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Comparison Of Swallowing Difficulty Between Anterior And Posterior Circulation Stroke

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Introduction

Dysphagia is a term derived from the Greek word *phagein* (to swallow) combined with *dys*- (difficulty), meaning difficulty in swallowing. It refers to a disruption in the process of moving food or liquid from the mouth to the stomach. Dysphagia may involve behavioral, sensory, or motor impairments related to swallowing, including reduced cognitive awareness, difficulty recognizing food through sight or smell, and abnormal physiological responses to food (Leopold & Kagel, 1996). According to *Singular's Illustrated Dictionary of Speech-Language Pathology* (2000), dysphagia is swallowing difficulty often associated with motor disorders or esophageal obstruction. The *American ICD-10-CM Diagnosis Code R13.1* defines it as difficulty swallowing due to neuromuscular conditions or mechanical blockage

Dysphagia is a common problem in healthcare settings and is frequently associated with various medical conditions. It is particularly prevalent in ageing populations due to age-related structural and functional changes (Wirth et al., 2016). However, swallowing difficulties can affect individuals of any age and arise from multiple causes. Dysphagia may involve impairments in the oral, pharyngeal, or esophageal phases of swallowing. Clinical evaluation should identify the specific anatomical or physiological abnormalities and assess appropriate treatment options. Speech-language pathologists play a key role in understanding normal swallowing and in the assessment and management of dysphagia

Incidence & Prevalence

It's tough to get exact numbers on swallowing disorders, or dysphagia, because of different definitions and measurement methods. However, understanding its prevalence is key for healthcare planning. In the US, an estimated 6 to 10 million (ASHA, 1987) adults experience swallowing problems. The most often reported aetiology was stroke (422,000 ± 77,000; 11.2% ± 1.9%), which was followed by head and neck cancer (185,000 ± 40,000; 4.9% ± 1.1%) and other neurologic causes (269,000 ± 57,000; 7.2% ± 1.5%). The average number of days that the swallowing issue persisted was 139 ± 7 (Neil Bhattacharyya, 2014). In New

Zealand, there will be 9,250 (7000–12,500) cases of dysphagia overall in year 2020. Parkinson's disease, dementia, and strokes account for a sizable share of the overall incidence. A smaller amount is contributed by other illnesses such as paediatric instances, traumatic brain injury, cancer, motor neuron disease, and multiple sclerosis (S Duncan et.al, 2024). By physical and endoscopic examination, the prevalence of dysphagia in 11 patients with severe brain damage and coma was shown to be 77% oral stage dysfunction, 66% pharyngeal phase impairment, and 80% airway protection abnormalities. (Bremare, A et.al,2016). Generally, the likelihood of dysphagia increases with the severity of the original injury.

Site of lesion

Earlier, post-stroke dysphagia was believed to occur only with brainstem damage or bilateral cerebral lesions. However, advances in imaging have shown that even a single cortical or subcortical stroke can cause swallowing difficulties. Studies suggest that strokes anterior to the central sulcus are more strongly associated with dysphagia and a higher risk of aspiration than posterior strokes (Daniels & Foundas, 1999; Robbins et al., 1993).

Stroke patients with involvement of major blood vessels like the middle cerebral artery are more prone to aspiration than those with small vessel disease like deep white matter lesions. Dysphagia in stroke patients is linked to specific areas such as the brainstem, premotor and primary motor cortices, primary somatosensory cortex, and the insula. Additionally, lesions in white matter tracts can disrupt connectivity between cortical and subcortical regions (Alberts et.al 1992; Cola, Daniels,et al., 2010; Daniels et.al, 1997; Galovic et al., 2013; Gonzalez-Fernandez et.al, 2008; Suntrup, et al., 2015)

Objective

Although many studies link neuroimaging findings to the presence of dysphagia after stroke, limited research has examined how specific lesion type and location influence the characteristics of dysphagia. In particular, comparisons between anterior and posterior brain lesions remain underexplored. This gap restricts early identification and targeted intervention planning.

