

Surgical treatment of dysphagia after anterior cervical interbody fusion

Guy R. Fogel, MD*, Mark F. McDonnell, MD

Houston Spine Surgery, 5225 Katy Freeway, Suite 600, Houston, TX 77007, USA

Received 22 September 2003; accepted 30 June 2004

Abstract

BACKGROUND CONTEXT: Dysphagia is a frequent complication after anterior cervical interbody fusion (ACIF). Although dysphagia usually improves over 6 months, it remains a significant and persistent problem for some patients. The etiology is poorly understood but has been reported to be associated with vocal cord paralysis, dislodgement of instrumentation and unidentified causes, such as hematoma, adhesion formation and denervation of the pharyngeal plexus. A surgical treatment of dysphagia after ACIF has not been reported.

PURPOSE: We report the surgical treatment of persistent dysphagia occurring after ACIF with instrumentation.

STUDY DESIGN/SETTING: A retrospective review of cervical discectomy and interbody fusion patients identified a subset of patients with symptomatic dysphagia who chose surgical treatment of the dysphagia. The hypothesis is that removal of the anterior cervical plate will release mechanical adhesions of the esophagus to the anterior spine around the plate. Outcome was graded by examination and a final telephonic interview with a dysphagia questionnaire.

METHODS: Thirty-one patients who elected surgical treatment for persistent dysphagia were assessed at clinic visits after surgery at 3, 6 and 12 months for symptomatic dysphagia, and with a final telephonic questionnaire. The average time from initial surgery to time of surgical treatment for dysphagia was 18 months. Final follow-up was an average 11 months (range, 6 to 25 months) with a dysphagia questionnaire using the Bazaz-Yoo dysphagia score. Thirty-one patients responded to a phone questionnaire with the Bazaz-Yoo dysphagia score.

RESULTS: The primary operative finding was extensive adhesions attaching the esophagus to the prevertebral fascia and anterior cervical spine around the periphery of the cervical plate. Seventeen patients (55%) were significantly improved to no dysphagia of solids and liquids ($p \leq .0001$). Ten patients (32%) reported mild dysphagia occasionally with specific foods. Three patients had persistent moderate occasional dysphagia with solid food. Two patients had persistent severe dysphagia of solids and liquids. Previous cervical surgery, particularly with pre-existing dysphagia, and unexpectedly extreme amounts of adhesions at surgery were contributing factors to the cases with persistent severe dysphagia.

CONCLUSIONS: Surgical treatment of dysphagia after ACIF has not been reported. Removal of the cervical instrumentation in patients will improve the dysphagia. This improvement with surgical management, as compared with the dissatisfaction before surgical treatment, documents that this surgical treatment is a reasonable option. © 2005 Elsevier Inc. All rights reserved.

Keywords: Dysphagia; Complications, cervical; Cervical plate

FDA device/drug status: approved for this indication (DePuy cervical plate).

Nothing of value received from a commercial entity related to this research.

* Corresponding author. South Texas Orthopaedics and Spinal Surgery Associates, 9150 Huebner Road, #350, San Antonio, TX 78240, USA. Tel.: (210) 561-7234; fax: (210) 561-7240.

E-mail address: gfogel@spinetex.com (G.R. Fogel)

Introduction

Anterior cervical discectomy and interbody fusion is frequently performed for disc herniation and spondylosis. Although the procedure is associated with low morbidity, dysphagia is a common postoperative complaint [1–17]. Dysphagia is defined as difficulty with swallowing both solids and liquids and includes the inability to protect the airway from aspiration. Patients with dysphagia report

difficulty with solid and liquid food. Some report painful swallowing (odynophagia), difficulty with saliva, food sticking in the throat and coughing with eating. Common symptoms are listed in Table 1.

Postoperative dysphagia usually improves with time. However, there are some patients with persistent symptoms that do not improve spontaneously. Winslow et al. [5] in a questionnaire study of noninstrumented anterior cervical interbody fusion (ACIF) patients found early dysphagia in 60% and long-lasting dysphagia in 23% [5]. In a prospective consecutive series of both instrumented and noninstrumented ACIF, Bazaz et al. [2] described a significant rate of dysphagia that decreased over time and stabilized at a 12.5% rate at 12 months. Yue et al. [14] evaluated 74 patients at an average 7.2 years after instrumented ACIF and found a 35% incidence of persistent dysphagia with 17.6% moderate and severe symptoms.

