

## CERVICAL SPINE

## Retropharyngeal Steroids and Dysphagia Following Multilevel Anterior Cervical Surgery

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**Study Design.** A retrospective case–control study.**Objective.** The aim of this study was to determine the effect of retropharyngeal steroids on postoperative dysphagia scores and clinical outcomes following multilevel anterior cervical discectomy and fusion (ACDF).**Summary of Background Data.** Dysphagia is a well-known complication following ACDF surgery and increased rates of dysphagia are seen with increased levels of surgery. Retropharyngeal steroids have been shown to decrease painful swallowing and prevertebral soft tissue (PSTS) swelling in 1- and 2-level anterior cervical surgery.**Methods.** A retrospective review of 44 patients undergoing multilevel (2-, 3-, 4-level) ACDF. Twenty-two patients who received retropharyngeal steroids (methylprednisone) placed on a collagen sponge at the time of surgery were compared with a matched cohort of controls who did not receive local steroids. Postoperative day 1 and 6-week radiographs were analyzed for differences in PSTS. Clinical outcomes were measured preoperatively, 6 weeks, and 3 months postoperatively utilizing the Neck Disability Index (NDI), the Bazaz-Yoo Dysphagia Scoring System, and Eat Assessment Tool (EAT-10).**Results.** Significant improvement in dysphagia scores were seen utilizing both outcome measures. Bazaz-Yoo scores were significantly better at both 6 weeks and 3 months in patients receiving local steroids compared with controls ( $P=0.008$  and  $P=0.022$ , respectively). EAT-10 showed similar improvement of the steroid group versus control at 6 weeks and 3 months ( $P=0.067$  and  $P=0.012$ , respectively). A trend toward decreased PSTS was found with locally delivered steroids on initial postoperative radiographs $(P=0.07)$ , but was no longer evident at 6 weeks. NDI, although improved from pre-operative scores, failed to demonstrate significant differences between groups. No differences in length of stay or complications were observed between the groups.**Conclusion.** The use of retropharyngeal steroids resulted in decreased rates of dysphagia following multilevel ACDF. Locally delivered methylprednisone did not result in increased rates of short-term postoperative complications.**Key words:** anterior cervical discectomy and fusion, dysphagia, prevertebral soft tissue swelling, retropharyngeal steroid.**Level of Evidence:** 4**Spine 2016;41:E530–E534**

Anterior cervical spine surgery is commonly used in the treatment of degenerative spinal conditions and has been shown to have substantial and sustained long-term clinical benefits; however, dysphagia is a common complication of this procedure. In prospective studies, the rates of dysphagia 1 month postoperatively are reported to be approximately 50%, which decreases to about 10% at 1-year follow-up.<sup>1–3</sup> In these studies, risks factors for the development of postoperative dysphagia included female gender, age (>60 years), pre-existing swallowing dysfunction, and multilevel surgery.

Several studies have reported on the use of altered techniques as an attempt to reduce the rate of dysphagia following anterior cervical spine surgery. These techniques have focused on altering endotracheal cuff pressures, reducing esophageal retraction/pressure, plate design, bone morphogenetic protein use, and modifications in the plane of dissection.<sup>4–7</sup> Each of these techniques has been associated with varying degrees of success.

The administration of steroids both systemically and locally has also been used in an attempt to reduce postoperative dysphagia rates. Pedram *et al*<sup>8</sup> demonstrated that high doses of Intravenous (IV) methylprednisolone given at the end of surgery, at 12 hours, and at 24 hours reduced findings of an abnormal pharyngeal wall, arytenoids, and vocal cords as seen on fiberoptic examination, although it did not reduce the rate of subjective dysphagia. Song *et al*<sup>9</sup> used 250 mg of IV methylprednisolone every 6 hours for 24 hours to significantly reduce objective postoperative

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Acknowledgment date: May 29, 2015. First revision date: August 28, 2015. Acceptance date: October 6, 2015.

The device(s)/drug(s) is/are FDA-approved or approved by corresponding national agency for this indication.