The main objective of this study is to compare the specific characteristics of dysphagia in individuals with anterior versus posterior brain lesions.

Method

Prospective study with a comparative observational design allows to observe and record behavior or phenomena in natural environment without intervening or manipulating variables.

Inclusion Criteria:

Participants included in this study are chosen using following criteria:

Timeframe of Stroke (0–30 days): Participants must have experienced an acute stroke within 30 days prior to enrolment to examine early stroke effects, including dysphagia.

Glasgow Coma Scale (GCS) > 8: Participants must have a GCS score above 8 to ensure adequate consciousness and ability to participate in assessment.

Age ≥ 18 Years: Only adults aged 18 years or older were included to maintain consistency, as stroke characteristics and outcomes differ across age groups

Exclusion criteria

Participants excluded from this study are chosen using following criteria

Multiple Stroke History: Individuals with recurrent or multiple strokes were excluded to avoid confounding effects.

Severe Neurodegenerative Disease: Patients with conditions such as Parkinson’s disease or Alzheimer’s disease were excluded to prevent pre-existing swallowing or neurological impairments from influencing results.

GCS < 8: Individuals with a Glasgow Coma Scale score below 8 were excluded due to reduced consciousness and inability to participate.

Age < 18 Years: Participants under 18 years were excluded to maintain an adult study population

Ethical Approval

This study received ethical clearance from the relevant institutional ethics review committee. All procedures involving human participants were conducted in accordance with recognized ethical guidelines.

Instrument & Stimuli

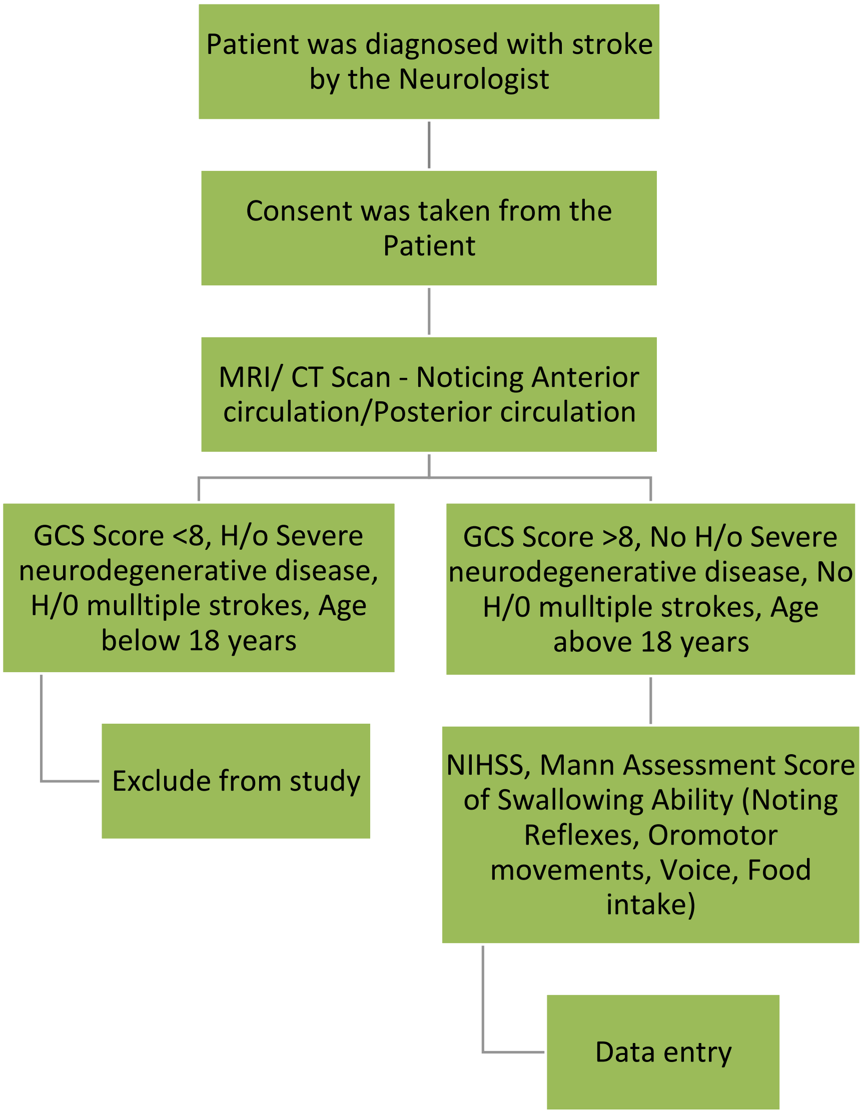
In this study, multiple tools were used to assess swallowing function. MRI/CT reports identified lesion location and structural abnormalities. The Glasgow Coma Scale (GCS) was used for eligibility (excluding scores ≤ 8) and to determine level of consciousness. Stroke severity was evaluated using the National Institutes of Health Stroke Scale (NIHSS). Finally, the Mann Assessment of Swallowing Ability (MASA) assessed functional swallowing, including oral motor control and pharyngeal efficiency. Together, these measures provided a comprehensive evaluation of swallowing function.

