not in the control group (4.72 to 4.52, p=0.06). The improvement was significantly greater in the active group (mean change =1.36 vs. 0.2, p<0.001).<br><br>There was significant improvement in mean horizontal and vertical displacement (cm) of the hyoid bone for patients in the active treatment group, but not the control group.<br><br>There were 11 losses to follow-up. |
| **Lim et al. 2014**<br><br>**Korea**<br><br>**RCT** | CA: ☒<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☑ | 60 patients ≥18 years, with VFS-confirmed dysphagia following unilateral stroke occurring within the previous 6 months, who were able to understand and follow verbal commands. Mean age was 63 years, 57% were men. Mean NIHSS score was 8.5 | Patients were randomly assigned 1:1:1 to one of 3 groups: 1) conventional swallowing therapy group (muscle-strengthening, exercise for range of motion of the neck and tongue, thermal tactile stimulation and Mendelson maneuver), 2) NMES using the VitalStim for 30 minutes, 5x/week x 2 weeks + conventional therapy or 3) rTMS, delivered for 20 minutes (total 1,200 pulses a day), 5x/week x 2 weeks + conventional therapy. | **Primary outcome:**<br>Functional Dysphagia Scale (FDS)<br><br>**Secondary outcomes:**<br>pharyngeal transit time (PTT), Penetration Aspiration Scale (PAS), American Speech-Language Hearing Association National Outcomes Measurement System (ASHA NOMS)<br><br>Assessments were conducted at baseline, and at 2 and 4 weeks | Mean time from stroke onset to randomization was 34.5 days.<br><br>There was improvement in mean FDS and PAS scores in all groups over time. The difference in mean scores from baseline to 2 weeks and baseline to 4 weeks did not differ between groups using a semi-solid test bolus, but mean scores were significantly more improved in both the rTMS and NMES groups at both 2 and 4 weeks using a liquid test bolus, compared with conventional therapy group for both outcomes.<br><br>There was significant improvement in mean PTT (semi-solid and liquid boli) and ASHA NOMS scores among the 3 groups, but no significant differences in mean changes between groups.<br><br>There were 11 dropouts. |
| **Xia et al. 2011**<br><br>**China** | CA: ☒<br><br>Blinding: | 120 patients with post-stroke dysphagia (mean duration of 9 days) | Patients were randomly assigned to one of 3 groups: 1) conventional swallowing | **Primary outcome:**<br>Standardized Swallowing Assessment (SSA) | Mean±sd scores of groups 1, 2, 3 before and after treatment. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **RCT** | Patient ☒<br>Assessor ☑<br><br>ITT: ☒ | admitted to either the rehabilitation or neurology departments of a hospital. | therapy group, 2) electrical stimulation (ES) with the VitalStim therapy group, and 3) VitalStim therapy plus conventional swallowing therapy group. Treatments with ES were given twice a day for 230 min each, 5 days a week for 4 weeks. | **Secondary outcomes:** Dysphagia Severity Scale assessed using VMBS, Swallowing-related Quality of Life (SWAL-QoL) (44 items, higher scores indicate improvement)<br><br>Assessments were conducted before and after treatment. | SSA: 40.9±6.4 to 30.1±3.8 vs. 38.7±6.9 to 29.6±4.2 vs. 39.5±7.1 to 24.1±3.5<br><br>There were significant differences in scores between: groups 1 vs. 3 and 2 vs. 3<br><br>Dysphagia Severity Scale:2.74±1.63 to 5.32±1.43 vs. 2.65±1.56 to 5.63±1.57 vs. 2.53±1.58 to 6.88±1.58<br><br>There were significant differences in scores between: groups 1 vs. 3 and 2 vs. 3<br><br>SWAL-QoL: 863±83 to 624±45 vs. 850±75 to 645±58 vs. 885±60 to 458±35<br><br>There were significant differences in scores between: groups 1 vs. 3 and 2 vs. 3<br><br>There were no dropouts. |

