Original Article

AO SPINE

Global Spine Journal
2022, Vol. 12(5) 877–882

DOI: 10.1177/2192568220967358
journals.sagepub.com/home/gsj

SAGE

Combined Anterior Osteophytectomy and Cricopharyngeal Myotomy for Treatment of DISH-Associated Dysphagia

Kevin Hines, MD[1,2], Nicholas Elmer, BS[1,2], Maxwell Detweiler, BS[1,2], Umma Fatema, BS[1,2], Glenn A. Gonzalez, MD[1,2], Thiago S. Montenegro, MD[1,2], Daniel Franco, MD[1,2], Srinivas Prasad, MD[1,2], Jack Jallo, MD, PhD[1,2], Ashwini Sharan, MD[1,2], Joshua Heller, MD[1,2], Maurits Boon, MD[1], Joseph Spiegel, MD[1], and James Harrop, MD[1,2]

Abstract

Study Design: Retrospective observational case series.

Objective: To assess the outcome of patients with diffuse idiopathic skeletal hyperostosis (DISH) with dysphagia who underwent cricopharyngeal myotomy (CPM) in conjunction with anterior osteophytectomy (OP).

Methods: This is a retrospective observational study of 9 patients that received combined intervention by neurosurgeons and otolaryngologists. Inclusion criteria for surgery consisted of patients who failed to respond to conservative treatments for dysphagia and had evidence of both upper esophageal dysfunction and osteophyte compression. We present the largest series in literature to date including patients undergoing combined OP and CPM.

Results: A total of 88.9% (8/9) of the patients who underwent OP and CPM showed improvement in their symptoms. Of the aforementioned group, 22.2% of these patients had complete resolution of their symptoms, 11.1% did not improve, and only 2 patients showed recurrence of their symptoms. None of the patients in whom surgery was performed required reoperation or suffered serious complication related to the surgical procedures.

Conclusion: Based on the literature results, high rate of improvements in dysphagia, and low rate of complications, combined OP and CPM procedures may be beneficial to a carefully selected group of patients.

Keywords

osteophytectomy, cricopharyngeal myotomy, dysphagia, DISH, swallowing, diffuse idiopathic skeletal hyperostosis

Introduction

Cervical osteophytes secondary to diffuse idiopathic skeletal hyperostosis (DISH) may develop in 16.9% to 32.1% of adult patients.[1] Up to 10% of these patients present with dysphagia, airway compromise, and/or limited neck mobility and ultimately require surgery after failing conservative measurement.[2] Conservative methods of treatment include dietary modification, speech and swallow therapy, and anti-inflammatory medications.[3] After failure of conservative measurement, progressive symptoms, or appearance of laryngeal signs, surgical intervention may be indicated.[4] Operative treatment in literature most often includes anterior osteophytectomy (OP)[1] with improvement in most cases. However, some of these patients fail to improve and also exhibit upper esophageal sphincter dysfunction. While cricopharyngeal myotomy (CPM) has only been described once in conjunction with OP in the current literature,[5] it has been useful in conjunction with other anterior spinal procedures[6] and may improve dysphagia

[1] Thomas Jefferson University, Philadelphia, PA, USA
[2] Jefferson Hospital for Neuroscience, Philadelphia, PA, USA

Corresponding Author:
James Harrop, Division of Spine and Peripheral Nerve Surgery, Department of Neurological Surgery, Thomas Jefferson University Hospital, 901 Walnut Street 3rd Floor, Philadelphia, PA 19107, USA.
Email: james.harrop@jefferson.edu

Figure 1. Preoperative CT scan of patients demonstrating diffuse osteophytosis of the cervical spine with dysphagia related to esophageal dysfunction.

outcomes in DISH patients. Here we describe outcomes of the largest series of concurrent CPM and OP in literature.

Methods

This study was reviewed by the institutional board review (IRB) and was determined to be exempt for IRB review. Patients were identified after searching operative records from 2013 to 2020 for patients with otolaryngology and spine co-surgeons. From this list, 9 consecutive patients were confirmed to have undergone OP and CPM by checking operative reports. Upon review of operative reports, all confirmed combined OP and CPM surgical approaches were included in the study. Operative patients met criteria for surgery by failing conservative methods of treatment for dysphagia such as diet change and swallowing rehabilitation. At this point they were recommended for OP and CPM if they had evidence of both upper esophageal sphincter dysfunction as well as osteophytic compression contributing to dysphagia. This would allow for one operative procedure to address both contributors to dysphagia at one time.