During evaluation, various materials such as gloves, tongue depressors, water, custard, and biscuits were used to elicit swallowing responses. These items provided different sensory inputs and food consistencies, enabling comprehensive assessment of swallowing function in realistic conditions.

Procedure

In this study, accurate data entry was ensured through systematic documentation. Participants’ demographic details, including age, gender, and medical history, were recorded in a secure database. Information about stroke diagnosis, including date and clinical characteristics, was also documented to support analysis and interpretation of findings.

After obtaining consent, neuroimaging findings (MRI/CT) were recorded to identify anterior or posterior circulation involvement and classify participants accordingly. Individuals meeting inclusion criteria (GCS > 8, no severe neurodegenerative disease, no multiple strokes) were enrolled, while others were excluded. NIHSS scores were also documented for stroke severity assessment



After enrolment, swallowing function was assessed using the Mann Assessment of Swallowing Ability (MASA), evaluating reflexes, oromotor function, voice quality, and food intake. Results were systematically recorded for accurate analysis. Ethical standards and patient confidentiality were maintained throughout the data entry process

Data Analysis

Data analysis was performed using SPSS version 26.0.0. A normality test was first conducted to assess data distribution. Based on the results, independent sample t-tests or Mann–Whitney U tests were used to compare groups. Bivariate tests were also applied to examine correlations between variables.

Demographic detail

The study examined a cohort of 25 right-handed stroke patients (N=25) aged 30–87, primarily Hindi-speaking, with no prior history of swallowing difficulties. All participants were assessed within 20 days of stroke onset, reflecting a population in the acute stage of recovery.

No	Age	Site of lesion	Education	Time since stroke	Handedness	Language at home
1	78	Anterior	Ph.D	14	Right	Hindi & English
2	63	Anterior	Graduate	10	Right	Hindi
3	66	Anterior	Graduate	9	Right	Hindi
4	30	Anterior	Graduate	9	Right	Hindi
5	79	Anterior	Graduate	1	Right	Hindi
6	77	Anterior	Graduate	4	Right	Hindi
7	64	Anterior	Graduate	7	Right	Dogri
8	60	Anterior	Graduate	2	Right	Hindi
9	73	Anterior	Undergraduate	5	Right	Hindi
10	55	Posterior	Postgraduate	1	Right	Hindi
11	64	Posterior	Graduate	8	Right	Hindi & English
12	48	Posterior	Graduate	2	Right	Punjabi
13	87	Anterior	Undergraduate	7	Right	Punjabi
14	56	Posterior	Graduate	3	Right	Hindi
15	74	Posterior	Undergraduate	5	Right	Bhojpuri
16	84	Anterior	Graduate	3	Right	Hindi
17	69	Posterior	Graduate	2	Right	Punjabi
18	61	Posterior	Graduate	2	Right	Hindi
19	79	Posterior	Postgraduate	2	Right	Hindi
20	78	Anterior	Undergraduate	2	Right	Himachali
21	66	Anterior	Graduate	2	Right	Sindhi
22	49	Anterior	Graduate	20	Right	Hindi
23	71	Anterior	Graduate	5	Right	Hindi
24	66	Posterior	Graduate	7	Right	Hindi
25	60	Anterior	Graduate	5	Right	Hindi