No funds were received in support of this work.

Relevant financial activities outside the submitted work: consultancy, grants, stocks.

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DOI: 10.1097/BRS.0000000000001293

E530 www.spinejournal.com

May 2016

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dysphagia scores during inpatient hospitalization and to reduce length of stay. In a prospective randomized study of 50 patients, Lee *et al*<sup>10</sup> applied steroids locally on a collagen sponge to the retropharyngeal space in patients undergoing 1- and 2-level surgery. In this study, steroids significantly reduced pre-vertebral soft tissue swelling on postoperative radiographs and rates of odynophagia compared with control patients.<sup>10</sup>

We sought to expound upon the work of Lee *et al*<sup>10</sup> to determine the effects of steroids placed with a morcellized collagen sponge in the retropharyngeal space at the end of surgery. Our hypothesis was that retropharyngeal steroid administered would reduce postoperative soft tissue swelling and dysphagia in higher risk patients, in particular those undergoing multilevel (2-, 3-, and 4-level) anterior cervical spine surgery. A secondary objective of our study was to investigate potential acute phase complications associated with retropharyngeal steroid administration in anterior cervical spine surgery.

## MATERIAL AND METHODS

This study was conducted in accordance with an Institutional Review Board-approved protocol and complied with all local, state, and federal regulations. A retrospective review of medical records was performed on patients who underwent anterior cervical discectomy and fusion (ACDF) procedures for radiculopathy or myelopathy between January 1, 2013 and May 31, 2014, performed by a single surgeon (DKP). Single-level procedures, revision procedures, and procedures performed for trauma, infection, tumor, or autoimmune-related diseases (*i.e.*, rheumatoid arthritis) were excluded from our review. After identification of those patients who received retropharyngeal steroids, a matched cohort of patients who did not receive retropharyngeal steroids at the time of multilevel ACDF was identified from the same treatment period to serve as the control group. Baseline demographics and the Charlson comorbidity index were examined for each patient and utilized to ensure that a similar patient population was compared.

## Description of Procedure

One orthopedic spine surgeon (DKP) performed all surgeries using a standard left-sided Smith–Robinson approach to access the cervical spine. Cortical allografts packed with demineralized bone matrix and local bone were used for graft material. All surgeries were plated with Depuy Skyline (Raynham, MA) system with variable angle screws. Intraoperatively, all patients received 10 mg IV dexamethasone with 20 mg IV famotidine for gastrointestinal prophylaxis. Patients in the steroid group also received 80 mg of methylprednisolone, which was soaked into a morcellized collagen sponge (Gelfoam; Baxter Healthcare Corporation, Hayward, CA) and placed on the top of the cervical plate just before wound closure. A closed suction Jackson–Pratt drain was placed in all patients. All patients were immobilized for 6 weeks in a hard collar to wear when out of bed but were instructed to remove collar when sleeping, showering, and eating.

## Radiographic Measures

Radiographs taken on postoperative day 1 and at the 6-week follow-up visit were utilized for measurements. Prevertebral soft tissue swelling (PSTS) was determined by using the technique described by Lee *et al*.<sup>10</sup> Briefly, PSTS is based on the ratio of the anteroposterior (AP) diameter of each vertebral body at its midpoint to the prevertebral soft tissue thickness at that level. PSTS was calculated from C3 to C7. If the plate obscured the ability to perform the measurements, the AP diameter of the C3 vertebral body was used. The PSTS index, which was an average of the ratios from C3 to C7, was used to compare between the retropharyngeal steroid and control groups (Figure 1). A higher PSTS index represents less prevertebral swelling.

## Clinical Outcomes

Hospital and office charts were analyzed for postoperative complications. Overall clinical outcomes were assessed using the Neck Disability Index (NDI) obtained preoperatively, 6 weeks, and 3 months postoperatively. Dysphagia scores were also recorded at the same time points using 2 dysphagia assessment tools, the Bazaz–Yoo Dysphagia



**Figure 1.** Demonstration of radiographic measuring technique to determine prevertebral soft tissue swelling. Length of vertebral body/prevertebral soft tissue swelling—Prevertebral soft tissue swelling index is an average of the ratios at each level.