Early in our experience, several patients were referred for otolaryngology evaluation for persistent dysphagia after instrumented anterior cervical interbody fusion. The patients returned without meaningful abnormalities detected on barium swallow, laryngeal endoscopy or esophageal manometry. The otolaryngology specialists suggested no remedy for the dysphagia. In the same time period, the senior author had noted a clinical improvement in dysphagia occurring after cervical instrumentation removal in two patients with severe preoperative symptoms of dysphagia. The hypothesis is that removal of the anterior cervical plate will release mechanical adhesions of the esophagus to the anterior spine around the plate.

With clinical success in two patients, cervical instrumentation removal was offered to patients with significant persistent dysphagia after ACIF. Our series of anterior cervical discectomy and interbody fusion (ACIF) for treatment of disc herniation and spondylosis was reviewed. Patients were identified who chose to have exploration of the anterior fusion with removal of anterior cervical instrumentation. We report the surgical treatment results in this group of ACIF patients with persistent dysphagia.

Table 1
Symptoms of dysphagia

More obvious symptoms
Pain with swallowing
Difficulty swallowing
Heartburn
Coughing or choking with swallowing
Regurgitation of old foodstuffs
Nasal regurgitation
Feeling of blockage
Weight loss
Less obvious symptoms
Food avoidance
Frequent throat clearing
Changes in breathing after swallowing
Wet voice quality

Methods

Forty-four patients were identified as undergoing plate removal and lysis of adhesions for the indication of dysphagia in the period January 1999 to December 2001. Attempts by mail and phone were made to contact all patients, and 31 of the 44 responded to a final telephone questionnaire using the Bazaz-Yoo dysphagia score giving a last follow-up an average 11 months (range, 5 to 25 months) after instrumentation removal in 31 patients. In the 31 patients with complete follow-up, the average time to surgical treatment for dysphagia was 18 months.

The 31 patients underwent anterior exploration of the fusion, with removal of the anterior cervical instrumentation and lysis of adhesions between the esophagus and the anterior cervical spine. The right-side anterior approach was made excising the previous incisional scar. The anterior instrumentation was the PEAK plate (DePuy, Warsaw, IN), in all cases. The surgeon used self-retraction systems (Trimline; Sofamor Danek, Memphis, TN). Anesthesia included the use of an esophageal stethoscope, and the endotracheal cuff was kept at low pressure throughout the procedure. Iliac crest autograft and additional PEAK plate instrumentation was used in revision of nonunion or treatment of adjacent segment deterioration cases. Postoperative immobilization consisted of a hard collar in revision cases, and no immobilization was required otherwise.

Patients were evaluated at clinic visit by the author (MFM) 1, 6 and 12 months after the procedure. Questions about dysphagia have been standard intake questions at follow-up in the practice. We use the dysphagia score published by Bazaz et al. [2]. These authors published a validated grading system for postoperative dysphagia (Table 2). The patients are graded as having none, mild, moderate or severe dysphagia. Patients with no episodes of swallowing difficulty were graded as “none.” Patients who experienced rare episodes of dysphagia were graded “mild.” These patients thought their dysphagia was insignificant. “Moderate” dysphagia was defined as occasional swallowing difficulty with specific foods (ie, steak or bread). “Severe” dysphagia was defined as frequent difficulty swallowing the majority of foods. Using the dysphagia score retrospectively, the patients were graded as having none, mild, moderate or severe dysphagia of liquids and solids based on follow-up visit clinical evaluation and a telephonic questionnaire in those patients unavailable for a final clinical visit. Records were

Table 2
Dysphagia score symptoms

Severity	Liquid	Solid
0.None	None	None
1.Mild	None	Rare
2.Moderate	None or rare	Occasionally with specific food
3.Severe	None or rare	Frequent (majority of solids)

From Bazaz et al. [2].

reviewed for patient's age, gender, surgical procedure, tobacco use and number and location of surgical levels addressed.

The average age was 43 years with a range of 25 to 66 years. Twenty-eight (64%) were men and 18 (41%) women. The number of levels in the initial anterior cervical interbody fusion in the 31 patients ranged from one to four levels with a mean of three levels. Seventy percent of the fusions were at three or four levels.