Table 1. *Demographic detail*

The 25 participants were all college-educated, with a mean age of 66.28 ± 12.75 years (range: 30–87). Clinical profiles showed 16 patients with anterior strokes and 9 with posterior lesions. The cohort was in the acute phase, with a mean post-stroke assessment time of 5.48 ± 4.48 days (range: 1–20).

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	25	30.00	87.00	66.28	12.749
Duration after stroke occurrence	25	1.00	20.00	5.48	4.482
Valid N (listwise)	25				

Table 2: *Descriptive statistics of participants*

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
GCS score	25	9.00	15.00	12.20	2.45
NIHSS score	25	.00	20.00	8.68	6.25
MASA Score	25	81.00	198.00	151.12	34.91
Valid N (listwise)	25				

Table 3: *Descriptive statistics of scoring*

GCS scores ranged from 9 to 15 ±12.20, NIHSS from 0.00 to 20.00 ±8.68, and MASA from 81 to 198 ±151.12. The average anterior GCS score is 11.37 ±2.50, the posterior GCS is 13.66 ±1.58.

Group Statistics					
	Type of lesion	N	Mean	Std. Deviation	Std. Error Mean
GCS score	Anterior	16	11.37	2.50	.62
	Posterior	9	13.66	1.58	.52

Table 4: *Descriptive Statistics GCS Score*

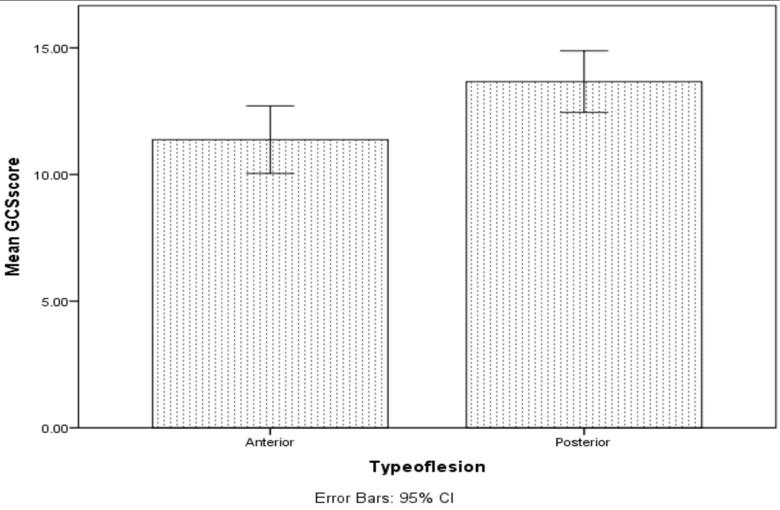


Figure 1. *Type of lesion GCS Score*

The mean anterior NIHSS score is 10.75 ±5.96, the posterior NIHSS score is 5.00 ± 5.17.

Group Statistics					
	Type of lesion	N	Mean	Std. Deviation	Std. Error Mean
NIHSS score	Anterior	16	10.7500	5.96098	1.49025
	Posterior	9	5.0000	5.1204	1.72401