**TABLE 1. Patient Demographics**

	Steroid Group	Control Group	P
Patients	23	23	
Age (yr $\pm$ SD)	55.1 $\pm$ 7.9	57.6 $\pm$ 9.9	0.35
Length of stay (days $\pm$ SD)	1.27 $\pm$ 0.6	2.2 $\pm$ 1.9	0.03
Number of levels			
2-level	10	10	
3 level	11	11	
4-level	1	1	
CCI	2.7 $\pm$ 1.3	3.1 $\pm$ 0.3	0.31
Males	10	11	
Females	12	11	

CCI indicates Charlson comorbidity index; SD, standard deviation.

Score<sup>2</sup> and Eat Assessment Tool (EAT-10),<sup>11</sup> which are routinely collected by the surgeon (DKP) in patients undergoing any cervical spine surgery. The Bazaz–Yoo score is used to determine the presence of dysphagia on the basis of the patient’s perception of their ability to swallow liquids and solids. The Bazaz–Yoo score is graded on a scale of severity as follows: none (no episodes of dysphagia), mild (rare episodes of dysphagia), moderate (occasional difficulty swallowing certain foods such as bread or steak), and severe (frequent difficulty with swallowing the majority of foods). The EAT-10 score is a 10-item questionnaire that reviews both swallowing and the psychosocial issues that surround swallowing. An EAT-10 score greater than 3 is considered abnormal and indicative of dysphagia.

### Statistical Analysis

All statistical analysis was performed with the aid of data analysis software (SPSS Version 22; IBM Corp., Armonk, NY). Normality and equal variance assumptions of the NDI score were verified using the Shapiro–Wilk and Levene’s test, respectively. Differences in the normally distributed NDI score were examined with a Student’s *t*-test between control and steroid groups and a paired *t*-test within groups. Differences in the Bazaz–Yoo score between control and steroid were compared using the Mann–Whitney *U*-test and a Wilcoxon signed-rank test within groups. A Fisher’s exact test was used to compare differences in the EAT-10 score between control and steroid groups and a Wilcoxon test was used to calculate differences within groups. For all statistical analyses, statistical significance was defined as results with  $P < 0.05$ .

## RESULTS

Twenty-two patients were identified who received retropharyngeal steroids (Group 1) and a matched cohort of patients with the same number of levels performed at the time of surgery was utilized as control (Group 2). The study population included 10 two-level procedures, 11 three-level procedures, and 1 four-level procedures for each group, respectively. Baseline demographics between groups were

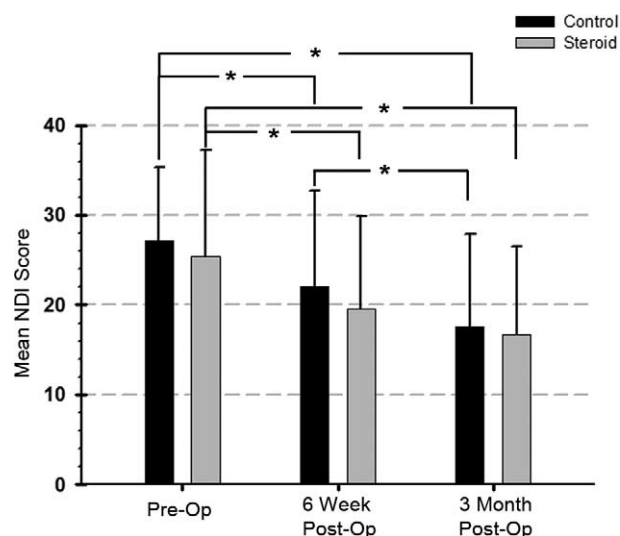
similar (Table 1), although there was a significant difference in the length of stay between the groups (Group 1: 1.27  $\pm$  0.6 days, Group 2: 2.2  $\pm$  1.9 days,  $P = 0.03$ ) and no complications were encountered for either group. No patient required readmission after discharge.