## Pharyngeal Electrical Stimulation

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Bath et al. 2016**<br><br>**UK**<br><br>**RCT**<br>***Swallowing Treatment Using Pharyngeal Electrical Stimulation (STEPS) Trial*** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☑ | 162 patients, recruited from 20 sites, ≥18 years, with a recent ischemic or hemorrhagic stroke and dysphagia, defined as a penetration aspiration score (PAS) of ≥3, who could be treated within 42 days of stroke onset. Patients with a history of dysphagia were excluded. Mean age was 74 years, 58% were men. The mean time from stroke onset to randomization was 13 days. Mean Barthel Index score was 28.4. | Patients were randomized to receive 3 days of pharyngeal electrical stimulation (PES, n=87) or sham stimulation (n=75). Patients in the PES group received treatment for 10 minutes at a treatment current of threshold plus 75% of the difference between threshold and tolerance levels. Patients in the sham group received no stimulation after establishment of threshold and tolerated levels | **Primary outcome:**<br>Penetration Aspiration Score<br>(PAS) at 2 weeks<br><br>**Secondary outcomes:**<br>PAS at 12 weeks, Dysphagia Severity Rating Scale (DSRS), mRS, Barthel Index and death, assessed at 2 and 12 weeks | Mean baseline PAS were 4.8 (PES) and 4.7 (sham).<br><br>The mean treatment stimulation level was 14.5 mA.<br><br>141 patients received at least one treatment session. 58% of PES-treated patients had a treatment level <10.2 mA (i.e sub-therapeutic)<br><br>At two weeks following treatment, there was no significant between group difference in mean of 8 boli PAS (3.7 vs. 3.6, p=0.86). There were no interactions noted in subgroup analyses (age, sex, time from stroke onset, stroke type and severity, dysphagia severity or treatment intensity)<br><br>There was no significant difference between groups in the percentage of patients with any PAS >3 on any of the 8 test boli (85.7% vs. 80.4%, p=0.79).<br><br>There was no significant difference between groups in mean PAS at 12 weeks (average of all 8 test boli) 3.3 vs. 3.0, p=0.41.<br><br>There were no significant differences between groups on any of the secondary outcomes.<br><br>There were no serious adverse events recorded as probably or possibly related to treatment. |
| **Vasant et al. 2016**<br><br>**UK**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☑ | 36 patients, recruited from 3 hospitals with new onset dysphagia following stroke occurring within the previous 6 weeks. Eligible patients were screened using the TOR-BSST. Patients who | Patients were randomized to receive 3 consecutive days of pharyngeal electrical stimulation (PES, n=18) or sham stimulation (n=18). Patients in the PES group received treatment for 10 minutes at a treatment current | **Primary outcome:**<br>Presence of no/mild dysphagia (DSR of 0-3) at 2 weeks.<br><br>**Secondary Outcomes:**<br>As per primary outcome, assessed at 3 months, | Mean stimulation intensities were 19.9 mA (day 1), 18.1 mA (day 2) and 12.5 mA (day 3)<br><br>At 2 weeks, there was no significant difference between groups in the proportion of patients with no or mild dysphagia (11 patients (61%) in the active treatment group vs. 9 patients (50%) in the sham group, OR=2.5, 95% CI 0.52-14, p=0.26). |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | failed the screen were then identified as dysphagic using either VFS exam or FEES. Median age was 71 years, 61% were men. Median time from stroke onset to randomization was 13 days. Median baseline Dysphagia Severity Rating Scale (DSR) score was 8.0 | of 75% of the maximum level tolerated. Patients in the sham group received no stimulation. Patients in both groups received standard dysphagia therapy by a SLP. | time from randomization to hospital discharge, time from randomization to removal of feeding tube, Penetration Aspiration Scale (PAS) ≥3 | At 3 months there was no significant difference between groups in the proportion of patients with no or mild dysphagia (14 patients (78%) in the active treatment group vs. 13 patients (76%) in the sham group, OR=0.97, 95% CI 0.13-7, p=0.97).<br><br>The median times from randomization until hospital discharge were not significantly different (39 days in active vs. 52 days in sham groups, p=0.62).<br><br>Median time to NG tube removal was 8 days in active vs. 14 days in sham group, (p=0.33). |
| **Scutt et al. 2015**<br><br>**UK**<br><br>**Patient-level meta-analysis** | NA | 3 RCTs (n=72) including adults recovering from ischaemic or hemorrhagic stroke within 90 days of onset. Mean age was 72 years, 62% were men. Mean baseline NIHSS score was 10.6. Mean time from stroke onset to randomization was 15 days. | Treatment contrast was pharyngeal electrical stimulation versus control (sham or open label) treatment | **Primary outcomes:**<br>Aspiration, defined as a score of >3 using the Penetration Aspiration Score<br>(PAS) at 2 weeks and clinical dysphagia severity, defined as a score of >3, using the Dysphagia Severity Rating Scale (DSRS)<br><br>**Secondary outcomes:**<br>NIHSS score, pneumonia, LOS and death | The mean threshold sensitivity was 11.4 mA and treatment level was 16.8 mA.<br><br>Using the mean of the first three boli, the mean PAS score was significantly lower in the active PAS group (3.4 vs. 4.1). In a model adjusting for trial, relevant baseline score, age, and NIHSS, the difference in the OR between groups was -0.9, 95% CI -1.7 to -0.1, p=0.02. In subgroup analysis, treatment was more effective in patients with more severe strokes (NIHSS >10 vs. ≤10 and for those with more severe dysphagia (PAS .4 vs. ≤4). Treatment was also more effective for patients sensitive to low stimulation currents (<8mA).<br><br>A significantly lower percentage of participants in the active PAS group had a DSRS score >3 (30.3% vs. 53.3%, p=0.032), and had lower mean DSRS scores (3.8 vs. 4.4, p=0.04).<br><br>There were no significant differences between groups for any of the secondary outcomes. |