Table 5. *Type of lesion & NIHSS score*

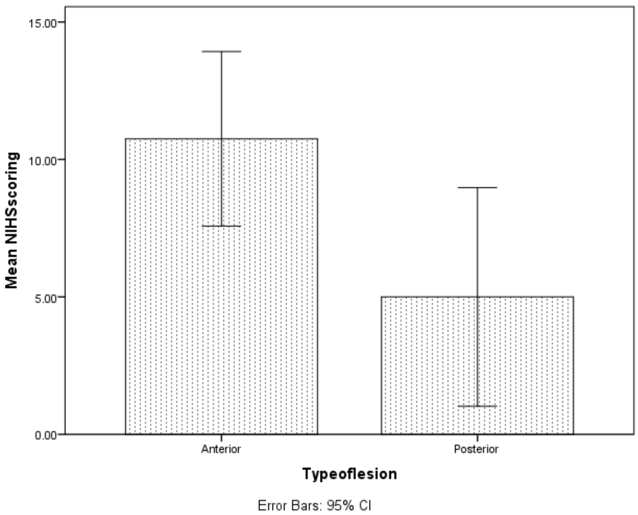


Figure 2. *Type of lesion & NIHSS scoring*

The mean anterior MASA score observed was 141.12 ±35.75, the posterior NIHSS score is 168.89 ± 26.57.

Group Statistics					
	Type of lesion	N	Mean	Std. Deviation	Std. Error Mean
MASA score	Anterior	16	141.1250	35.74516	8.93629
	Posterior	9	168.8889	26.57275	8.85758

Table 7. *Descriptive statistics of MASA score*

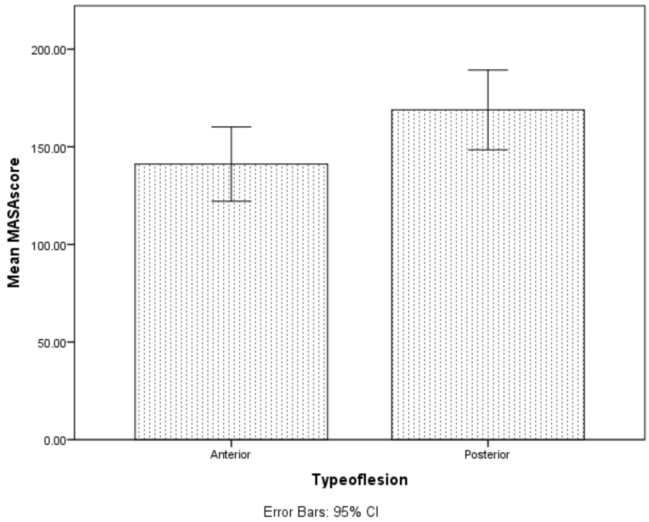


Figure 3. *Type of lesion & MASA scoring*

Discussion

This study investigates the distinctive features of swallowing ability between anterior and posterior circulation strokes. Twenty-five individuals with acute stroke, occurring within 1 to 20 days, were examined. Participants were categorized into anterior or posterior circulation stroke groups, excluding those with Glasgow Coma Scale (GCS) scores ≤ 8. All subjects were adults aged between 30 to 87 years with normal swallowing function and no prior neurological impairments. Significant differences were observed in GCS scores, with posterior circulation stroke patients exhibiting better consciousness (mean GCS score of 13.66 ± 1.58) compared to anterior circulation stroke patients (mean GCS score of 11.37 ± 2.50). Moreover, the National Institutes of Health Stroke Scale (NIHSS) scores indicated less severe neurological deficits in posterior circulation strokes (mean NIHSS score of 5.00 ± 5.17) compared to anterior circulation strokes (mean NIHSS score of 10.75 ± 5.96). However, there were no significant differences in the Mann Assessment of Swallowing Ability (MASA) scores between anterior and posterior circulation strokes, including total general, oral preparation, and pharyngeal swallowing phase scores.

As study depicted more preserved neurological area in posterior circulation type of stroke by better GCS and NIHSS score same was Found by Unal e.d., 2023, The median (IQR) NIHSS score was greater in right anterior circulation ischemic stroke (ACIs). The average GCS score was lower in the right anterior circulation ischemic stroke. Admission NIHSS scores differed significantly across ACI and PCI groups ($p < 0.001$). In De Marchis et.al different analogy (2011), it becomes apparent that PCS and ACS share more similarities than differences across various facets, including baseline variables, etiology, and outcome measures.