All patients had indication of symptomatic anterior hardware and dysphagia categorized as moderate or severe. Additional indications at the time of surgical treatment of dysphagia were exploration for pseudarthrosis (five; 16%) or adjacent segment deterioration (six; 19%). Three patients had undergone previous surgery, and two of these had pre-existing dysphagia and dysphonia before the index ACIF.

Results

The Bazaz-Yoo dysphagia score before surgical treatment of dysphagia in the 31 patients was moderate dysphagia in 15 (48%) or severe dysphagia in 16 (52%). The patients had more severe dysphagia with solids than liquids (Table 3). The Bazaz-Yoo dysphagia score after instrumentation removal in the 31 patients at last examination showed significant improvement in dysphagia scores of liquids and solids ($p \leq .0001$). One (3%) had continued severe dysphagia of solids and liquids. Three patients (10%) had persistent moderate dysphagia. In 17 patients (55%) there was no dysphagia at all. Ten (32%) reported mild occasional dysphagia with certain solids, such as steak and bread (Table 3).

At the time of cervical instrumentation removal, the primary operative finding was extensive adhesions attaching the esophagus-trachea midline structures to the prevertebral fascia and anterior cervical spine around the periphery of the cervical instrumentation and through any open aperture in the plate. Releasing the adhesions between the esophagus and the anterior cervical spine was the key to restoring mobility to the esophagus. Fig. 1 illustrates the plane of surgical release of adhesions accomplished with removal of the cervical plate. The status and condition of the plates at the time of surgery was uniformly benign. The plates were not fractured or corroded. There was no screw failure or

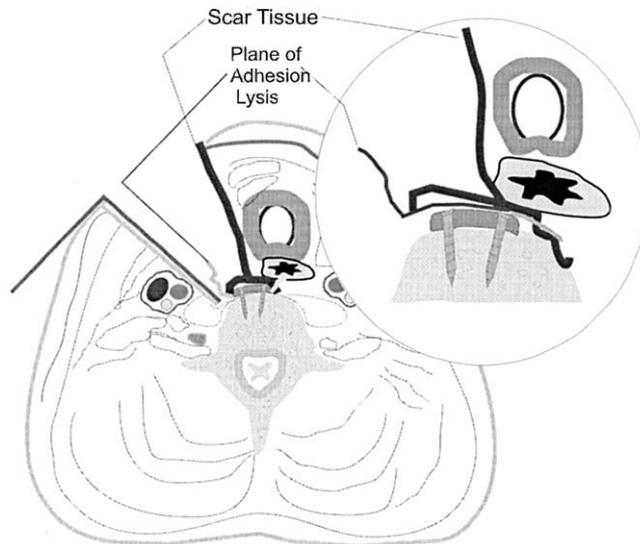


Fig. 1. Scar tissue forms with the incision from skin to spine, sweeping over the plate and attaching to the anterior cervical spine along the edges of the plate. Adhesions may bind the trachea and the esophagus to the scar overlying the plate. Removal of the plate will release the adhesions and free the esophagus from the spine surface.

screw loosening observed. In three cases, there was some tissue staining beneath the plate, typical of titanium plates and screws. There were no cases with visible metallic wear debris reported.

Approaching the cervical spine through the previous incision was not difficult. However, twice there was unusually dense and prolific adhesions found at the time of surgery. In these two cases, the dissection was more difficult. In both of the patients there was recurrent moderate to severe dysphagia. In one patient, there was a history of three additional previous surgeries, with pre-existing dysphonia and dysphagia rated as moderate. An otolaryngologist performed preoperative evaluation of the vocal cords and the approach at the index surgery and reported intense scarring but no damage to the vocal folds or visceral structures. At final examination, there was barium swallow evidence of a pharyngeal diverticulum. His dysphagia was rated severe. His dysphonia was mild. In the other patient with extreme scarring at surgery, there was an extraordinary odynophagia, choking of solids and liquids, and difficulty breathing before surgery rated as severe dysphagia and dysphonia. For 2 months after surgery, the dysphagia was improving; thereafter the symptoms recurred and worsened. At final examination there was severe dysphagia and a vocal fold paralysis that responded finally to a gelfoam implant. Complications of the surgical treatment of dysphagia were continued symptoms of dysphagia as severe in 2 (5%), moderate in 3 (7%) and mild in 16 (36%). Two were initially much improved in their dysphagia, but symptoms recurred 6 to 12 weeks after surgical treatment. One patient had a persistent vocal fold paralysis and 3 more had dysphonia without known vocal fold paralysis. One developed a symptomatic pharyngeal diverticulum