## Non-invasive Brain Stimulation (NIBS)

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
|---|---|---|---|---|---|
| **Li et al. 2021**<br><br>**China**<br><br>**Systematic review & meta-analysis** | PEDro scores ranged from 6-9. | 18 RCTs including 738 patients with post-stroke dysphagia. Mean ages ranged from 55 to 79 years. | Trials compared tDCS (n=7) and rTMS (n=11) vs. sham stimulation.<br><br>All tDCS trials targeted the pharyngeal motor cortex of the unaffected side or affected side (1-2 mA), while the target areas varied in the rTMS trials (1-5 Hz).<br><br>Duration of the intervention ranged from 10 days to 8 weeks. | **Primary outcomes:** Dysphagia Outcome and Severity Scale (DOSS), Standardized Swallowing Assessment (SSA) and Penetration-aspiration Scale (PAS)<br><br>**Secondary outcomes:** Functional Dysphagia Scale (FDS), water swallow test (WST) | NIBS was associated with significantly higher DOSS scores (SMD=1.44, 95% CI 0.80 to 2.08, 8 trials, n=284). The effect size was larger for rTMS (SMD=2.58 vs. 1.05).<br><br>NIBS was associated with significant improvement in SSA scores (SMD=-1.04, 95% CI -1.50 to -0.58, 7 trials, n=414). The effect size was larger for rTMS (SMD=-1.29 vs.-0.46).<br><br>NIBS was associated with significant improvement in PAS scores (SMD=-0.85, 95% CI -1.33 to -0.36, 8 trials, n=297).<br><br>NIBS was associated with significant improvement in FDS scores (SMD=-1.05, 95% CI -1.48 to -0.62, 3 trials, n=98).<br><br>NIBS was associated with significantly higher WST scores (SMD=6.23, 95% CI 5.44 to 7.03, 2 trials, n=150).<br><br>Adverse events were reported in only 2 trials Dizziness, headache, or nosebleed were reported, but resolved shortly after treatment. |
| **Suntrup-Krueger et al. 2018**<br><br>**Germany**<br><br>**RCT** | CA: ☒<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☒ | 60 patients ≥ 18 years diagnosed with dysphagia resulting from acute ischemic stroke. Mean age was 67.5 years, 58% were men. Mean NIHSS score at admission was 12. | Patients were randomized 1:1 to receive contralesional anodal tDCS (1mA) or sham stimulation over the contralesional swallowing motor cortex for 20 minutes, once daily for 4 consecutive days. | **Primary outcome:** Improvement in Fiberoptic Endoscopic Dysphagia Severity Scale (FEDSS) scores<br><br>**Secondary outcomes:** Dysphagia Severity Rating Scale (DSRS), dysphagia limit (the amount of water that could be swallowed without piecemeal deglutition or clinical signs of aspiration) | Mean time from stroke onset to study inclusion was 4.8 days.<br><br>Mean FEDSS scores improved significantly from baseline to post intervention (active tDCS group: $p < 0.001$ and sham group: $p = 0.027$) and from then to discharge within both groups.<br><br>At the end of treatment there was significantly greater improvement in mean FEDSS and DSRS scores in the active stimulation group (-1.3 vs. -0.4, p=0.005, and -4.0 vs. -1.5, p<0.001, respectively). The improvements were maintained until discharge. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | | | At the end of treatment there was significantly greater improvement in dysphagia limit in the active stimulation group (mean 5.0 vs. 1.8 mL fluid, p=0.018).<br><br>The incidence of pneumonia was non-significantly lower in the active stimulation group (37.9% vs. 53.3%, p=0.235). |
| **Du et al. 2016**<br><br>**China**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☒ | 40 patients with dysphagia secondary to first-ever hemispheric ischemic stroke, recruited from a single institution from 2013-2014, with onset of symptoms within 2 months. Mean age was 58 years, mean time from stroke to recruitment was 7 days. | Patients were randomized to receive high-frequency (3-Hz), low-frequency (1-Hz), or sham (control) rTMS for 5 consecutive days. | **Primary outcome:**<br>Standardized Swallowing Assessment (SSA) at 3 months<br><br>**Secondary outcomes:**<br>mRS score, Barthel Index<br><br>Assessments were conducted at baseline, day 5, 1, 2 and 3 months | There was significant improvement in the SSA scores at 3 months for patients in both rTMS groups, which was maintained over time, but not for patients in the control group.<br><br>There was significantly greater improvement in mean mRS and median BI scores over at 3 months for patients in both rTMS groups, but not for patients in the control group. |
| **Shigematsu et al. 2013**<br><br>**Japan**<br><br>**RCT** | CA: ☒<br><br>Blinding:<br>Patient ☑<br>Assessor ☑<br><br>ITT: ☒ | 20 patients, recruited from a single rehabilitation facility at least 4 weeks from stroke onset, with chronic, severe dysphagia. Mean age was 65.8 years, 65% | Patients were randomized to receive real (n=10) or sham (n=10) anodal tDCS for 10 days. In the real tDCS group, the stimulation level was 1-mA, treatment was provided for 20 minutes. Electrodes were placed over the ipsilesional hemisphere, at the location of the pharyngeal motor cortex. Patients in both groups also received conventional swallowing therapy. | **Primary outcome:**<br>Dysphagic Outcome and Severity Scale (DOSS),<br><br>Assessments were conducted before and after treatment and at 1-month post treatment. | Mean duration from stroke onset to initiation of treatment was 12 weeks.<br><br>Mean admission FIM score was 34.1.<br><br>Mean DOSS scores improved significantly over time in the real tDCS group (1.9 ± 0.7 to 3.3 ± 1.3, post treatment, (mean change =1.4, p=0.006) to 4.7 ± 0.9, at one month (mean change from baseline=2.8, p=0.004).<br><br>In the sham tDCS group, mean DOSS score increased non-significantly from 2.3 ± 1.0 to 2.8 ± 1.0, post treatment (mean change from baseline=0.5, p=0.059), but the increase at 1-month post treatment was significant (3.5 ± 0.9, mean change=1.2, p=0.026).<br><br>The differences in mean scores post treatment and at one-month post treatment between groups were significant (p= p=0.029 and |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | | | p=0.007, respectively).<br><br>Before therapy, 2 patients in the real tDCS group and 3 in the sham group were fed PO exclusively. After treatment, all patients in the real tDCS group and 2 in the sham group were taking an oral diet exclusively. |
| **Park et al. 2013**<br><br>**South Korea**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☑<br>Assessor ☒<br><br>ITT: ☑ | 18 patients with unilateral hemispheric stroke and oropharyngeal dysphagia confirmed by VFS examination, lasting more than one month. Mean age was 71.3 years, 56% were men. | Patients were randomized to receive 10 days of real (n=9) or sham rTMS (n=9).<br><br>In the real rTMS group, stimulation was applied for 10 min every day (5-Hz stimulation, 10 blocks of 50 pulses), with coil positioned over esophageal area of the affected hemisphere. | **Primary outcomes**: Videofluoroscopic dysphagia scale (VDS) and Penetration-aspiration scale (PAS) scores.<br><br>Outcomes were assessed before and after the intervention and at 2 weeks follow-up. | Mean duration from stroke onset to initiation of treatment was 62 days.<br><br>Mean VDS score in the real rTMS group was reduced significantly from baseline to post-intervention (33.6 to 25.3, p<0.05). The improvement was maintained at 2-week follow-up. The improvement was most pronounced in the pharyngeal phase, compared with oral phase).<br><br>Mean VDS score in the sham rTMS group did not improve significantly over the study period (baseline 23.4, post treatment 21.2, 2-week follow-up 20.4, p>0.05)<br><br>Mean PAS scores were reduced significantly among patients in the real rTMS group over the study period (3.41 to 1.93to 1.37, p<0.05), but were not among patients in the sham group (3.30 to 3.00 to 3.11, p>0.05).<br><br>Baseline prevalences of aspiration, pharyngeal residue, delayed triggering of pharyngeal swallowing and abnormal pharyngeal transit time (PTT) in EG were 66.7%, 66.7%, 33.3%, and 44.4%, respectively.<br><br>After rTMS, the prevalences of aspiration and pharyngeal residue were both reduced to 33.3%. However, the prevalence of delayed triggering and abnormal PTT was not changed. |