Patients were evaluated by otolaryngology and found to have persistent dysphagia. Dysphagia was worked up with flexible video stroboscopy, cervical imaging (X-rays, CT [computed tomography], and MRI [magnetic resonance imaging]), and barium swallow or esophageal manometry. This workup was sufficient to both identify anterior osteophytes as a contributor to dysphagia (Figure 1), screen for upper esophageal dysfunction or hypotonicity, and rule out spinal cord compression that would require a decompressive surgery rather than an OP only. Patients were referred to a neurosurgeon for evaluation of the spinal imaging preoperatively and operative approaches were reviewed. If patients selected for OP had dysphagia related to upper esophageal sphincter dysfunction without diverticula on preoperative workup, as well as upper esophageal sphincter compression and irritation by cervical osteophytes, they were eligible for concurrent CPM and OP. Each patient's MRI was also evaluated for compressive spinal cord pathology amenable to an anterior approach. If no such pathology was present, patient would receive OP and CPM anteriorly. If the patients had such pathology, they were not be candidates for OP and CPM and would instead be candidates for anterior decompression and fusion and CPM.[6] This did not exclude patients requiring a posterior approach to address compressive spinal pathology who also had dual pathology dysphagia.

Surgical technique included joint neurosurgery and otolaryngology operations. Neurosurgery begins the procedure by making incision, localizing, and exposing the appropriate anterior cervical spine vertebrae. Similar to exposure of anterior cervical discectomy and fusion procedures, a left-sided transverse skin incision is made obliquely from midline to the border of the sternocleidomastoid. This is followed by division of the platysma and pretracheal fascia providing the plane between the carotid sheath and esophagus toward cervical spine where osteophyte resection occurs. A large exposure is required to facilitate both removal of osteophytes, often diffuse in nature, and access to the cricopharyngeus muscle in the same incision. This is often located at the C5 or C6 levels.[7] Given the pathological distortion of cervical anatomy, traditional landmarks may be difficult to identify and fluoroscopic identification of correct levels and anatomy may be used to aid the surgeon. The longus colli is dissected laterally in a subperiosteal manner to expose the cervical spine ostoephytes.

The osteophytes are then resected with fluoroscopic assistance to ensure adequate resection of the correct levels. This may accomplished with a combination of techniques. An assistant provides temporary retraction with Cloward handheld tractors placed under the longus colli muscles bilaterally to protect the esophagus and carotid sheath. Careful use of osteotomes provides efficient and satisfactory resection by gently dissection the plane between osteophytes and anterior longitudinal ligament. Depending on the quality of the bone, a high speed drill or Leksell rongeurs may be used to smooth the resection

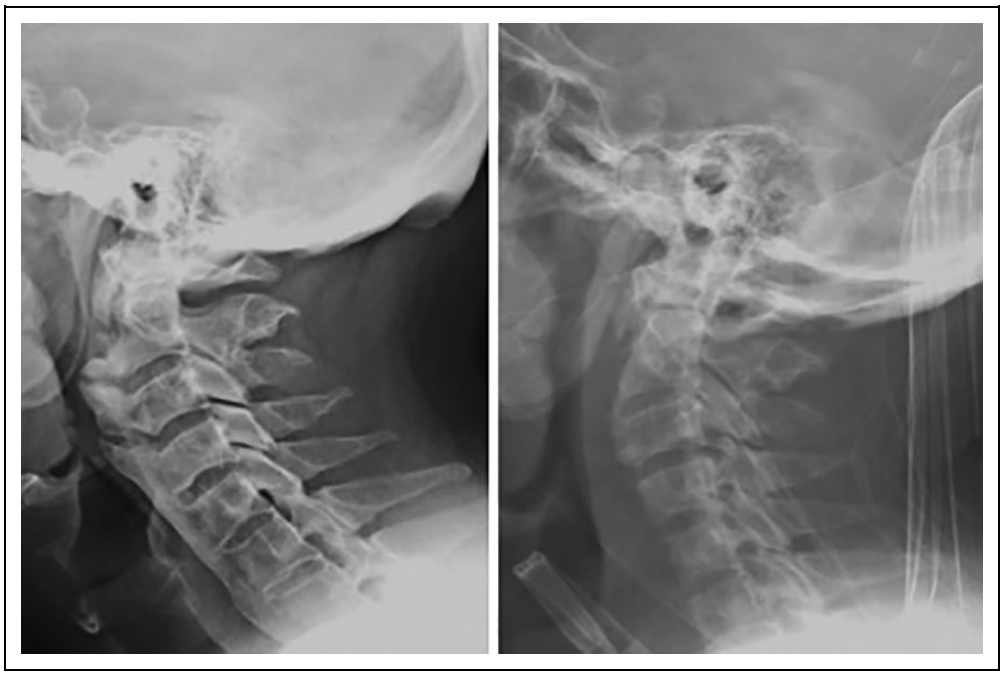

Figure 2. Preoperative and postoperative X-rays of patient 8 undergoing OP+CPM. The patient had no complications and had immediately improved swallowing function postoperatively.

