

## Use of Fiberoptic Endoscopic Evaluation of Swallowing (FEES) in Patients with Amyotrophic Lateral Sclerosis

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**Abstract.** This study investigated the use of fiberoptic endoscopic evaluation of swallowing (FEES) to both diagnose pharyngeal dysphagia and make treatment recommendations in 17 consecutive patients with a new diagnosis of amyotrophic lateral sclerosis (ALS) and complaints of dysphagia. Ten of 17 (59%) patients exhibited pharyngeal dysphagia with aspiration or aspiration risk with clear liquids, i.e., 5 of 8 (63%) limb and 5 of 9 (56%) bulbar. If depth of bolus flow was a problem, thickened liquids and single, small bolus sizes were recommended. If bolus retention was a problem, a small clear liquid bolus after each puree or solid bolus was recommended to aid pharyngeal clearing. Five of 17 (30%) patients required multiple FEES evaluations because of disease progression. For the first time in patients with ALS, FEES was shown to be successful in assessing preswallow anatomy and physiology, diagnosing pharyngeal dysphagia, and providing objective data for appropriate therapeutic interventions to promote safer oral intake. Visual biofeedback provided by FEES was successful for both patient and family education and to investigate individualized therapeutic strategies that, if successful, can be implemented immediately. Serial FEES allows for objective monitoring of dysphagia symptoms and timely implementation of diet changes and/or therapeutic strategies to continue safer oral intake and maintain optimum quality of life.

**Key words:** Deglutition — Deglutition disorders — Dysphagia — Amyotrophic lateral sclerosis — Fiberoptic endoscopy.

Dysphagia is both a common [1,2] and one of the most serious symptoms [3] for the patient with amyotrophic lateral sclerosis (ALS). ALS is a progressive neurodegenerative disorder involving primarily motor neurons in the cerebral cortex, brainstem, and spinal cord [4]. Swallowing and quality-of-life issues need to be addressed both at the onset of dysphagia symptoms and with disease progression. Objective diagnostic data that are convenient and patient friendly to obtain [5], reliable [6–8], and easily repeatable based on patient needs [9] are needed to achieve safer oral intake and timely implementation of feeding strategies in order to maintain optimum quality of life [1].

Diagnosis and treatment recommendations for the patient with ALS have been based on either a functional, i.e., clinical, severity scale [1] or a videofluoroscopic swallowing evaluation [2] with or without manometry [3]. Any functional swallowing scale is, by definition, subjective as no direct viewing of the pharyngeal swallow is possible. Feeding strategies, therefore, cannot be corroborated with actual pharyngeal anatomy or physiology [10]. Videofluoroscopic evaluation is objective and used widely but requires an appointment and transportation to the fluoroscopy suite; entails positioning issues if transfer from a wheelchair is required; requires ingestion of barium sulfate-impregnated food and irradiation exposure; and incurs increased cost and personnel requirements, e.g., a radiologist, radiology technician, and speech–language pathologist. Manometric or videomanofluorometric studies are rarely done.

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**Table 1.** Patient characteristics

| S              | Sex  | Age                              | Presentation:<br>Limb/Bulbar |
|----------------|------|----------------------------------|------------------------------|
| 1 <sup>a</sup> | F    | 76                               | <b>Limb</b>                  |
| 2              | F    | 57                               | <b>Bulbar</b>                |
| 3              | F    | 74                               | <b>Bulbar</b>                |
| 4              | F    | 77                               | <b>Bulbar</b>                |
| 5              | M    | 82                               | Bulbar                       |
| 6              | F    | 48                               | Bulbar                       |
| 7              | M    | 54                               | <b>Limb</b>                  |
| 8              | M    | 58                               | <b>Limb</b>                  |
| 9              | M    | 71                               | Limb                         |
| 10             | F    | 71                               | Limb                         |
| 11             | M    | 56                               | Bulbar                       |
| 12             | F    | 68                               | Bulbar                       |
| 13             | F    | 56                               | <b>Bulbar</b>                |
| 14             | F    | 48                               | Limb                         |
| 15             | M    | 76                               | <b>Limb</b>                  |
| 16             | M    | 47                               | <b>Limb</b>                  |
| 17             | F    | 64                               | <b>Bulbar</b>                |
| N = 17         | M7   | Mean = 63 y<br>(range = 47–82 y) | Limb = 8/Bulbar = 9          |
|                | F 10 | Mean = 64 y<br>(range = 48–77 y) |                              |

<sup>a</sup>Bolded subjects exhibited pharyngeal dysphagia with aspiration or aspiration risk.