## Enteral Feeding

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Zhao et al. 2022**<br><br>**China**<br><br>**RCT**<br>***Optimizing Early Enteral Nutrition in Severe Stroke (OPENS) study*** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☑ | 321 adult patients with acute severe ischaemic or haemorrhagic stroke (Glasgow Coma Scale score ≤12 or NIHSS score ≥11 on admission), recruited from 16 acute care centres who were expected to receive enteral nutrition for more than 7 days. Median age was 71 years, 58% were men. Median NIHSS score was 17. Time from stroke onset to randomization was <2 days. | Patients were randomized (1:1:1) to receive full enteral nutrition (70–100% of estimated caloric requirements), modified full enteral nutrition (full enteral nutrition plus prokinetic agents), or hypocaloric enteral nutrition (40–60% of estimated caloric requirements), initiated within 24 hours and maintained for 7 days. | **Primary outcome:**<br>Poor outcome (mRS score ≥3) at day 90<br><br>**Secondary outcomes:**<br>Barthel Index (BI) at 90 days, NIHSS score at discharge, 90-day mortality | The trial was stopped prematurely, due to excess deaths.<br><br>The percentage of patients with the primary outcome was 80% (full enteral nutrition), 82% (modified full enteral nutrition) and 73% (hypocaloric).<br><br>There were no significant differences in pair-wise comparisons between groups, in adjusted analysis.<br>Modified full enteral nutrition vs. full enteral nutrition OR=0·87, 95% CI 0·41−1·86<br>Hypocaloric enteral nutrition vs. full enteral nutrition OR=0·61, 95% CI 0·30−1·27).<br>Hypocaloric enteral nutrition vs modified full enteral nutrition OR=0·70, 95% CI 0·34−1·46.<br><br>Median 90-day BI scores were 35 (full enteral nutrition), 30 (modified full enteral nutrition) and 20 (hypocaloric). There were no significant differences in pair-wise comparisons between groups, in adjusted analysis.<br><br>Median discharge NIHSS scores were 13 (full enteral nutrition), 14 (modified full enteral nutrition) and 15 (hypocaloric).<br><br>The percentage of patients who were dead at 90 days was 23% (full enteral nutrition), 17% (modified full enteral nutrition) and 34% (hypocaloric).<br><br>In pair-wise comparisons, the odds of death were increased significantly in hypocaloric enteral nutrition group vs full enteral nutrition group (OR=1·92, 95% CI 1·00−3·69) and modified full enteral nutrition group (OR=2·89, 95% CI 1·46−5·72). |
| **Gomes et al. 2015** | All trials were at high | 11 RCTs (735 participants, 462 with | Trials compared enteral feeding using NG vs. PEG | **Primary outcome:**<br>Treatment failure (feeding | Length of follow-up ranged from 4 weeks to 6 months. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Brazil**<br><br>**Cochrane review** | risk of performance bias (lack of blinding participants, 3 did not blind outcome assessors), >30% of trials were at risk of "other" biases. | stroke), including adults with swallowing disturbances or dysphagia, with an indication for nutritional support. | devices. | interruption due to blocked or dislodged tubes, or non-adherence)<br><br>**Secondary outcomes:** mortality, nutritional status, pneumonia, adverse events | PEG feeding was associated with a significantly reduced risk of treatment failure including feeding interruption, blocking or leakage of the tube, non-adherence (RR= 0.18, 95% CI 0.05-0.59). Results from 8 trials included. GRADE: low certainty<br><br>PEG feeding was not associated with a significantly reduced risk of mortality at end of follow-up (RR= 0.86, 95% CI 0.58-1.28). Results from 9 trials included. GRADE: very low certainty<br><br>PEG feeding was not associated with a significantly reduced risk of adverse events or pneumonia (RR= 0.83, 95% CI 0.51-1.34, results from 6 trials and RR= 0.70, 95% CI 0.46-1.06, results from 7 trials, respectively). GRADE: low certainty |
| **Dennis et al. 2005**<br><br>**UK**<br><br>**RCT**<br>***Feed or Ordinary Diet trial (FOOD*)**<br>**(part I- timing and method of feeding)** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☑ | 1,210 patients admitted within 7 days of first or recurrent stroke, from 47 hospitals in 11 countries.<br><br>In the early vs. avoid group mean age was 76 years, 45% were men. 8.5% were malnourished at baseline.<br><br>In the NG vs. PEG group, mean age was 76 years, 45% were men. 28% were malnourished at baseline. | i) Patients were randomized to receive feeds as early as possible (n=429) or to avoid feeding for 7 days (n=460) using either a PEG or NG feeding tube.<br><br>ii) Patients were randomized to receive either a PEG (n=162) or NG feeding tube (n=159) within 3 days of enrolment into the study | **Primary outcome:**<br>Death or poor outcome (defined as a mRS score of 4-5), assessed at 6 months.<br><br>**Secondary outcomes:**<br>Components of the primary outcome, LOS, discharge destination and complications | *Early vs. avoid feeding*<br>Early tube feeding was not associated with a reduction in the primary outcome (early 339 [79%] vs. avoid 344 [80%], absolute risk reduction=1.2%, 95% CI -4.2 to 6.6, p=0.7). In subgroup analysis, age, nutritional status (underweight/normal weight/overweight) and stroke severity were not effect modifiers.<br><br>Early tube feeding was not associated with a significant reduction in death at 6 months (early 182 [42%] vs. 207 [48%], absolute risk reduction=5.8%, 95% CI -0.8 to 12.5, p=0.09) or a reduction in poor outcome (early 157 [37%] vs.137 [32%]).<br><br>The mean LOS was 45 days in the early group and 44 days in the avoid group (mean difference=1·3 days, 95% CI –8·6 to 5·9).<br><br>There was a single loss to follow-up.<br><br>*PEG vs. NG feeding*<br>PEG feeding was associated with a nonsignificant increase in the primary outcome (PEG 144 [89%] |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | | | | vs. NG 129 [81%], absolute risk increase= 7·8%, 95% CI 0·0% to 15·5%, p=0·05). In subgroup analysis, age, nutritional status (underweight/normal weight/overweight), stroke severity and early/late randomization were not effect modifiers.<br><br>PEG feeding was not associated with a reduction in the risk of death at 6 months (PEG 79 [49%] vs. NG 76 [8%], absolute risk increase=1.0%, 95% CI -10.0 to 11.9, p=0.9).<br><br>The mean LOS was 55 days in the PEG group and 53 days in the NG group (mean difference= –2·1 days, 95% CI –15·5 to 11·3).<br><br>There were no significant differences in the discharge destinations between the two groups in either trial.<br><br>Adverse events: Gastro-intestinal bleeds occurred more frequently in the early feeding group compared with the late group (22 vs. 11, p=0.04) and with NG tubes compared with PEG (18 vs. 5, p=0.005). There were more pressure sores in the PEG group compared with NG (12 vs. 4, p=0·04). |
| **Hamidon et al. 2006**<br><br>**Malaysia**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☒<br><br>ITT: ☒ | 23 consecutive patients admitted with acute ischemic stroke with persistent dysphagia for ≥7 days. Median age was 72 in the NG group and 65 years in the PEG group. 48% were men. | Patients were randomized to receive either an NG (n=13) or PEG feeding tube (n=10). | Primary outcomes:<br>Changes in nutritional indices at 4 weeks follow-up including: triceps skinfold (TSF), bicep skinfold (BSF), mid-arm circumference (MAC), serum albumin, and treatment failure, defined as persistent blocked or dislodged tubes | 22 patients completed the study.<br><br>At the end of four weeks, patients in the PEG group had significant increase in the median serum albumin values compared with baseline, whereas subjects in the NG group experienced a decrease (+2.5 vs. -5.0 g/L, p=0.045).<br><br>There were more treatment failures in the NG group (5/10 vs. 0/8, p=0.036).<br><br>There were no other significant differences between groups. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Norton et al. 1996**<br><br>**UK**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☒<br><br>ITT: ☑ | 30 patients admitted to 2 hospitals with severe stroke, who were unconscious at the time of admission and with dysphagia which persisted for ≥ 8 days. Mean age was 77 years, 63% female. Mean Barthel Index score at randomization was 3. | At a mean of 14 days post stroke, patients were randomized to receive either a gastrostomy (G, n=16) feeding tube or nasogastric (NG, n=14) feeding tube for enteral feeding. | **Primary outcomes:**<br>Mortality at 6 weeks after initiation of feed and changes in nutritional state during this period.<br><br>**Secondary outcomes:**<br>Treatment failure, LOS | At 6 weeks, a significantly greater proportion of patients had died in the NG group compared to patients in the G group (2 vs 8), p<0.05).<br><br>Patients in the G group had significantly better nutritional indices including weight, serum albumin, mid-arm circumference.<br><br>There were no omitted feeds among patients in the G group compared to at least one missed feed in 10 patients in the NG group. |

