Partial Epiglottoplasty for Pharyngeal Dysphagia due to Cervical Spine Pathology

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

Abstract

Objective. To examine the role of epiglottoplasty in patients with pharyngeal dysphagia due to pharyngeal crowding from cervical spine pathology and to assess swallowing outcomes following epiglottoplasty.

Study Design. Retrospective case series.

Setting. Academic tertiary care medical center.

Subjects and Methods. Dysphagia can occur in patients with cervical spine pathology because of hypopharyngeal crowding. Swallowing studies, such as modified barium swallow study and fiberoptic endoscopic evaluation of swallowing, may demonstrate a nonretroflexing epiglottis owing to cervical spine osteophytes or hardware, thus impeding pharyngeal bolus transit. We performed partial epiglottoplasties in a series of these patients. A retrospective review of swallowing outcomes was performed to assess the efficacy of this surgery in this patient population.

Results. Epiglottic dysfunction causing dysphagia due to cervical spine pathology was diagnosed by modified barium swallow study and/or fiberoptic endoscopic evaluation of swallowing in 12 patients. Findings included hypopharyngeal crowding because of cervical osteophytes (\(n = 8\)) or cervical hardware (\(n = 4\)) associated with absent epiglottic retroflexion and retained vallecular residue. Partial epiglottoplasty resulted in significant reduction of vallecular residue and a significant increase in functional swallow outcomes without an increase in swallow morbidity.

Conclusion. There is a role for partial epiglottoplasty in patients with dysphagia attributed to hypopharyngeal crowding from cervical spine pathology. Surgery enables reduced vallecular residue and improved functional swallowing outcomes.

Keywords
dysphagia, cervical osteophyte, epiglottoplasty, epiglottidectomy, epiglottic dysfunction, diffuse idiopathic skeletal hyperostosis, Forestier’s disease

Swallowing is a highly complex neuromuscular event that is composed of 3 phases: oral, pharyngeal, and esophageal. Dysphagia may occur with disruption or inefficiency at any 1 of these phases and is a common reason for consultation with an otolaryngologist. Frequently encountered causes of dysphagia include stroke, neurodegenerative disorders, chemoradiation, cricopharyngeal dysfunction, malignancies, and esophageal stenosis.\(^1\) A less commonly diagnosed cause of dysphagia is pharyngeal crowding from cervical spine pathology. Anterior cervical osteophytes (ACOs) are present in 10.6% of patients presenting with dysphagia and are thought to cause problems in the pharyngeal and esophageal phases of swallow.\(^2\) Pharyngeal-phase dysphagia caused by ACOs is typically due to pharyngeal narrowing from a protuberant posterior pharyngeal wall with concurrent alteration of swallow physiology, including reduction or absence of epiglottic retroflexion, leading to attenuation of intrabolus pressures above the obstructing epiglottis and consequently resulting in vallecular residue.\(^2\) The same finding is often noted in patients who have undergone cervical spine surgery with hardware placement. Irritation of the cricopharyngeus muscle by the ACOs may lead to cricopharyngeal muscle spasm and dysphagia.\(^4,5\) Unfortunately, resection of cervical osteophytes may lead to worsening dysphagia and can be fraught with other complications, including pharyngeal, esophageal, and laryngeal nerve injury.\(^2,6\) Furthermore, ACOs typically occur in the elderly population, in whom age-related swallow...
changes, such as depletion of pharyngeal strength and intrabolus pressure generation, contribute to baseline worsening of the swallow. Furthermore, the presence of other comorbidities may not allow for a major operation, and conservative therapy (e.g., diet modification and swallow therapy) may not be adequate to improve quality of life.

Although present in up to a third of the elderly population, ACOs are typically asymptomatic until they reach a size that disrupts pharyngeal or esophageal swallow. For those patients who present to a physician with symptomatic ACOs, the most common presenting symptom is dysphagia. In evaluating our dysphagia population, we have observed on endoscopic evaluation a number of patients who present with a narrow oropharynx and hypopharynx and fullness of the midline posterior pharyngeal wall. Swallow testing with fiberoptic endoscopic evaluation of swallowing (FEES) or modified barium swallow study (MBSS) demonstrated that in these patients, swallow efficiency was at least partly impeded by lack of epiglottic retrusion owing to collision with the protuberant posterior pharyngeal wall. Fiberoptic endoscopic evaluation of swallowing was performed in this patient, resulting in vallecular residue.