FEES is an objective technique that permits preswallow assessment of both pharyngeal anatomy and physiology and the presence of pooled secretions in the pharynx, larynx, or trachea [11]. FEES is done at bedside or in the outpatient clinic with or without an appointment, uses regular food, requires one clinician (usually a speech–language pathologist), patient positioning is not an issue, can be repeated as often as needed, can be performed for as long as necessary to note fatigue with eating because there is no irradiation exposure, provides pre- and postswallowing visual biofeedback to the patient and family, and allows for immediate assessment of diet modifications [5–9]. The purpose of the present study was to investigate the use of FEES to both diagnose pharyngeal dysphagia and make treatment recommendations for patients with ALS and complaints of dysphagia.

## Methods

### Participants

Table 1 shows descriptive statistics for the 17 consecutive adult patients referred between September 1997 and June 2003 by neurology with a clinically definite diagnosis of ALS [4] and complaints

of dysphagia. (One additional patient refused a swallowing evaluation.) Patient reports of dysphagia included coughing, inability to maintain nutritional status, and/or an aspiration event. All patients were eating orally. There were 7 males (mean age = 63 years, range = 47–82 years) and 10 females (mean age = 64 years, range = 48–77 years). Eight subjects had lumbar and 9 had bulbar presentation.

### Equipment

FEES equipment consisted of a 3.6-mm-diameter flexible fiberoptic rhinolaryngoscope (Olympus, ENF-P3/P4), light source (Olympus, CLK-4), camera (ELMO, MN401E), and color monitor (Magnovox, RJ4049WA01).

### Procedures

The basic FEES protocol [6,7] was done either in the outpatient clinic ( $n = 14$ ) or at bedside ( $n = 3$ ), with the patient sitting upright or as upright as tolerated, and without administration of topical anesthesia to the nasal mucosa, thereby eliminating any potential adverse anesthetic reactions and ensuring a reliable physiologic evaluation [12]. FEES allows for visualization of the entire pharyngeal swallow, except for a very brief period when the contracting pharyngeal walls obstruct the optical tip of the endoscope. Puree boluses (3–5 cc of custard) were always given first via spoon, followed by liquid boluses (3–5 cc of milk and water) via straw, and solid boluses (cracker), if success was noted on liquid and puree consistencies and dentition/dentures were present.

Diagnosis of pharyngeal stage dysphagia with aspiration or aspiration risk was made if one or more of the following features were observed: (1) abnormal stage transition characterized by depth of bolus flow to the pyriform sinuses or bolus stasis in the vallecula or pyriform sinuses prior to the pharyngeal swallow; (2) abnormal bolus retention in the vallecula or pyriform sinuses after the pharyngeal swallow; (3) laryngeal penetration defined as material in the laryngeal vestibule but not passing below the level of the true vocal folds either before or after the pharyngeal swallow; and (4) tracheal aspiration defined as material below the level of the true vocal folds either before or after the pharyngeal swallow [6,7,13].

Dysarthria was judged as mild (i.e., intelligible speech), moderate (i.e., intelligible speech with careful listening), or severe (i.e., unintelligible speech or intelligible only with multiple repetitions) [14].

## Results

A unique advantage of FEES over other techniques is preswallow assessment of pharyngeal and laryngeal anatomy and physiology and evidence of pooled secretions [11]. Table 2 shows results of this preswallow assessment. Two of 11 (18%) patients with dysarthria aspirated, while 1 of 6 (17%) patients without dysarthria aspirated. There were no pooled secretions in the valleculae, pyriform sinuses, or laryngeal vestibule preswallow and all patients exhibited bilateral true vocal fold mobility. Eight of 17 (47%) subjects exhibited velopharyngeal insufficiency, all without nasal reflux. Oral motor assessment indicated lingual