surface. As overgrown osteophytes are resected, the intervertebral disc space becomes apparent and traditional landmarks become more recognizable. Once satisfactory resection is achieved with fluoroscopic confirmation, bone wax is used to aid in careful hemostasis and inhibit boney regrowth.[8]

The case is then turned over to otolaryngology for esophageal dilation and CPM. With the endoscopic guidance, a bougie dilator is placed in the oral cavity and passed beyond the level of the cricopharyngeus. At this point, the inferior portion of the neck incision is utilized to access the cricopharyngeus. During dissection recurrent laryngeal nerve is identified and preserved. After dissecting the cricopharyngeus, a sharply made posterolateral incision approximately 6 cm in length is made at the level of the cricoid and carried inferiorly.[7,9] The incision is made all the way through the muscle to the depth of the submucosa. Careful hemostasis is achieved and visual inspection to identify any perforation is performed. The bougie dilator is removed postoperatively. A surgical drain is typically left in the site and removed post-operative day one. (Figure 2 demonstrates preoperative and postoperative X-rays after OP+CPM procedure).

In one of the cases, the patient did have posterior cervical spinal cord compression on preoperative imaging and myelopathic signs. Given pathology was amenable to posterior approach for treatment while meeting criteria for OP and CPM to address dysphagia, an anterior-posterior approach was planned. After the anterior portion of the procedure was completed, the patient was positioned prone and posterior cervical decompression and fusion was performed.

Subsequent patient follow-up was examined to evaluate for patient subjective stability, improvement, or worsening of dysphagia. All follow-up results were obtained through otolaryngology and neurosurgery provider documentation of patient-reported outcomes at office visits. Any further therapy or recurrence was determined by the need for repeat treatment such as esophageal dilations. Patient outcomes were followed as far from surgery as follow-up was documented by otolaryngology or neurosurgery.

Results

Please see Table 1 for a summary of the procedures, outcomes, and characteristics of the case series patients. Of our series of 9 patients both undergoing OP and CPM, 8 (88.9%) patients noted improvement of symptoms and 2 (22.2%) of those patients reported complete resolution of symptoms. Only 1 (11.1%) patient did not improve, and 2 had postoperative recurrence of symptoms (22.2%). However, none of the patients reported worsening of symptoms postprocedurally. Of note, recurrence of symptoms manifested 3 months postoperatively in patient 3, and 6 years later in patient 7. Both had improvement of symptoms with subsequent esophageal dilation and did not require revision CPM or OP. No patients had postoperative infections, esophageal perforation, vocal cord paresis, or any other significant postoperative complication. Postoperatively only one patient noted hoarseness of the voice thought to be related to intubation granuloma. This improved with the use of a proton pump inhibitor. No patients were noted to have radiographic recurrence of DISH related changes.

It is important to note that of the 9 patients included in the study, 5 had postoperative follow-up of 18 months or greater. Of these patients, all symptoms were improved or resolved

Table 1. Summary of Case Series and Patient Outcomes.

Patient #	Procedure	OP levels	Dysphagia outcome	Follow-up (months)	Symptom recurrence?	Barium swallow study	Preoperative UES manometry (mm Hg)
1	OP, CPM, ED	C4-7	Stable	1	No	CB	NA
2	OP, CPM, ED	C2-7	Resolved	18	No	ASP, CB	NA
3	OP, revision CPM	C3-T1	Improved	60	Yes	NA	Residual 18.7
4	OP, CPM, ED	C2-4	Improved	2	No	ASP, CB	NA
5	OP, CPM, ED, PCDF	C3-4, 6-7	Improved	37	No	NA	↑ @ rest
6	OP, CPM, ED	C3-7	Improved	27	No	HH, CB	NA
7	OP, CPM, ED	C4-6	Resolved	80	Yes	Na	Residual 11.7
8	OP, CPM, ED	C2-6	Improved	3	No	NA	206 Resting
9	OP, CPM, ED	C3-5	Improved	3	No	CB	Relaxation 820 m/s

Abbreviations: OP, osteophytectomy; UES, upper esophageal sphincter; CPM, cricopharyngeal myotomy; ED, esophageal dilation; CB, cricopharyngeal bar; ASP, aspirating; NA, data unavailable/study not obtained; HH, hiatal hernia.

compared to preoperative; however, 2 patients noted recurrence. None required further operation but the 2 patients who underwent further esophageal dilation are included among these patients.

