

Delineating Swallowing Safety & Efficiency Impairment Profiles in Amyotrophic Lateral Sclerosis.

BACKGROUND:

- Dysphagia (swallowing impairment) occurs in a reported 85% of ALS patients (Chen and Garrett, 2005) and is characterized by impairments in swallowing safety (swallowed material entering the airway) and efficiency (pharyngeal residue).
- Despite the high prevalence of dysphagia in ALS, the relative appearance and profiles of impairments in swallowing safety vs. efficiency is unknown.

AIMS:

1. Determine profiles of swallowing safety and efficiency in ALS.
2. Determine the relative appearance of unsafe vs. inefficient swallowing in ALS.

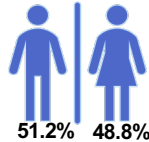
METHODS:

Participants:

- Eighty individuals with ALS were enrolled in this study.
- Race: 90% Caucasian, 5% African American, 1.3% Asian, 1.3% Native Hawaiian, 2.5% Unknown.
- Disease Onset Type: 50% Spinal, 43% Bulbar, 67% Mixed.

Table 1. Patient Demographics.

	Mean:	SD:	Range:
Age (years)	63.6	10.7	28 - 85
ALSFERS-R Total	35	8.7	3 - 48
ALSFERS-R Bulbar	9.1	2.3	3 - 12
Disease Duration	26.8	21.3	5 - 109



Procedures:

Videofluoroscopic Swallowing Examination:

- A videofluoroscopic swallowing examination (VFSE; Fig. 1) with a standard bolus presentation (Table 2) was completed.
- Two independent and blinded raters analyzed all swallows with a 100% agreement requirement. Discrepancy meetings were used to finalize ratings not in agreement.

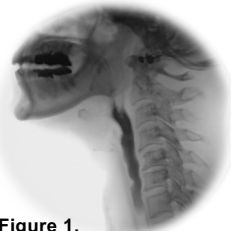


Figure 1. Videofluoroscopic swallowing examination.

Table 2. Standardized Protocol.

Bolus Type:	#:
5-mL Thin Liquid	3
Cup Sip Thin	1
Consecutive Sips Thin	1
Teaspoon Thin Honey	3
Teaspoon Paste	2
¼ Cracker w/ Paste	1
13mm Barium Tablet	1

Validated Outcomes of Swallowing:

Penetration Aspiration Scale:

- PAS scores were derived for every bolus trial to index swallowing safety.
- The worst PAS score across trials was used for statistical analysis and established criteria used for binary safety classifications:
 - ✓ Safe Swallowing: Worst PAS < 2
 - ✓ Unsafe Swallowing: Worst PAS ≥ 3

Table 2. Penetration Aspiration Scale.

1	Material does not enter airway	Safe
2	Material enters airway, remains above vocal folds, and is ejected from airway	
3	Material enters airway, remains above vocal folds, and is not ejected from airway	Penetration
4	Material enters airway, contacts the vocal folds, and is ejected from airway	
5	Material enters airway, contacts the vocal folds, and is not ejected from airway	Aspiration
6	Material enters airway, passes below vocal folds, ejected into larynx or out of airway	
7	Material enters airway, passes below vocal folds, not ejected out of airway despite effort	
8	Material enters airway, passes below vocal folds, and no effort made to eject	

(Rosenbek et al., 1995)

Swallowing Efficiency:

- The ASPEKT residue component (Steele, 2019) was used to index efficiency.
- Established binary efficiency classifications were derived:
 - ✓ Efficient Swallowing: Cup sip total residue = <3%
 - ✓ Inefficient Swallowing: Cup sip total residue = ≥3%

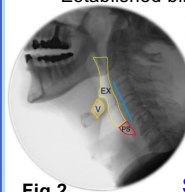


Fig 2.

Residue Sites.

Statistical Analysis:

Descriptive statistics and a chi-square analysis were performed.

ASPEKT area of residue outlines in the valleculae (orange, V), pyriform sinuses (red, PS) and extra pharyngeal spaces (yellow, EX) are expressed as a percentage relative to the C2-C4 vertebrate distance squared (blue line).

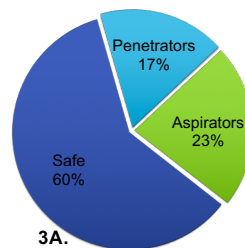
RESULTS:

Safety Profiles:

- Raw PAS data are presented in Table 3 and safety classifications in Figure 3.
- 60% of patients demonstrated safe swallowing and 40% unsafe swallowing.
- The most common aspiration response profile was silent aspiration (no cough).

Table 3. Raw PAS data.

PAS:	n=	%
1:	28	35%
2:	20	25%
3:	12	15%
4:	0	0%
5:	2	2.5%
6:	4	5%
7:	1	1.3%
8:	13	16.3%



Aspiration Response Profiles:

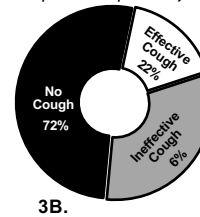


Fig. 3A. Safety classification profiles indicated that 17% of ALS patients penetrated and 23% aspirated. 3B. Silent aspiration represented the most common response pattern to tracheal aspirate.

Swallowing Efficiency Profiles:

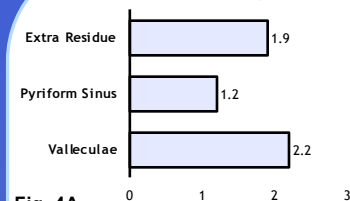


Fig. 4A. Mean percent residue across sites. The valleculae site was noted to have the highest degree of residue and the pyriforms the least.

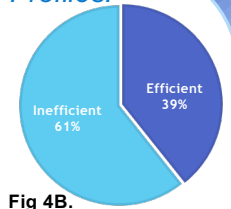


Fig 4B. Binary efficiency ratings revealed that 61% of ALS patients had inefficient swallowing.

Global Swallowing Profiles:

- Global swallowing profiles were noted to significantly differ, $p < 0.05$.
- Unsafe but efficient swallowing was only present in 4 patients while inefficient with safe swallowing was present in 17 patients.

Table 4. Two-by-Two Contingency Table Denoting Relative Frequency of Global Swallowing Status:

		Efficiency:		
		Efficient	Inefficient	
Safety:	Safe	20 (32.8%)	17 (27.9%)	n=37
	Unsafe	4 (6.6%)	20 (32.8%)	n=24
		n=24	n=37	

CONCLUSIONS:

- Unsafe and inefficient swallowing was noted in 40% and 61% of ALS patients respectively.
- Thus, efficiency impairments were more prevalent than safety impairments in this cohort.
- Impairments in swallowing efficiency were four times more likely to be the presenting dysphagia impairment vs. safety impairments.
- These cross sectional data suggest an evolution of dysphagia impairment profiles.
- Future work is needed that incorporates longitudinal research designs to further elucidate these preliminary findings.