Table 3
Dysphagia of liquids and solids before surgery and last examination

Severity	Liquid		Solid	
	Preoperative/ last score (%)	p Value	Preoperative/ last score (%)	p Value
0.None	0/81	<.0001	0/55	<.0001
1.Mild	26/16	<.0001	0/32	<.0001
2.Moderate	65/3	<.0001	48/10	<.0001
3.Severe	10/0	.0377	52/3	<.0001
Median	2/0		3/0	
SD	1/0		1/1	

Table 4
Complications

Levels	Complications	LFU Symptoms
C3–C7	Dysphonia	Dysphonia mild with singing
C4–C6	None	Snoring increased
C3–C7	Dysphagia and dysphonia before surgery	Mild occasional choking on large solids, mild dysphonia, continued neck pain, diabetic
C3–C6	None	Continued dysphagia improved 1 grade
C3–C6	Most severe scarring, 1 inch thick	Severe residual dysphagia, pharyngeal diverticulum, severe neck pain and headaches
C3–C6	None	Initially good but recurrent dysphagia
C3–C7	Dysphonia	Continued dysphonia
C4–C6	Horner syndrome for 3 months	Horner syndrome resolved
C3–C6	Most intense scarring, VFP	VFP with implant; dysphagia improved 2 months, then worsened; normal barium swallow
C4–T1	Dysphagia and dysphonia before surgery	Good relief of dysphagia, mild dysphonia

LFU=last follow-up; VFP=vocal fold paralysis.

associated with severe dysphagia. One Horner syndrome resolved at 3 months after surgery (Table 4).

Discussion

The literature on the incidence of dysphagia is largely retrospective. The incidence varies widely from the literature, with reports varying from 2% to 60% [2,5,15,18,19]. From reports in the literature, persistent dysphagia occurs whether or not the anterior cervical spine is instrumented [1,2,10,17]. The incidence in the instrumented versus noninstrumented cases in the literature may be slightly higher in the instrumented group. Albert et al. [7] in the multicentric cervical plate study sponsored by the Cervical Spine Research Society are currently reporting incidence of 7.9% dysphagia in instrumented ACIF patients at 24 months and 5.3% in nonplated ACIF patients. Edwards et al. [8] compared the outpatient records of four spine surgeons from two different academic medical centers with the results of a brief survey mailed to patients. Dysphagia was recorded as present in surgeon records 25 times and 104 times by patient survey. Edwards et al. concluded that dysphagia was underreported by 76% in surgeon records with very poor correlation to the patients' responses in the survey.

Bazaz et al. [2] found a 50% incidence of dysphagia at 1 month after anterior cervical surgery that improved to 12.6% at 12 months. Yue et al. [14] invited 74 patients to return for examination by two independent reviewers at an average 7.2 years (range, 5.4 to 11.1 years). Persistent dysphagia of mild to severe was present in 36% and moderate or severe dysphagia was found in 17.6% [14]. The persistent dysphagia rate in the current study is very similar to that determined by Yue et al. The dysphagia incidence in the current study may appear higher than expected, but it is clear from the Yue et al. and the Edwards et al. reports that the true incidence of persistent dysphagia is higher than that previously stated in the literature and is often underreported.