Figure 1. Example of the endoscopic appearance of a patient with anterior cervical osteophytes resulting in protuberance of the posterior pharyngeal wall. Fiberoptic endoscopic evaluation of swallowing was performed in this patient, resulting in vallecular residue.

Table 1. Grading of Vallecular and Pyriform Sinus Residue.\textsuperscript{11,a}

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None to trace coating</td>
</tr>
<tr>
<td>1</td>
<td>Thick coating</td>
</tr>
<tr>
<td>2</td>
<td>Up to 50% full of residual</td>
</tr>
<tr>
<td>3</td>
<td>Greater than 50% full of residual</td>
</tr>
<tr>
<td>4</td>
<td>Overflowing with residual</td>
</tr>
<tr>
<td>5</td>
<td>Oropharyngeal stasis (entire bolus stays within vallecula)</td>
</tr>
</tbody>
</table>


Methods
This retrospective study was approved by the Medical Internal Review Board of the University of California, Los Angeles. Medical records were reviewed to identify all consecutive patients with dysphagia who underwent partial epiglottoplasty during a 15-month period. Criteria for inclusion in the study were as follows: patient complaint of dysphagia (with or without need for diet modification), limited or absent epiglottic inversion noted on MBSS or FEES, and presence of cervical spine pathology (ACOs or cervical spine hardware), as noted on radiographic or endoscopic studies. The subjective nature of the dysphagia was typically described by patients as a “sticking” sensation. Criteria for exclusion were as follows: history of treatment for head and neck cancer, stroke, vocal fold immobility, and lack of pre- and postoperative MBSS or FEES.

When \(>1\) swallow evaluation was available for review, we used the last study before surgery and the first study after surgery (typically performed 1 month postoperatively to account for recovery from surgical trauma). Whenever available, the same study type was used for pre- and postoperative comparison (i.e., FEES compared with FEES and MBSS with MBSS). Pre- and postoperative MBSS and/or FEES studies were compared to assess for the following: (1) amount of vallecular residue after the first swallow, as an indicator of the amount of obstruction provided by the dysfunctional epiglottis (\textit{Table 1}); (2) pharyngeal phase time, defined as the time taken from initiation of the pharyngeal phase (bolus entering the pharynx) until cessation of volitional bolus clearance; and (3) degree of penetration-aspiration as defined by Rosenbek et al.\textsuperscript{12} Patients served as their own controls (pre- vs postoperative) in this comparison. A single consistent texture and amount of food was used for each subject to compare pre- and postoperative swallows (typically, 0.5 or 1 tsp of puree).

Office notes, FEES reports, and MBSS reports were reviewed by a speech and language pathologist (A.E.) who was not involved in the surgery, to assess pre- and postoperative functional outcome swallowing scale (FOSS) scores, pneumonia history, diet recommendations, and subjective change in the swallow following surgery.\textsuperscript{13}

Suprahyoid epiglottoplasty was performed via a transoral approach under general anesthesia as previously described.\textsuperscript{11} In brief, the epiglottis was trimmed halfway between the hyoepiglottic ligament and the tip of the epiglottis, with the use of the carbon dioxide laser. All patients tolerated the
procedure well. There was 1 complication of a postoperative pneumonia in this patient population. Patients were discharged home the same day, on the diet that they were previously tolerating.

Statistical analysis was performed with the Wilcoxon signed-rank test to assess significance in the differences between pre- and postoperative data.

Results

Epiglottic dysfunction (ie, lack of normal epiglottic retroflexion) causing symptoms of dysphagia due to cervical spine pathology was diagnosed by MBSS and/or FEES in 12 patients. A total of 9 patients fitting the inclusion and exclusion criteria underwent epiglottoplasty in the specified time frame (Table 2). Three patients were excluded because of a history of stroke, vocal fold immobility, or lack of appropriate pre- or postoperative swallow studies. Seven patients were men and 2 were women, ranging in age from 62 to 85 years (median, 82). Length of follow-up ranged from 1 to 11 months. All patients presented with a complaint of dysphagia and were diagnosed with cervical spine abnormalities. Two men and 1 woman had undergone anterior cervical spine surgery causing retropharyngeal bulging and oropharyngeal narrowing prior to onset of dysphagia. The remaining patients were diagnosed with ACOs contributing to dysphagia.