**Table 2.** Preswallow assessment

| S                    | Dysarthria | Aspiration <sup>a</sup> | Pooled secretions | VPI <sup>b</sup> | True vocal folds | Lingual ROM <sup>c</sup> | Labial ROM <sup>c</sup> | Facial symmetry  |
|----------------------|------------|-------------------------|-------------------|------------------|------------------|--------------------------|-------------------------|------------------|
| <b>1<sup>d</sup></b> | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>N</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| <b>2</b>             | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>N</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| <b>3</b>             | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>Y</b>         | <b>WNL</b>       | <b>Decreased</b>         | <b>Weak</b>             | <b>Decreased</b> |
| <b>4</b>             | <b>Y</b>   | <b>Y</b>                | <b>N</b>          | <b>Y</b>         | <b>WNL</b>       | <b>Decreased</b>         | <b>Weak</b>             | <b>Decreased</b> |
| 5                    | N          | N                       | N                 | N                | WNL              | WNL                      | WNL                     | WNL              |
| 6                    | Y          | N                       | N                 | Y                | WNL              | Decreased                | Weak                    | Decreased        |
| 7                    | N          | N                       | N                 | N                | WNL              | Decreased                | WNL                     | Decreased        |
| <b>8</b>             | <b>N</b>   | <b>Y</b>                | <b>N</b>          | <b>N</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| 9                    | N          | N                       | N                 | N                | WNL              | WNL                      | WNL                     | WNL              |
| 10                   | N          | N                       | N                 | N                | WNL              | WNL                      | WNL                     | WNL              |
| 11                   | Y          | N                       | N                 | Y                | WNL              | Decreased                | WNL                     | WNL              |
| 12                   | Y          | N                       | N                 | Y                | WNL              | WNL                      | WNL                     | WNL              |
| <b>13</b>            | <b>Y</b>   | <b>Y</b>                | <b>N</b>          | <b>N</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| 14                   | N          | N                       | N                 | N                | WNL              | WNL                      | WNL                     | WNL              |
| <b>15</b>            | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>Y</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| <b>16</b>            | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>Y</b>         | <b>WNL</b>       | <b>WNL</b>               | <b>WNL</b>              | <b>WNL</b>       |
| <b>17</b>            | <b>Y</b>   | <b>N</b>                | <b>N</b>          | <b>N</b>         | <b>WNL</b>       | <b>Decreased</b>         | <b>WNL</b>              | <b>WNL</b>       |
|                      | 11         | 3                       | 0                 | 8                | 17               |                          |                         |                  |

<sup>a</sup>Aspiration based on postswallow FEES results.

<sup>b</sup>VPI: velopharyngeal insufficiency.

<sup>c</sup>ROM: range of motion.

<sup>d</sup>Bolded subjects exhibited pharyngeal dysphagia with aspiration or aspiration risk.

range of motion within normal limits for 11 of 14 (79%), labial closure within normal limits for 14 of 17 (82%), and facial symmetry (smile/pucker) within normal limits for 14 of 17 (82%) subjects. One of 17 (5%) patients exhibited oral dysphagia with inability to suck on a straw or masticate. No trend was observed between oral motor functioning and aspiration status.

Ten of 17 (59%) patients (bolded in Tables 1 and 2) exhibited pharyngeal dysphagia with aspiration or aspiration risk with clear liquids, i.e., 5 of 8 (63%) limb and 5 of 9 (56%) bulbar. Seven patients (S# 7, 13, 15, 16 limb and S# 2, 4, 17 bulbar) exhibited bolus flow to the valleculae, pyriform sinuses, and/or laryngeal vestibule preswallow. Three patients (S# 1, 8, limb and S# 3 bulbar) exhibited bolus retention in the valleculae, pyriform sinuses, and/or laryngeal vestibule postswallow.

Five of 17 (30%) patients (S# 1, 7, 9, 13, 14) required multiple FEES evaluations because of disease progression, i.e., decreased strength and stamina, an isolated episode of coughing, or anxiety associated with eating. Range of re-FEES was 3 days to 1 year 11 months. Typical findings were increased depth of bolus flow prior to the swallow requiring a diet change to thickened liquids and increased bolus retention due to a weak pharyngeal swallow requiring smaller bolus sizes and either a small liquid bolus or multiple swallows/bolus to aid in pharyngeal clear-

ing. A normal FEES provided reassurance that swallowing was not impaired, decreased anxiety, and permitted oral nutrition to continue.