## Oral Hygiene

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| **Campbell et al. 2020**<br><br>**UK**<br><br>**Cochrane review** | Using the Cochrane RoB tool, 25%-60% of all trials were at low risk of bias in ≥1/9 domains assessed. | 15 RCTs (n= 1,546) including persons recovering from stroke in the hospital, nursing homes or community setting and mixed samples; and healthcare personnel (e.g., nurses, dentists, dental assistants). | Trials examined interventions designed to improve the cleanliness and health of the mouth, tongue and teeth who received assisted oral health care (OHC) led by healthcare staff or informal carers.<br><br>Trials compared OHC vs. no treatment/usual care (n=7); OHC vs. placebo (n=3) and one OHC intervention vs. another OHC (n=12).<br><br>Types of OHC interventions included combinations of education and training, materials (e.g., | **Primary outcomes:**<br>Dental plaque (Plaque scale), Denture plaque (Denture Cleanliness Scale)<br><br>**Secondary outcomes:**<br>presence of gingivitis; denture-induced stomatitis; pneumonia and staff/patient oral health knowledge | *OHC vs. usual care*<br>Oral health interventions were not associated with significant reductions in dental plaque one month after the intervention was delivered (MD=-0.66, 95% CI -1.40 to 0.09; 2 trials, n=83). GRADE: very low certainty; *or* the presence of gingivitis (MD=-0.60, 95% CI -1.66 to 0.45; 2 trials, n=83). GRADE: very low certainty; *or* denture-induced stomatitis (MD=–0.33, 95% CI –0.92 to 0.26; 1 trial, n=38). GRADE: low certainty *or* pneumonia (OR=4.17, 95% CI 0.82 to 21.11; 1 trial, n=204). GRADE: low certainty<br><br>Oral health interventions were associated with a significant reduction in denture plaque (MD=-1.31, 95% CI -1.96 to -0.66; 1 trial, n=66). GRADE: low certainty and improvement in staff/patient OHC knowledge one month after the intervention was delivered (MD=0.70, 95% CI 0.06 to 1.35; 3 trial, n=728). GRADE: very low certainty<br><br>*OHC vs. placebo* |