Preoperative vallecular residue scores ranged from 0 to 3 (Table 3). Except for 1 patient whose preoperative score was 0 and did not change after surgery, all patients demonstrated a reduction in vallecular residue postoperatively, with an average score reduction of 1.8 ($P < .05$). Penetration-aspiration scores (PASs) were unchanged postoperatively in 3 patients, with score improvement in 6 patients. Overall, the average change in PAS following surgery was a score improvement of 1.6 ($P < .05$). This was presumably due to improved or resolved epiglottic dysfunction. Notably, no patients demonstrated worsening of their penetration-aspiration status following epiglottoplasty. Similarly, the average change in FOSS was a significant score improvement of 1.2 points ($P < .05$), with score improvement noted in 8 patients and no change noted in 1 patient.

Pharyngeal phase time was calculated for the 6 patients who underwent MBSS pre- and postoperatively (Table 4). Four patients (patients 3, 5, 7, 9) demonstrated reduction in their pharyngeal phase times by approximately one half, and 1 patient’s time (patient 1) was essentially unchanged (4% reduction). Patient 4’s pharyngeal phase time, however, demonstrated a marked increase. This patient had improvement in vallecular residue as well as FOSS scores but performed extra swallows to clear the residue, thus increasing pharyngeal transit time. The average time change was a reduction of 2.4 seconds, but this did not reach statistical significance despite improvement in the majority ($P = .5$).

Five patients had a preoperative history of aspiration pneumonia (Table 3). At the time of latest follow-up, 1 of these 5 reported an episode of postoperative pneumonia 1 week after surgery. This was the only noted complication. However, MBSS performed about 1 month after surgery revealed improvement in swallowing parameters without evidence of penetration or aspiration. This patient’s swallowing on FEES continued to improve over the next 3 to 6 months.

Seven patients continued their preoperative diet type, while 2 were able to advance their diets. Of these 2, 1 was nil per os prior to surgery and was advanced to a puree diet. The other patient was advanced from a soft diet to a regular diet. When asked the question “Do you feel that swallowing has become easier?” all patients responded in the affirmative, describing an improvement in the ease of swallow and reduction of the previously described “sticking” sensation.

Discussion

ACOs are believed to occur in 20% to 30% of the general population, although the rate of cervical vertebral modification may be higher than 75% in the 65+ age population.2,4,7 The
most common causes of ACOs are degenerative spine conditions and diffuse idiopathic skeletal hyperostosis (DISH), which are also the etiologies thought to lead to osteophyte-related dysphagia. In the majority, these ACOs are asymptomatic. However, when they become symptomatic—typically once the osteophyte reaches a size of at least 10 mm²—solid food dysphagia is the most common presenting symptom, affecting 17% to 28% of patients with DISH. The cervical vertebral levels most often involved in this population are C5-C6 (40%), followed by C4-C5 (23%) and then C3-C4 and C2-C3 (14% each).

The logical way to address bony overgrowths of the cervical spine would be to surgically remove the osteophytes. Indeed, after failure of conservative therapy, an anterolateral transcervical approach to a partial anterior vertebral corpectomy is the gold standard in addressing cervical osteophytes. In appropriately selected patients, the rate of swallow improvement following osteophytectomy with return to regular diet is reportedly 77% to 100%. Unfortunately, ACO caused by DISH has the potential for recurrence because of an average bony regrowth rate of 1 mm per year. Additionally, a study by Carlson et al noted postoperative postswallow pharyngeal residue in 62% following osteophytectomy, with silent aspiration in 8%.

For some patients, diet modification and swallow therapy are either not sufficient for symptomatic improvement or unsatisfying from a quality-of-life perspective. Unfortunately, many of these patients are not ideal candidates for a major surgical intervention, typically because of age and other comorbidities. Furthermore, the risks of osteophytectomy, even in a healthy patient, cannot be discounted. Documented risks include hematoma with possible airway compromise, injury to the superior and recurrent laryngeal nerves, injury to the marginal mandibular branch of the facial nerve, hypoglossal nerve injury, cervical sympathetic chain injury, esophageal perforation, salivary fistula formation, vertebral artery injury, and even death. In a retrospective review of 71 patients who underwent single- or dual-level cervical corpectomies for spondylosis or osteophytosis with titanium mesh or cage placement, there was a 25% complication rate. The most significant complications were failure of osteosynthesis, hardware subsidence, incorrect screw placement, and dysphagia related to hardware placement requiring reoperation (2 patients). Five patients experienced permanent dysphagia and dysphonia postoperatively. Of note, this study excluded patients who had undergone ≥3-level corpectomy due to their “high rate [of] morbidity.”