Taking to verifying a comprehensive study encompassing 1449 patients, multivariate analysis revealed distinct patterns between Acute Ischemic Stroke (PCS) and Acute Ischemic Stroke (ACS) cohorts. Specifically, PCS patients exhibited lower NIHSS scores upon admission and were more prone to manifest symptoms such as decreased consciousness, visual field deficits, and vestibulo-cerebellar signs, while comparatively presenting with fewer occurrences of hemisyndromes, dysarthria, and cognitive impairments typically observed in ACS cases (Zürcher, E et.al, 2019).

In this study we found lesser correlation between anterior and posterior circulation for swallowing inability. Similarly, dysphagia remained unaffected by both the lateralization of the lesion and the type of stroke (ischaemic/haemorrhagic), as evidenced by the absence of significant differences across the studied regions regarding the location of the lesion (Fernández-Pombo et.al,2019).

Conclusion

In conclusion, this study elucidated no significant differences in swallowing ability between anterior and posterior circulation strokes. Through the utilization of comprehensive assessments including the Glasgow Coma Scale (GCS), National Institutes of Health Stroke Scale (NIHSS), and Mann Assessment of Swallowing Ability (MASA), several key findings emerged.

Firstly, participants with PCS exhibited higher GCS scores, indicating better levels of consciousness compared to those with anterior circulation strokes. Additionally, the NIHSS scores revealed less severe neurological deficits in participants with PCS, further emphasizing the clinical distinctions between these stroke subtypes.

Despite these differences in neurological status, the MASA scores did not demonstrate significant variations between anterior and posterior circulation strokes in overall swallowing function

Clinical Implication

Although posterior circulation stroke patients may present with higher GCS scores and lower NIHSS scores, indicating better consciousness and seemingly milder stroke severity, swallowing difficulties can be comparable to those seen in anterior circulation strokes. This suggests that dysphagia risk cannot be predicted solely by overall stroke severity or level of alertness. Therefore, early and routine swallowing screening is essential in both anterior and posterior circulation strokes to ensure timely detection and intervention, preventing complications such as aspiration and pneumonia.

Limitation/ Recommendation

- Longitudinal studies are needed to track swallowing recovery over time and determine whether differences between anterior and posterior circulation strokes persist, as well as how rehabilitation influences long-term outcomes.

 Neuroimaging studies using advanced techniques like fMRI and DTI can help identify neural mechanisms and lesion–swallowing relationships, providing deeper insight into the neuroanatomical basis of post-stroke dysphagia.

 Subgroup analyses based on stroke type (ischemic vs. hemorrhagic) and lesion characteristics (size and location) may identify high-risk groups and support more individualized treatment planning.

 Interventional studies, particularly randomized controlled trials, are essential to evaluate the effectiveness of targeted dysphagia management strategies such as swallowing exercises, neuromuscular electrical stimulation, and dietary modifications, ensuring evidence-based rehabilitation approaches.

Conflict of Interest

No conflict of interest with any other research.

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GLASSGOW COMA SCALE

Eye opening

Criterion	Observed	Rating	Score
Open before stimulus	✓	Spontaneous	4
After spoken or shouted request	✓	To sound	3
After finger tip stimulus	✓	To pressure	2
No opening at any time, no interfering factor	✓	None	1
Closed by local factor	✓	Non testable	NT

Verbal response

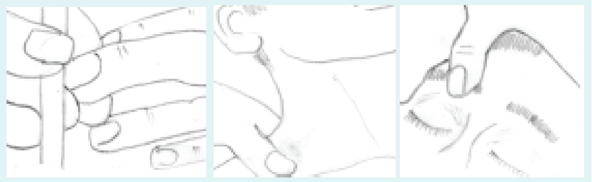
Criterion	Observed	Rating	Score
Correctly gives name, place and date	✓	Orientated	5
Not orientated but communication coherently	✓	Confused	4
Intelligible single words	✓	Words	3
Only moans / groans	✓	Sounds	2
No audible response, no interfering factor	✓	None	1
Factor interferring with communication	✓	Non testable	NT