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| | | | toothbrush, toothpaste, mouth gel, mouthwash, tongue cleaners, lip balm, care protocols), selective decontamination of the digestive tract, povidone-iodine rinse. | | Oral health interventions were not associated with a significant reduction in the odds of pneumonia (OR=0.39, 95% CI 0.14 to 1.09; 2 trials, n=242). GRADE: low certainty<br><br>*OHC intervention vs. another OHC*<br>An enhanced multi-component OHC intervention was not associated with significant reductions in dental plaque compared with conventional OHC interventions at 3 months (MD=-0.04, 95% CI -0.33 to 0.25; 1 trial, n=61). GRADE: low certainty |
| **Yuan et al. 2020**<br><br>**China**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☑<br><br>ITT: ☒ | 113 patients with an acute (within 24 hours) stroke to a neurological intensive care unit. Mean age was 61% were men. Median NIHSS score was 9. | 84 patients were randomized 1:1 to receive intensified oral hygiene care (IOHC) or routine oral hygiene care for 7 days. In the IOHC group, in addition to oral self-care, all teeth and oral soft tissues were swabbed with 0.12% chlorhexidine digluconate mouth wash (5-minute duration, 3 times daily). Routine dental care was performed by patients as was their custom, or with oral swabbing with saline (2-minute duration, twice daily) for patients who could not perform this task themselves. | **Primary outcome:**<br>Stroke-associated pneumonia (SAP) | During 7 days of follow-up, the incidence of SAP was 6 in the IOHC group and 13 in the routine care group (OR=0.349, 95% CI 0.118-1.033, p=0.052).<br><br>In subgroup analysis, the incidence of SAP was significantly lower in the IOHC among men, patients with NIHSS scores >10, those with Glasgow Coma Scale scores <12, a Gugging Swallowing Screen score <15 and a Debris Index score ≥1.8. |
| **Murray & Scholten 2017**<br><br>**Australia**<br><br>**Combined data from RCT + observational study** | NA | 89 patients recruited from 3 stroke units, with a confirmed diagnosis of stroke. Mean age of patients with dysphagia was 79 years, and 69 years in those without dysphagia. 64% were men. Mean time post | The outcomes of patients with (n=12) and without dysphagia (n=77) following 7 days of an oral care intervention, which included teeth or denture brushing with normal toothpaste twice daily, after breakfast and | **Primary outcome:**<br>Oral Health Assessment Tool (OHAT) | Patients with dysphagia were older (79 vs. 69 yrs, p<0.003) and recruited sooner after stroke (19.8 vs. 41.1 days, p=0.038).<br><br>For patients with dysphagia, there was significant improvement in median OHAT scores from day 0 to day 7 (4 to 3, p=0.024). 59% of participants had an improvement in their oral health scores of 1 or more points. |

| Study/Type | Quality Rating | Sample Description | Method | Outcomes | Key Findings and Recommendations |
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| | | stroke was <40 days. | in the evening, and rinsing of the mouth after lunch, were compared. The standard of care on the stroke unit was once-daily (morning) teeth brushing. | | For patients without dysphagia, there was no significant improvement in median OHAT scores from day 0 to day 7 (2 to 2, p=0.282). 29% of the participants had improved oral health scores at day 7.<br><br>The median OHAT scores were significantly different at baseline and after 7 days, between dysphagic and non-dysphagic patients. |
| **Lam et al. 2013**<br><br>**China**<br><br>**RCT** | CA: ☑<br><br>Blinding:<br>Patient ☒<br>Assessor ☒<br><br>ITT: ☒ | 102 dentate patients admitted to a rehabilitation unit following ischemic stroke or ICH within the previous 7 days, with a Barthel index score of <70. Mean age was 70 years. | Patients were randomized to receive oral hygiene instruction (OHI, n=33), OHI + chlorhexidine (CHI) mouth rinse, (n=34), or OHI + CHI + assisted tooth brushing (n=35) twice daily for 3 weeks | **Primary outcomes**:<br>Plaque Index (PI) (Silness & Loe, 1964). Scores range from 0-3 with lower scores indicating better oral hygiene status.<br>Gingival Bleeding Index (GBI, Carter & Barnes, 1974). The presence or absence of gingival inflammation is noted after passing unwaxed dental floss at 6 sites into the proximal sulci. Bleeding is recorded as present or absent (0,1).<br><br>Secondary outcomes:<br>Pneumonia, treatment satisfaction.<br><br>Outcomes were assessed before and after treatment | At baseline, only 33% of patients reported brushing their teeth daily.<br><br>The mean PI scores of patients in the OHI+CHX and OHI+CHX+assisted brushing groups improved significantly more than patients in the OHI group (p<0.001)<br>Mean before/after treatment scores<br>OHI: 2.0 to 1.2, OHI+CHX: 1.9 to 0.6, OHI+CHX+ assisted brushing: 1.9 to 0.5.<br><br>The mean GBI score of patients in the OHI+CHX group was improved significantly more than patients in the OHI group (p<0.032)<br>Mean before/after treatment scores<br>OHI: 16.7 to 17.7, OHI+CHX: 18.8 to 10.0, OHI+CHX+ assisted brushing: 16.7 to 7.6.<br><br>No patient in either group developed pneumonia during the treatment period.<br><br>Only 1 patient dropped out of the study due to non-compliance with CHX treatment. |
| **Lam et al. 2011**<br><br>**China**<br><br>**Systematic review** | NA | 8 studies that aimed to assess the effectiveness of oral health promotion activities in patients with cardiovascular disease.<br><br>Patients included in these studies were diagnosed | Most interventions evaluated included cleaning, scaling, root planing and/or extractions.<br><br>In the single RCT that included patients | **Primary outcome:**<br>Periodontal health | Results from stroke-specific study<br>There were no differences between groups in dental plaque, gingivitis, or denture-induced stomatitis at 1 and 6 months.<br><br>The experimental group exhibited significantly less denture plaque than the control group at 1 and 6 months (p<0.0001) |