Table 3. Pre- and Postoperative Residue, PAS, FOSS Results, and Patient Subjective Reports.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Subjective improvement?</th>
<th>Diet Preoperative</th>
<th>Postoperative</th>
<th>Aspiration pneumonia Preoperative</th>
<th>Aspiration pneumonia Postoperative</th>
<th>FOSS Preoperative</th>
<th>FOSS Postoperative</th>
<th>PAS Preoperative</th>
<th>PAS Postoperative</th>
<th>Vallecular residue score Preoperative</th>
<th>Vallecular residue score Postoperative</th>
<th>Change, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Soft</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>–4</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Soft</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
<td>4</td>
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<td>4</td>
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<td>0</td>
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<td>–3</td>
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<tr>
<td>3</td>
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<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>–2</td>
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<tr>
<td>4</td>
<td>Yes</td>
<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>Yes</td>
<td>4</td>
<td>1</td>
<td>4</td>
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<td>0</td>
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<tr>
<td>5</td>
<td>Yes</td>
<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>Yes</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0</td>
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<td>–4</td>
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<tr>
<td>6</td>
<td>Yes</td>
<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
<td>4</td>
<td>1</td>
<td>4</td>
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<td>0</td>
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<td>–2</td>
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<tr>
<td>7</td>
<td>Yes</td>
<td>Regular</td>
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<td>No</td>
<td>No</td>
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<td>–2</td>
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<tr>
<td>8</td>
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<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
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<td>0</td>
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<td>–2</td>
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<tr>
<td>9</td>
<td>Yes</td>
<td>Regular</td>
<td>Regular</td>
<td>No</td>
<td>No</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>–2</td>
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Table 4. Pharyngeal Phase Time Measurements.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Pharyngeal Phase Time, s</th>
<th>Change, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>–4</td>
</tr>
<tr>
<td>3</td>
<td>9.2</td>
<td>–53</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>308</td>
</tr>
<tr>
<td>5</td>
<td>11.7</td>
<td>–50</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>–46</td>
</tr>
<tr>
<td>9</td>
<td>11.8</td>
<td>–49</td>
</tr>
</tbody>
</table>
Review of baseline swallow and radiographic studies in a series of our patients presenting with dysphagia demonstrated the presence of either ACO or previously placed cervical hardware, with associated pharyngeal narrowing and reduction of epiglottic mobility, often leading to vallecular residue (Figure 2). In those patients who either were not candidates for a major spinal operation or were unwilling to undergo (further) spinal surgery, we proposed partial epiglottoplasty. We hypothesized that this would address the pharyngeal narrowing and enable physiologic epiglottic retroflexion, thereby increasing swallow efficiency and decreasing pharyngeal residue, as noted when a similar operation was performed in chemoirradiated head and neck cancer patients who developed epiglottic dysfunction, leading to marked dysphagia.11

Indeed, we did note improvement in a number of objective and subjective measures of swallow. Compared with preoperative findings, scoring of vallecular residue, penetration-aspiration, and functional swallow outcome showed significant improvement after surgery. Based on observations from MBSS, the reduced vallecular and pyriform sinus residue appears to be a direct result of improved epiglottic motion without collision with (and obstruction by) the cervical spine protuberance (Figure 3). Rates of aspiration were not increased by performing partial epiglottoplasty, as demonstrated by the significant improvement in PAS following surgery and no increase in PAS in any patient. Pharyngeal efficiency calculations based on pharyngeal phase times demonstrated improvement in at least 4 of the 6 patients in whom MBSS data were available. One patient developed an episode of aspiration pneumonia postoperatively. Interestingly, his postoperative MBSS (performed 1 month after surgery) revealed no evidence of penetration or aspiration, suggesting that despite this complication, he quickly recovered from a deglutition standpoint. Four other patients with documented preoperative aspiration pneumonia history remained pneumonia-free at latest follow-up. Two of these patients were actually able to advance their diets, 1 of whom was able to transition from nil per os status to a puree diet by mouth. In addition, all patients reported subjective improvement in swallowing after epiglottoplasty.