Discussion

The most common surgical procedure used to address dysphagia failing conservative treatment secondary to cervical osteophytosis is OP. While it is a well-tolerated procedure with minimal complications or morbidity,[10] some patients have recurrence of symptoms postoperatively.[11] One proposed mechanism of recurrence is progression of hyperostosis with recurrent extrinsic esophageal compression. In Miyato's series of 7 patients who underwent OP for cervical osteophytosis, 2 required revisional procedures due to recurrence of osteophyte.[11] Another study reported that in a series of 5 patients who underwent surgical intervention for cervical osteophytosis all patients had radiographic evidence of osteophyte recurrence.[12] Of these, only one of the patients developed worsening symptoms and required revision.[13]

The other mechanism of recurrence and failure involves untreated pathology related to dysphagia. It has been hypothesized that hyperostosis may contribute to dysphagia via direct compression, local edema and inflammation, and spasm of adjacent of cricopharyngeal musculature.[14] While resection of osteophytes may address the first and second mechanisms, spasticity of the cricopharyngeal muscles and subsequent hypertonicity may not be addressed by OP alone. Given this elevated pressure in the cricopharyngeal region, patients may require CPM to address this pathology.[15] A procedure with little risk of morbidity and mortality, it may be easily approached and performed concurrently with OP through the same incision.[16] In prior literature, open and endoscopic CPM have similar complication rates of 5/38 and 2/41 (esophageal rent, pharyngeocutaneous fistula, mucosal tearing, esophageal perforation).[9] Among 79 patients in this study, only one of these complications resulted in negative sequelae.[9] This suggests that a concurrent open approach carries similar morbidity to endoscopic approaches, spares the patient extra procedures, and avoids a potentially challenging surgery in a revision surgical site should patient require subsequent CPM after OP.

The current study suggests an outcome benefit in patients presenting with dysphagia who received OP with concurrent CPM. In comparison to the only case report previously reported in the literature,[5] our study demonstrated 88.9% (8/9) of patients who underwent OP+CPM had resolution of dysphagia or symptom improvement. In addition, all 9 patients in the series were able to undergo their OP without having immediately worsening postoperative dysphagia despite having risk factors predisposing them to this complication after anterior cervical surgery.[17,18] These outcomes appear favorable compared to other studies examining OP alone with improvement of symptoms ranging from 71% to 100% depending on the size of the study and follow-up. The largest single series assessing anterior OP to date notes only a 76% improvement rate of symptoms,[10-13] consistent with pooled review of cases.[1] In addition, these studies did not differentiate between single and dual pathology contributing to dysphagia. One minor complication, transient postoperative hoarseness, was noted in the study. This rate of 11.1% (1/9) is comparable to prior literature.[10]

In terms of recurrence, many patients have radiographic recurrence of osteophytes given enough follow-up.[11] However, symptomatic recurrence in OP patients ranges from 0% to 29% of series with 0% to 14% of patients requiring reoperation for resection of osteophytes.[11,12,19,20] In more extensive series, 18% of patients noted symptom recurrence but none required reoperation.[10] It is important to note that other studies do not detail the need for further esophageal dilation postoperatively and may have been performed without inclusion in the results or discussion. This study's patients required no reoperations despite having dual pathology identified on preoperative swallow studies.

Of our patients undergoing both OP+CPM given dysphagia related to both osteophytic compression and cricopharyngeal dysfunction diagnosed on barium swallow or manometry, only 2 (22.2%) of these high-risk patients had recurrence of symptoms during follow-up ranging from 1 to 80 months. Similar to other studies, none of these patients required reoperation.