## Discussion

Since dysphagia is one of the most important symptoms in the prognosis of ALS, correct diagnosis, appropriate therapeutic interventions, and timely followup of swallowing skills are necessary. For the first time, FEES has been shown to successfully fulfill all three of these requirements.

Patients with ALS exhibit a wide range of variability in symptoms and disease progression [1]. This requires symptoms management of dysphagia based upon objective information which allows for optimum success for continued safer oral intake or the decision for supplemental enteral tube feedings. Since 30% of patients in the present study required multiple examinations, serial FEES allows for timely evaluation of dysphagia symptoms as they occur in order to achieve safer swallowing [9], to allow the patient and family to understand the swallowing problems, to decrease patient anxiety by demonstrating that swallowing is successful, and to promote optimum quality of life [1].

Two basic diet modifications and treatment strategies were made based on the etiology of the

pharyngeal swallow disorder. If depth of bolus flow was a problem, liquids were thickened to either nectar or honey consistency and single, small bolus sizes, i.e., 2–3 cc, were recommended. If bolus retention was a problem, multiple swallows/bolus or a small clear liquid bolus, i.e., 2–3 cc, after each puree or solid bolus consistency was recommended to aid pharyngeal clearing. In the case of the patient with oral dysphagia, a spoon, rather than a straw or cup, was successful in delivering a bolus into the oral cavity.

No correlation statistics were possible between dysarthria and dysphagia due to the small sample size, i.e., 2 of 5 (40%) patients who exhibited severe dysarthria aspirated while none of the 6 patients with mild or moderate dysarthria aspirated. Additional data are needed before it can be confirmed that not until speech rate becomes markedly slow and intelligibility impaired do swallowing skills begin to deteriorate [1]. More data are also needed to determine if there is a correlation between oral motor functioning and aspiration status, e.g., 6 of 10 (60%) patients with oral motor functioning within normal limits either aspirated or were at aspiration risk, while 2 of 7 (29%) patients with decreased oral motor functioning swallowed successfully. Lastly, by definition, patients with motor neuron disease are without sensory deficits. Therefore, endoscopic sensory assessment of the laryngopharynx, although reported to be predictive of airway protection without administration of a food bolus [15], may not be optimal for the evaluation of swallowing in the ALS population.

FEES is ideally suited for this particular patient population because direct visualization of the pharynx and larynx before, partially during, and after the swallow is obtained. Before an actual swallow is attempted, visual confirmation of pooled secretions in the valleculae, pyriform sinuses, and especially the laryngeal vestibule, are highly predictive of aspiration of food or liquid [11]. If the endoscopist observes large amounts of pooled secretions, FEES can be deferred, and since no food was introduced there was no risk to the patient [16]. Overt and silent aspiration before and during the initiation of the swallow, due to spillage of the bolus into the laryngeal vestibule, glottis, and trachea, can be observed. Also, overt and silent aspiration both immediately after the swallow and later as a result of retention of the bolus in the laryngeal vestibule can be clearly identified via the endoscopic image [5]. Major advantages of FEES for patients with ALS include ability of performing the evaluation in the clinic or at bedside thereby eliminating transportation and positioning problems in

the fluoroscopy suite, visualization of pooled secretions prior to testing that are not apparent fluoroscopically, use of regular food, avoidance of irradiation exposure and use of barium sulfate, no time limit in performing the procedure, and easy repeatability [5–9].

## Conclusions

FEES was successful in assessing preswallow anatomy and physiology, diagnosing pharyngeal dysphagia, and providing objective data for appropriate therapeutic interventions to promote safer oral intake in patients with amyotrophic lateral sclerosis. Visual biofeedback provided by FEES was successful for both patient and family education and to investigate individualized therapeutic strategies that, if successful, can be implemented immediately. Serial FEES allows for objective monitoring of dysphagia symptoms and timely implementation of diet changes and/or therapeutic strategies to continue safer oral intake and maintain optimum quality of life.

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