Risk factors for dysphagia, such as age, gender, primary versus revision surgery, usage of cervical plate and number of levels treated, have been previously described [1,5,10–12,20–23]. Dysphagia has been reported to be associated

with vocal cord paralysis [1,15,16,24] or prevertebral edema [10]. Frempong-Boadu et al. [1] reported 48% of ACIF patients had preoperative evidence of radiographic swallowing abnormalities, and Doran et al. [25] found 50% of patients with prior cervical surgery had postoperative barium swallow abnormalities. Revision surgery with additional scarring, the risks of reoperation through a previous incisional scar and previous dysphagia and dysphonia may increase the risk of recurrent and persistent dysphagia. Increased prominence of the instrumentation, graft or screws could cause esophageal irritation, even erosion and death [26]. All current anterior cervical plating systems are designed with minimal profile and the screw lock to the plate by various methods to prevent screw back out, which could cause esophageal irritation and dysphagia [27]. The PEAK Plate system of Depuy-Acromed used in this study is a contemporary system with a profile height of 3.2 mm and a width of 18.1 mm. Dislodgement of the graft or instrumentation is a known cause of dysphagia [18,28]. No case of instrumentation dislodgement or bone graft displacement was identified in this series. Anterior instrumentation, screw heads and grafts should be kept flush with the surface of the spine to minimize local esophageal irritation.

Intense adhesions were found in each of our cases at instrumentation removal surgery. These adhesions seem to flow smoothly around the surfaces of the plate along all edges, without actually attaching to it. Adhesions extended from the esophagus through the holes in the plate down to the bone surface. The adhesions attach the esophagus to the anterior vertebral surfaces around the borders of the plate. While removing the plate, adhesions attaching the esophagus to the vertebral surface adjacent to the plate are removed. The esophagus is freed from the cervical surface below. With the initial ACIF, the magnitude of the adhesions is increased by the presence of raw and oozing bone exposed during the subperiosteal dissection, drilling and burring necessary for the adequate preparation of the site. The adhesion formation after plate removal may be less intense because there is no exposed bleeding bone surface to produce a significant hematoma. The patient has a better chance of not adhering the esophagus to the bone again.

One shortcoming of this study is the inability to answer the question of whether relief of dysphagia with lysis of adhesions in other situations, such as noninstrumented cases or instrumented cases treated without plate removal, would be as effective in treatment of dysphagia. Unfortunately, this study, without a noninstrumented control group, cannot answer that question. In literature review, there is a similar incidence of dysphagia in the instrumented and noninstrumented cases. However, it is interesting that dysphagia may be improved in cases with revision for pseudarthrosis or extension for adjacent segment deterioration with removal and insertion of a new plate. Another shortcoming of the present study is the lack of pre- and postoperative barium swallow and otolaryngology evaluations. It is our opinion from the literature and our experience that the testing does not reflect the severity of the dysphagia, and it does not suggest any remedy for the severe symptoms. A last shortcoming is a proper assessment of the effect of the instrumentation's contribution to dysphagia; for example, the thickness of the plate and such properties as corrosion and tissue staining may have some effect. This study did not find any direct contribution of the instrumentation to dysphagia.

Conclusions

Surgical treatment of dysphagia after ACIF has not been reported. Removal of the anterior cervical instrumentation in patients with residual significant dysphagia will improve the dysphagia. This improvement with surgical management, as compared with the dissatisfaction before instrumentation removal surgery because of dysphagia, documents that this surgical treatment is a reasonable option.