However, they did both undergo subsequent esophageal dilation with further relief of symptoms. None of these patients had recurrence of compressive DISH pathology on subsequent imaging. When investigating prior literature on OP alone, radiographic recurrence of osteophytes is documented in multiple studies.[11,12] However, symptom recurrence ranges in literature from 0% to 29% of series with 0% to 14% of patients requiring reoperation for resection of osteophytes.[11,19,20] In longer term follow-up when excluding patients in this study with 3 months or less follow-up, 100% (5/5) of patients noted improvement or resolution of symptoms but 40% (2/5) noted recurrence of symptoms clinically significant enough to require esophageal dilation. This is difficult to compare to other studies because most do not quantify need for further less invasive intervention such as esophageal dilation. They only document reoperation in terms of revision OP or CPM.

This is the first multi-patient study examining combined OP and CPM in patients with DISH related dysphagia. When compared to the single case previously reported in literature, the results of this study are supported by this case.[5] Chen et al describe a patient with 2 years of dysphagia who also had CT-confirmed osteophytic esophageal compression and cricopharyngeal hypertrophy on barium swallow. Similar to the present study, the patient's improvement was immediate and noted at the first follow-up appointment. He had resolution of his symptoms and did not present with recurrence for the 12 months he was followed postoperatively. In carefully selected patients, OP and CPM may serve as an effective treatment for dual pathology often resulting in immediate postoperative improvement as seen by the cases in this study and the prior case reported in literature.

This study has several limitations. A challenge permeating anterior cervical spine surgery is the reporting of dysphagia related outcomes.[21,22] While tools such as EAT-10[23] and the Bazaz dysphagia scoring system[24] have been developed, they remain inconsistently used by spine surgeons to report outcomes. Unfortunately, this patient population is no exception and may limit interpretation due to the subjective nature of the data. The other major limitation of this study that should be noted is the large range of follow up (1-80 months). Given the insidious nature of DISH, longer term follow-up is important in truly assessing outcome in these patients as recurrence of symptoms is often delayed. Future directions of study in the use of combined OP and CPM include longer term follow-up with more consistent use of objective measures to describe dysphagia-related outcomes in this challenging pathology.

Conclusion

This is the largest series in the literature describing dysphagia outcomes for patients who received OP+CPM. While demonstrating no additional complications, OP+CPM may be beneficial compared to outcomes in OP alone (88.9% vs 76% in larger analyses[1,10]) when examining patients with dual pathology. To our knowledge, there has only been one report of OP+CPM and surgery-related outcomes previously reported.[5] OP+CPM may improve dysphagia outcomes in patients with dysphagia secondary to both mechanical compression and cricopharyngeal dysfunction while minimizing complications and the need for multiple surgeries to address a patient's dysphagia.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Kevin Hines, MD https://orcid.org/0000-0003-1700-174X
Umma Fatema, BS https://orcid.org/0000-0002-3174-2555

References

1. Verlaan JJ, Boswijk PFE, de Ru JA, Dhert WJA, Oner FC. Diffuse idiopathic skeletal hyperostosis of the cervical spine: an underestimated cause of dysphagia and airway obstruction. *Spine J*. 2011;11:1058-1067. doi:10.1016/j.spinee.2011.09.014
2. Resnick D, Shapiro RF, Wiesner KB, Niwayama G, Utsinger PD, Shaul SR. Diffuse idiopathic skeletal hyperostosis (DISH). *Semin Arthritis Rheum*. 1978;7:153-187. doi:10.1016/0049-0172(78)90036-7
3. Oppenlander ME, Orringer DA, La Marca F, et al. Dysphagia due to anterior cervical hyperosteophytosis. *Surg Neurol*. 2009;72:266-271. doi:10.1016/j.surneu.2008.08.081
4. Lecerf P, Malard O. How to diagnose and treat symptomatic anterior cervical osteophytes? *Eur Ann Otorhinolaryngol Head Neck Dis*. 2010;127:111-116. doi:10.1016/j.anorl.2010.05.002
5. Chen YR, Sung K, Tharin S. Symptomatic anterior cervical osteophyte causing dysphagia: case report, imaging, and review of the literature. *Cureus*. 2016;8:e473. doi:10.7759/cureus.473
6. Hines K, Stricsek G, Mahtabfar A, et al. The role of cricopharyngeal myotomy after anterior cervical decompression and fusion operations. *World Neurosurg*. 2020;137:146-148. doi:10.1016/j.wneu.2020.01.180
7. Parrish RM. Cricopharyngeus dysfunction and acute dysphagia. *Can Med Assoc J*. 1968;99:1167-1171.
8. Tham T, Roberts K, Shanahan J, Burban J, Costantino P. Analysis of bone healing with a novel bone wax substitute compared with bone wax in a porcine bone defect model. *Future Sci OA*. 2018;4:FSO326. doi:10.4155/fsoa-2018-0004
9. Huntley C, Boon M, Spiegel J. Open vs. endoscopic cricopharyngeal myotomy; is there a difference? *Am J Otolaryngol*. 2017;38:405-407. doi:10.1016/j.amjoto.2017.03.010
10. Chung YS, Zhang HY, Ha Y, Park JY. Surgical outcomes of dysphagia provoked by diffuse idiopathic skeletal hyperostosis in the cervical spine. *Yonsei Med J*. 2020;61:341-348. doi:10.3349/ymj.2020.61.4.341
11. Miyamoto K, Sugiyama S, Hosoe H, Iinuma N, Suzuki Y, Shimizu K. Postsurgical recurrence of osteophytes causing dysphagia in patients with diffuse idiopathic skeletal hyperostosis. *Eur Spine J*. 2009;18:1652-1658. doi:10.1007/s00586-009-1133-3