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| | | with hypertension (n=2), coronary artery disease and/or a previous coronary event (n=3) or were recovering from heart transplants (n=1). In one study, 67 patients residing in 20 nursing homes following stroke, were included. | following stroke, an oral health care education program (OHCE) was provided to nursing home care assistants vs. delayed intervention. | | Nursing staff receiving OHCE program exhibited higher knowledge scores ($p<0.005$) at 1 month, and 6 months ($p<0.001$) and significantly better attitudes to oral care ($p= 0.001$) |

**Abbreviations**

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| BI: Barthel Index | CA: Concealed Allocation |
| CI: Confidence Interval | FEES: Fibreoptic Examination of Swallowing Safety |
| FOIS: Functional Oral Intake Scale | ITT: Intention to treat |
| MASA: Mann Assessment of Swallowing Ability | MD: mean difference |
| N/A: Not Assessed/not applicable | NG: nasogastric |
| NIHSS: Nation Institutes of Stroke Scale | NMES: neuromuscular electrical stimulation |
| OR: Odds Ratio | PEG: Percutaneous Endoscopic Gastronomy |
| RCT: Randomized Controlled Trial | RoB: risk of bias |
| SLP: Speech-Language Pathologist | SMD: Standardized Mean Difference |
| VSF: Video Fluoroscopic Swallowing | |

# Reference List

Al-Khaled M, Matthis C, Binder A, Mudter J, Schattschneider J, Pulkowski U et al;for QugSS II Group. Dysphagia in patients with acute ischemic stroke: early dysphagia screening may reduce stroke-related pneumonia and improve stroke outcomes. *Cerebrovasc Dis* 2016;42(1-2):81-89.

Bath PM, Lee HS, Everton LF. Swallowing therapy for dysphagia in acute and subacute stroke. *Cochrane Database Syst Rev* 2018, Issue 10. Art. No.: CD000323. DOI: 10.1002/14651858.CD000323.pub3.

Bath PM, Scutt P, Love J, Clavé P, Cohen D, Dziewas R et al. Pharyngeal electrical stimulation for treatment of dysphagia in subacute stroke: A randomized controlled trial. *Stroke* 2016;47(6):1562-70**.**

Bax L, McFarlane M, Green E, Miles A. Speech-language pathologist-led fiberoptic endoscopic evaluation of swallowing: functional outcomes for patients after stroke. *J Stroke Cerebrovasc Dis*. 2014 Mar;23(3):e195-200.

Boaden E, Burnell J, Hives L, Dey P, Clegg A, Lyons MW, et al. Screening for aspiration risk associated with dysphagia in acute stroke. *Cochrane Database of Syst Rev*. 2021;10:CD012679 NEW

Bray BD, Smith CJ, Cloud GC, Enderby P, James M, Paley L et al; SSNAP Collaboration. The association between delays in screening for and assessing dysphagia after acute stroke, and the risk of stroke-associated pneumonia. J *Neurol Neurosurg Pschyiatry* 2017;88:25-30.

Campbell P, Bain B, Furlanetto DLC, Brady MC. Interventions for improving oral health in people after stroke. *Cochrane Database of Syst Rev* 2020, Issue 12. Art. No.: CD003864.

Carnaby G, Hankey GJ, Pizzi J. Behavioural intervention for dysphagia in acute stroke: A randomised controlled trial. *Lancet Neurol* 2006;5:31-37.

Carnaby GD, LaGorio L, Silliman S, Crary M. Exercise-based swallowing intervention (McNeill Dysphagia Therapy) with adjunctive NMES to treat dysphagia post-stroke: A double-blind placebo-controlled trial. *J Oral Rehabil*. 2020 Apr;47(4):501-510.

Chen YW, Chang KH, Chen HC, Liang WM, Wang YH, Lin YN. The effects of surface neuromuscular electrical stimulation on post-stroke dysphagia: a systemic review and meta-analysis. *Clin Rehabil*. 2016 Jan;30(1):24-35.

Dennis MS, Lewis SC, Warlow C. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): A multicentre randomised controlled trial. *Lancet* 2005;365:764-72.

DePippo KL, Holas MA, Reding MJ, Mandel FS, Lesser ML. Dysphagia therapy following stroke: a controlled trial. *Neurology* 1994;44:1655-60.

Du J, Yang F, Liu L, Hu J, Cai B, Liu W. et al. Repetitive transcranial magnetic stimulation for rehabilitation of poststroke dysphagia: A randomized, double-blind clinical trial. *Clin Neurophysiol* 2016;127(3):1907-1913.

Duncan S, McAuley DF, Walshe M, McGaughey J, Anand R, Fallis R, Blackwood B. Interventions for oropharyngeal dysphagia in acute and critical care: A systematic review and meta-analysis. *Intensive Care Med*. 2020 Jul;46(7):1326-1338.

Gomes Jr CAR, Andriolo RB, Bennett C, Lustosa SAS, Matos D, Waisberg DR, Waisberg J. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. *Cochrane Database of Systematic Reviews* 2015, Issue 5. Art. No.: CD008096. DOI: 10.1002/14651858.CD008096.pub4.

Gurgel-Juarez N, Egan M, Wiseman M, Finestone H, Flowers HL. Technology for maintaining oral care after stroke: considerations for patient-centered practice. *Disabil Rehabil Assist Technol*. 2022 Nov;17(8):916-926.

Hamidon B, Abdullah S, Zawawi M, Sukumar N, Aminuddin A, Raymond A. A prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding in patients with acute dysphagic stroke. *Med J Malaysia* 2006;61(1):59–66.

Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S; Stroke Practice Improvement Network Investigators. Formal dysphagia screening protocols prevent pneumonia. *Stroke* 2005;36:1972-76.

Joundi RA, Martino R, Saposnik G, Giannakeas V, Fang J, Kapral MK. Predictors and outcomes of dysphagia screening after acute ischemic stroke. *Stroke* 2017;48(4):900-906.