References

- [1] Frempong-Boadu A, Houten JK, Osborn B, et al. Swallowing and speech dysfunction in patients undergoing anterior cervical discectomy and fusion: a prospective, objective preoperative and postoperative assessment. *J Spinal Disord Tech* 2002;15(5):362–8.
- [2] Bazaz R, Lee MJ, Yoo JU. Incidence of dysphagia after anterior cervical spine surgery: a prospective study. *Spine* 2002;27(22):2453–8.
- [3] Flynn TB. Neurologic complications of anterior cervical interbody fusion. *Spine* 1982;7(6):536–9.
- [4] Riley LH, Jr, Robinson RA, Johnson KA, Walker AE. The results of anterior interbody fusion of the cervical spine. Review of ninety-three consecutive cases. *J Neurosurg* 1969;30(2):127–33.
- [5] Winslow CP, Winslow TJ, Wax MK. Dysphonia and dysphagia following the anterior approach to the cervical spine. *Arch Otolaryngol Head Neck Surg* 2001;127(1):51–5.
- [6] Donnelly RE, O'Brien M, Dart D, Lowe TG, Dwyer TF. Dysphagia after multilevel cervical arthrodesis: a clinical and cineradiographic evaluation. Paper presented at: Cervical Spine Research Society Annual Meeting, Monterey, CA, November 29, 2001.
- [7] Albert TJ, Riley L, Skolasky RL. Cervical plate study. Paper presented at: Cervical Spine Research Society, Scottsdale, AZ, December 11, 2003.
- [8] Edwards CC, Heller JG, Murakami H. Corpectomy versus laminoplasty for multilevel cervical myelopathy: an independent matched-cohort analysis. *Spine* 2002;27(11):1168–75.
- [9] Edwards CC, Karpitskaya Y, Cha C, et al. Accurate identification of adverse outcomes after spine surgery. *J Bone Joint Surg Am* 2004;86-A:251–6.
- [10] Martin RE, Neary MA, Diamant NE. Dysphagia following anterior cervical spine surgery. *Dysphagia* 1997;12(1):2–10.
- [11] Stewart M, Johnston RA, Stewart I, Wilson JA. Swallowing performance following anterior cervical spine surgery. *Br J Neurosurg* 1995;9(5):605–9.
- [12] Vanderveldt HS, Young MF. The evaluation of dysphagia after anterior cervical spine surgery: a case report. *Dysphagia* 2003;18(4):301–4.
- [13] Welsh LW, Welsh JJ, Chinnici JC. Dysphagia due to cervical spine surgery. *Ann Otol Rhinol Laryngol* 1987;96(1 Pt 1):112–5.
- [14] Yue WM, Brodner W, Highland TR. Persistent swallowing and voice problems after anterior cervical discectomy and fusion with allograft and plating: a 5- to 11-year follow-up study. Paper presented at: Cervical Spine Research Society Annual Meeting, Scottsdale, AZ, December 11, 2003.
- [15] Morpeth JF, Williams MF. Vocal fold paralysis after anterior cervical discectomy and fusion. *Laryngoscope* 2000;110(1):43–6.
- [16] Nettekville JL, Koriwchak MJ, Winkle M, Courey MS, Ossoff RH. Vocal fold paralysis following the anterior approach to the cervical spine. *Ann Otol Rhinol Laryngol* 1996;105(2):85–91.
- [17] Cauthen JC, Kinard RE, Vogler JB, et al. Outcome analysis of non-instrumented anterior cervical discectomy and interbody fusion in 348 patients. *Spine* 1998;23(2):188–92.
- [18] Bose B. Anterior cervical fusion using Caspar plating: analysis of results and review of the literature. *Surg Neurol* 1998;49(1):25–31.
- [19] Clements DH, O'Leary PF. Anterior cervical discectomy and fusion. *Spine* 1990;15(10):1023–5.
- [20] Mathers-Schmidt BA, Kurlinski M. Dysphagia evaluation practices: inconsistencies in clinical assessment and instrumental examination decision-making. *Dysphagia* 2003;18(2):114–25.
- [21] Lind CD. Dysphagia: evaluation and treatment. *Gastroenterol Clin North Am* 2003;32(2):553–75.
- [22] Leslie P, Carding PN, Wilson JA. Investigation and management of chronic dysphagia. *Br Med J* 2003;326(7386):433–6.
- [23] Langmore SE. Evaluation of oropharyngeal dysphagia: which diagnostic tool is superior? *Curr Opin Otolaryngol Head Neck Surg* 2003;11(6):485–9.
- [24] Beutler WJ, Sweeney CA, Connolly PJ. Recurrent laryngeal nerve injury with anterior cervical spine surgery risk with laterality of surgical approach. *Spine* 2001;26(12):1337–42.
- [25] Doran SE, Walsh J, Kinkaid A, Cutler D. Prospective analysis of dysphagia following anterior cervical spine fusion. Paper presented at: Cervical Spine Research Society Annual Meeting, Scottsdale, AZ, December 11, 2003.
- [26] Gaudinez RF, English GM, Gebhard JS, Brugman JL, Donaldson DH, Brown CW. Esophageal perforations after anterior cervical surgery. *J Spinal Disord* 2000;13(1):77–84.
- [27] Fogel GR, Liu W, Reitman CA, Esses SI. Cervical plates: comparison of physical characteristics and in vitro pushout strength. *Spine J* 2003;3(2):118–24.
- [28] Brown JA, Havel P, Ebraheim N, Greenblatt SH, Jackson WT. Cervical stabilization by plate and bone fusion. *Spine* 1988;13(3):236–40.