12. Urrutia J, Bono CM. Long-term results of surgical treatment of dysphagia secondary to cervical diffuse idiopathic skeletal hyperostosis. *Spine J*. 2009;9:e13-e17. doi:10.1016/j.spinee.2009.04.006
13. Scholz C, Naseri Y, Hohenhaus M, Hubbe U, Klingler JH. Long-term results after surgical treatment of diffuse idiopathic skeletal hyperostosis (DISH) causing dysphagia. *J Clin Neurosci*. 2019;67:151-155. doi:10.1016/j.jocn.2019.05.057
14. Yee C, Wong HY, Fewer HD, Rogers AG. Two cases of dysphagia due to cervical spine osteophytes successfully treated surgically. *Can Med Assoc J*. 1985;132:810-812.
15. Bammer T, Salassa JR, Klingler PJ. Comparison of methods for determining cricopharyngeal intrabolus pressure in normal patients as possible indicator for cricopharyngeal myotomy. *Otolaryngol Head Neck Surg*. 2002;127:299-308. doi:10.1067/mhn.2002.128554
16. Mitchell RL, Armanini GB. Cricopharyngeal myotomy: treatment of dysphagia. *Ann Surg*. 1975;181:262-266. doi:10.1097/00000658-197503000-00003
17. Cho SK, Lu Y, Lee DH. Dysphagia following anterior cervical spinal surgery: a systematic review. *Bone Joint J*. 2013;95-B:868-873. doi:10.1302/0301-620X.95B7.31029
18. Zeng JH, Zhong ZM, Chen JT. Early dysphagia complicating anterior cervical spine surgery: incidence and risk factors. *Arch Orthop Trauma Surg*. 2013;133:1067-1071. doi:10.1007/s00402-013-1773-y
19. Hamouda WO. Timing for surgical intervention in DISHphagia. *J Craniovertebral Junction Spine*. 2018;9:227-231. doi:10.4103/jcvjs.JCVJS_83_18
20. Lui Jonathan YC, Sayal P, Prezerakos G, Russo V, Choi D, Casey ATH. The surgical management of dysphagia secondary to diffuse idiopathic skeletal hyperostosis. *Clin Neurol Neurosurg*. 2018;167:36-42. doi:10.1016/j.clineuro.2018.02.010
21. Edwards CC 2nd, Karpitskaya Y, Cha C, et al. Accurate identification of adverse outcomes after cervical spine surgery. *J Bone Joint Surg Am*. 2004;86:251-256. doi:10.2106/00004623-200402000-00006
22. Shriver MF, Lewis DJ, Kshettry VR, Rosenbaum BP, Benzel EC, Mroz TE. Dysphagia rates after anterior cervical diskectomy and fusion: a systematic review and meta-analysis. *Glob Spine J*. 2017;7:95-103. doi:10.1055/s-0036-1583944
23. Rosenthal BD, McCarthy MH, Bhatt S, et al. A comparison of patient-centered outcome measures to evaluate dysphagia and dysphonia after anterior cervical discectomy and fusion. *J Am Acad Orthop Surg*. 2019;27:848-853. doi:10.5435/JAAOS-D-17-00631
24. Bazaz R, Lee MJ, Yoo JU. Incidence of dysphagia after anterior cervical spine surgery: a prospective study. *Spine (Phila Pa 1976)*. 2002;27:2453-2458. doi:10.1097/00007632-200211150-00007