Best motor response

Criterion	Observed	Rating	Score
Obey 2-part request	✓	Obeys commands	6
Brings hand above clavicle to stimulus on head neck	✓	Localising	5
Bends arm at elbow rapidly but features not predominantly abnormal	✓	Normal flexion	4
Bends arm at elbow, features clearly predominantly abnormal	✓	Abnormal flexion	3
Extends arm at elbow	✓	Extension	2
No movement in arms / legs, no interfering factor	✓	None	1
Paralysed or other limiting factor	✓	Non testable	NT

Sites For Physical Stimulation

Finger tip pressure   Trapezius Pinch   Supraorbital notch



Features of Flexion Responses

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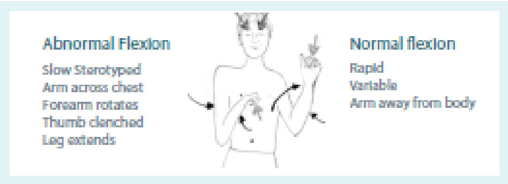
Ned Tijdschr Geneeskd



NATIONAL INSTITUTE OF HEALTH STROKE SCALE

PATIENT IMPRINT

Category	Score/Description		Date/Time Initials	Date/Time Initials	Date/Time Initials	Date/Time Initials	Date/Time Initials
1a. Level of Consciousness (Alert, drowsy, etc.)	0 = Alert 1 = Drowsy 2 = Stuporous 3 = Coma						
1b. LOC Questions (Month, age)	0 = Answers both correctly 1 = Answers one correctly 2 = Incorrect						
1c. LOC Commands (Open/close eyes, make fist/let go)	0 = Obeys both correctly 1 = Obeys one correctly 2 = Incorrect						
2. Best Gaze (Eyes open - patient follows examiner's finger or face)	0 = Normal 1 = Partial gaze palsy 2 = Forced deviation						
3. Visual Fields (Introduce visual stimulus/threat to pt's visual field quadrants)	0 = No visual loss 1 = Partial Hemianopia 2 = Complete Hemianopia 3 = Bilateral Hemianopia (Blind)						
4. Facial Paresis (Show teeth, raise eyebrows and squeeze eyes shut)	0 = Normal 1 = Minor 2 = Partial 3 = Complete						
5a. Motor Arm - Left **5b. Motor Arm - Right** (Elevate arm to 90° if patient is sitting, 45° if supine)	0 = No drift 1 = Drift 2 = Can't resist gravity 3 = No effort against gravity 4 = No movement X = Untestable (Joint fusion or limb amp)	Left					
		Right					
6a. Motor Leg - Left **6b. Motor Leg - Right** (Elevate leg 30° with patient supine)	0 = No drift 1 = Drift 2 = Can't resist gravity 3 = No effort against gravity 4 = No movement X = Untestable (Joint fusion or limb amp)	Left					
		Right					
7. Limb Ataxia (Finger-nose, heel down shin)	0 = No ataxia 1 = Present in one limb 2 = Present in two limbs						
8. Sensory (Pin prick to face, arm, trunk, and leg - compare side to side)	0 = Normal 1 = Partial loss 2 = Severe loss						
9. Best Language (Name item, describe a picture and read sentences)	0 = No aphasia 1 = Mild to moderate aphasia 2 = Severe aphasia 3 = Mute						
10. Dysarthria (Evaluate speech clarity by patient repeating listed words)	0 = Normal articulation 1 = Mild to moderate slurring of words 2 = Near to unintelligable or worse X = Intubated or other physical barrier						
11. Extinction and Inattention (Use information from prior testing to identify neglect or double simultaneous stimuli testing)	0 = No neglect 1 = Partial neglect 2 = Complete neglect						
	TOTAL SCORE						