Lakshminarayan K, Tsai AW, Tong X, Vazquez G, Peacock JM, George MG et al. Utility of dysphagia screening results in predicting poststroke pneumonia. *Stroke* 2010;41:2849-54.

Lam OL, McMillan AS, Samaranayake LP, Li LS, McGrath C. Randomized clinical trial of oral health promotion interventions among patients following stroke. *Arch Phys Med Rehabil* 2013;94:435-443.

Lam OL, Zhang W, Samaranayake LP, Li LS, McGrath C. A systematic review of the effectiveness of oral health promotion activities among patients with cardiovascular disease. *Int J Cardiol* 2011;151:261-267.

Li L, Huang H, Jia Y, Yu Y, Liu Z, Shi X, Wang F. Systematic review and network meta-analysis of noninvasive brain stimulation on dysphagia after stroke. *Neural Plast.* 2021 Nov 3;2021:3831472.

Lim KB, Lee HJ, Yoo J, Kwon YG. Effect of low-frequency rTMS and NMES on subacute unilateral hemispheric stroke with dysphagia. *Ann Rehabil Med* 2014;38(5):592-602.

Masrur S, Smith EE, Saver JL, Reeves MJ, Bhatt DL, Zhao X, et al. Dysphagia screening and hospital-acquired pneumonia in patients with acute ischemic stroke: Findings from Get with the Guidelines-Stroke. *J Stroke Cerebrovasc Dis.* 2013;22:e301-309.

Middleton S, McElduff P, Ward J, Grimshaw JM, Dale S, D'Este C, et al. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): A cluster randomised controlled trial. *Lancet* 2011;378:1699-706.

Miles A, Zeng IS, McLauchlan H, Huckabee ML. Cough reflex testing in dysphagia following stroke: a randomized controlled trial. *J Clin Med Res* 2013;5(3):222-233.

Murray J, Scholten I. An oral hygiene protocol improves oral health for patients in inpatient stroke rehabilitation. *Gerodontology* 2018 Mar;35(1):18-24.

Norton B, Homer-Ward M, Donnelly MT, Long RG, Holmes GK. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after acute dysphagic stroke. *BMJ* 1996;312:13-16.

Park JS, Oh DH, Hwang NK, Lee JH. Effects of neuromuscular electrical stimulation combined with effortful swallowing on post-stroke oropharyngeal dysphagia: A randomised controlled trial. *J Oral Rehabil* 2016;43(6):426-34.

Park HS, Oh DH, Yoon T, Park JS. Effect of effortful swallowing training on tongue strength and oropharyngeal swallowing function in stroke patients with dysphagia: a double-blind, randomized controlled trial. *Int J Lang Commun Disord*. 2019 May;54(3):479-484.

Park JW, Oh JC, Lee JW, Yeo JS, Ryu KH. The effect of 5Hz high-frequency rTMS over contralesional pharyngeal motor cortex in post-stroke oropharyngeal dysphagia: a randomized controlled study. *Neurogastroenterol Motil* 2013. 25:324-e250.

Rai N, Prasad K, Bhatia R, Vibha D, Singh MB, Rai VK, Kumar A. Development and implementation of acute stroke care pathway in a tertiary care hospital in India: A cluster-randomized study. *Neurol India* 2016;64, Suppl S1:39-45.

Sherman V, Greco E, Martino R. The benefit of dysphagia screening in adult patients with stroke: A meta-analysis. *J Am Heart Assoc*. 2021 Jun 15;10(12):e018753.

Shigematsu T, Fujishima I, Ohno K. Transcranial direct current stimulation improves swallowing function in stroke patients. *Neurorehabil Neural Repair*. 2013;27(4):363-9**.**

Smith EE, Kent DM, Bulsara KR, Leung LY, Lichtman JH, Reeves MJ et al; on behalf of the American Heart Association Stroke Council. Effect of dysphagia screening strategies on clinical outcomes after stroke: A systematic review for the 2018 guidelines for the early management of patients with acute ischemic stroke. *Stroke*.2018 Mar;49(3):e123-e128.

Suntrup-Krueger S, Ringmaier C, Muhle P, Wollbrink A, Kemmling A, Hanning U, et al. Randomized trial of transcranial direct current stimulation for poststroke dysphagia. *Ann Neurol* 2018;83(2):328-40.

Tarihci Cakmak E, Sen EI, Doruk C, Sen C, Sezikli S, Yaliman A. The effects of neuromuscular electrical stimulation on swallowing functions in post-stroke dysphagia: A randomized controlled trial. *Dysphagia*. 2023 Jun;38(3):874-885.

Vasant DH, Michou E, O'Leary N, Vail A, Mistry S, Hamdy S. Pharyngeal electrical stimulation in dysphagia poststroke: A prospective, randomized single-blinded interventional study. *Neurorehabil Neural Repair* 2016;30(9):866-75.

Wang T, Tai J, Hu R, Fan S, Li H, Zhu Y, Wu Y, Wu J. Effect of tongue-pressure resistance training in poststroke dysphagia patients with oral motor dysfunction: A randomized controlled trial. *Am J Phys Med Rehabil*. 2022 Dec 1;101(12):1134-1138.

Xia W, Zheng C, Lei Q, Tang Z, Hua Q, Zhang Y, Zhu S. Treatment of post-stroke dysphagia by vitalstim therapy coupled with conventional swallowing training. *J Huazhong Univ Sci Technolog Med Sci* 2011;31:73-76.

Yuan D, Zhang J, Wang X, Chen S, Wang Y. Intensified oral hygiene care in stroke-associated pneumonia: a pilot single-blind randomized controlled trial. *Inquiry* 2020; 57: 46958020968777.

Zhao J, Yuan F, Song C, Yin R, Chang M, Zhang W. et al; OPENS Trial Investigators. Safety and efficacy of three enteral feeding strategies in patients with severe stroke in China (OPENS): A multicentre, prospective, randomised, open-label, blinded-endpoint trial. *Lancet Neurol*. 2022;319-328