There are a number of weaknesses in this study. First, it is a retrospective review of a small case series. Cervical spine pathology is not uncommon, but it is usually asymptomatic. Although dysphagia is believed to be the most common presenting symptom, most reports of dysphagia associated with cervical spine pathology in the literature are case reports of 1 to 3 patients, and all refer to osteophytectomy as the only available surgical treatment option.2,4,5,8,9 Therefore, despite our small number of patients, we believe this to be a relatively large series of patients who have undergone a treatment paradigm that has not previously been described in the literature.

Another weakness is that not all patients underwent both pre- and postoperative MBSS. For example, when FEES performed in the office at follow-up visits demonstratedimproved...
improved swallow function, either patients were not routinely referred for a repeat postoperative MBSS to confirm these findings, or the patients themselves chose not to undergo follow-up MBSS. However, other dysphagia experts have argued that these 2 studies demonstrate good agreement with regard to penetration, aspiration, and pharyngeal residue, which were the primary treatment endpoints considered in this study.\textsuperscript{14}

Although about half of the patients in this series achieved a postoperative FOSS score of 0 or 1 (regular diet with or without episodic dysphagia symptoms), the other half did not improve beyond a FOSS score of 2 (significant diet modification). However, the latter patients improved their FOSS score by at least 1 point. Not surprising, this suggests that although partial epiglottoplasty helped improve their swallow to some degree, other causes of dysphagia were present. These were naturally not adequately addressed by epiglottoplasty alone. Indeed, dysphagia is typically multifactorial in nature.

Given the advanced age range of this group (seventh to ninth decades), another likely contributor to disordered swallowing is lingual and pharyngeal weakness, which leads to diminished intrabolus pressure generation. This aspect was not adequately examined in this review, although some patients underwent some form of swallow therapy (with limited benefit) prior to consideration of surgery. Unfortunately, manometry was not used in this patient cohort; this would have been helpful in evaluation of pharyngeal strength and assessing for possible improvement in postoperative intrabolus pressures.

Another possibility in this population is that the cervical spine pathology may have also affected the esophageal phase of swallow, as suggested by other authors.\textsuperscript{2} This aspect was not adequately investigated in this group of patients.

Follow-up in this preliminary study was limited. However, the postoperative swallow study in the majority of patients was performed 1 to 2 months postoperatively, which allowed for surgical outcome comparison at a similar time point with relation to recovery. With further follow-up, swallow outcomes may change. For patient 4, by way of example, an MBSS performed 2 months postoperatively was used to assess postsurgical swallow outcome. However, a follow-up FEES was performed 8 months after surgery, which demonstrated a safe and efficient swallow without any pharyngeal residue whatsoever. It has been our experience that following removal of pharyngeal obstruction, pharyngeal muscle strength may improve over the subsequent 3 to 6 months, leading to continuous, gradual improvement in one’s swallow efficiency, which has been shown.\textsuperscript{15}

Despite these drawbacks, objective and subjective assessment of swallow in these patients suggests a reduction of dysphagia that is not attributable to other causes. Although this is a preliminary study, we believe that in a select group of individuals—those with cervical spine pathology causing dysphagia related to epiglottic dysfunction—partial epiglottoplasty may be a treatment option.

**Conclusion**

Cervical spine pathology is an often-overlooked etiology of dysphagia, despite its presence in >10% of patients with this complaint. Although the primary way to address spinal pathology is by performing spinal surgery, this is not an option for all patients. For a select group of patients with dysphagia due to cervical spine pathology as well as epiglottic dysfunction, partial epiglottoplasty may be an option. Surgery in these patients may improve postswallow valvular residue and functional swallow outcomes.

**Author Contributions**

Nausheen Jamal, study conception; acquisition, analysis, and interpretation of data; drafting of work; final manuscript approval; accountable for all aspects of work; Andrew Erman, analysis and interpretation of data; drafting of work; final manuscript approval; accountable for all aspects of work; Dinesh K. Chhetri, study conception; acquisition, analysis, and interpretation of data; drafting of work; final manuscript approval; accountable for all aspects of work.

**Disclosures**

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