INITIAL	SIGNATURE	INITIAL	SIGNATURE	INITIAL	SIGNATURE

150337 '0004

MANN ASSESSMENT OF SWALLOWING ABILITY

Alertness	2 no response to speech	5 difficult to rouse	8 fluctuates		10 alert
Cooperation	2 no cooperation	5 reluctant	8 fluctuating cooperation		10 cooperative
Auditory comprehension	2 no response to speech	4 occasional motor response if cued	6 follows simple conversation with repetition	8 follows ordinary conversation with little difficulty	10 NAD
Respiration	2 chest infection suctioning	4 coarse basal crepitations chest physiotherapy	6 fine basal crepitations	8 sputum upper airway other condition	10 chest clear
Respiratory rate (for swallow)	1 no independent control	3 some control/uncoordinated	5 able to control breath rate for swallow		
Dysphasia	1 unable to assess	2 no functional speech sounds/single words	3 expresses self in limited manner short phrases/words	4 mild difficulty finding words or expressing ideas	5 NAD
Dyspraxia	1 unable to assess	2 groping/inaccurate/partial or irrelevant responses	3 speech crude/defective in accuracy or speed on command	4 speech accurate after trial and error, minor searching movements	5 NAD
Dysarthria	1 unable to assess	2 speech unintelligible	3 speech intelligible but obviously defective	4 slow with occasional hesitation or slurring	5 NAD
Saliva	1 gross drool	2 some drool consistently	3 drooling at times	4 frothy/expectorated	5 NAD
Lip seal	1 no closure unable to assess	2 incomplete seal	3 unilaterally weak poor maintenance	4 mild impairment occasional leakage	5 NAD
Tongue movement	2 no movement	4 minimal movement	6 incomplete movement	8 mild impairment in range	10 full ROM
Tongue strength	2 gross weakness	5 unilateral weakness	8 minimal weakness		10 NAD
Tongue coordination	2 no movement unable to assess	5 gross incoordination	8 mild incoordination		10 NAD
Oral preparation	2 unable to examine	4 no bolus formation no attempt	6 minimal chew thrust gravity assisted	8 lip or tongue seal bolus escape	10 NAD
Gag	1 no gag	2 absent unilaterally	3 diminished unilaterally	4 diminished bilaterally	5 hyperreflexive NAD
Palate	2 no spread or elevation	4 minimal movement nasal regurgitation/air escape	6 unilaterally weak	8 slight asymmetry mobile	10 NAD
Bolus clearance	2 no clearance	5 some clearance/residue	8 significant clearance/ minimal residue	10 fully cleared	
Oral transit	2 no movement observed	4 delay > 10 sec	6 delay > 5 sec	8 delay > 1 sec	10 NAD
Cough reflex	1 none observed/unable to assess		3 weak reflexive cough		5 NAD
Voluntary cough	2 no attempt/ unable to assess	5 attempt inadequate	8 attempt bovine	10 NAD	
Voice	2 aphonic unable to assess	4 wet/gurgling	6 hoarse	8 mild impairment slight huskiness	10 NAD
Trache	1 trache/cuffed		5 trache/fenestrated		10 no trache
Pharyngeal phase	2 no swallow unable to assess	5 pooling/gurgling laryngeal elevation incomplete	8 laryngeal elevation mildly restricted slow initiation incomplete clearance	10 immediate laryngeal elevation clearance of material	
Pharyngeal response	1 not coping/gurgling		5 cough before/during/after swallow		10 NAD
Diet recommendations	NBM risk too great	thick vitamized oddslot diet	modified soft	soft	normal
Fluid recommendation	NBM	thick fluid (batter)	thick (honey)	thick (nectar)	normal
Swallow integrity **Dysphagia** **Aspiration**	**definite** dysphagia aspiration	**probable** dysphagia aspiration	**possible** dysphagia aspiration	**unlikely** dysphagia aspiration	

Moderate dysphagia 139-167 *Mild dysphagia 168-177*
Moderate aspiration < or equal to 148 *Mild aspiration 149-169*

Total = ☐☐☐

Additional Problems: ____________

Summary: ____________

Recommendations: ____________

Diagnosis: ____________

Date: ____________ Signature: ____________