### Radiographic Measures

Radiographic analysis demonstrated a trend toward a lower PSTS index in patients who received retropharyngeal steroids than in the control group at postoperative day 1 (Group 1: 1.33  $\pm$  0.26; Group 2: 1.19  $\pm$  0.24,  $P = 0.09$ ). However, by 6 weeks, no differences were seen between the groups (Group 1: 1.62  $\pm$  0.36; Group 2: 1.58  $\pm$  0.70,  $P = 0.93$ ).

### Clinical Outcomes and Dysphagia Scores

At baseline, no significant differences were observed in NDI scores between the retropharyngeal steroid and control groups (Group 1: 26.4  $\pm$  11.8; Group 2: 27.1  $\pm$  8.2,  $P = 0.586$ ) (Figure 2). At 6 weeks, NDI scores demonstrated a trend toward improved scores for Groups 1 and 2,



**Figure 2.** Mean NDI score for Groups 1 and 2 at all pre- and postoperative time points.

**TABLE 2. Percentage of Patients From Each Group Within Each Yoo Score Category at all Pre- and Postoperative Time Points**

	Steroid Group			Control Group		
	Pre-Op	6 Weeks Post-Op	3 Months Post-Op	Pre-Op	6 Weeks Post-Op	3 Months Post-Op
None	95.5	61.9	76.2	100	22.7	47.6
Mild	0	9.5	14.3	0	9.1	9.5
Moderate	0	14.3	9.5	0	27.3	19
Severe	4.5	14.3	0	0	40.9	23.8

19.59 ± 10.3 and 22.0 ± 10.7, respectively. Comparison between the groups, however, demonstrated that the differences in the 6-week NDI score were not significantly different ( $P=0.443$ ). At 3 months, NDI scores continued to improve (Group 1: 16.7 ± 9.8; Group 2: 17.5 ± 10.3); however, there again was no statistically significant differences between the groups ( $P=0.796$ ). NDI scores for Group 1 and 2 demonstrated statistically significant improvements over baseline at both the 6-week ( $P=0.005$  and  $0.013$ , respectively) and 3-month time points ( $P=0.002$  and  $0.002$ , respectively) (Figure 2).

Pre-operative Bazaz–Yoo dysphagia scores were not significantly different between the groups ( $P=0.329$ ). The Bazaz–Yoo dysphagia scores were significantly better for patients who received retropharyngeal steroids than the control group at 6 weeks ( $P=0.008$ ), which remained significant at the 3-month time point ( $P=0.022$ ). In addition, the Bazaz–Yoo scores for Group 1 at 6 weeks and 3 months were not statistically significant from pre-operative scores ( $P=0.072$  and  $P=0.339$ , respectively), whereas Group 2 demonstrated significant difference from pre-operative scores at both 6 weeks ( $P<0.001$ ) and 3 months ( $P=0.004$ ). Statistically, patients in Group 1 remained at their pre-operative prevalence and severity of dysphasia at both 6 weeks and 3 months, whereas patients in Group 2 had a significantly higher onset and severity of dysphasia than Group 1 and did not return to their pre-operative state by 3 months (Table 2).

Similar trends were observed with respect to the EAT-10 scores. There was no significant difference between the groups at baseline ( $P=0.607$ ). Scores between groups were not significantly different at 6 weeks ( $P=0.067$ ), though more patients from Group 1 demonstrated EAT-10 scores in the normal range than Group 2 (Table 3). Scores were significantly different between the groups at the 3-month postoperative time point ( $P=0.012$ ), demonstrating that

more patients were within the normal EAT-10 score range in Group 1 than Group 2 (Table 3). Compared with baseline scores, Group 1 appeared to return to baseline at 6 weeks ( $P=0.508$ ) and 3 months ( $P=0.705$ ), whereas Group 2 remained significantly worse than the preoperative state at both the 6-week ( $P<0.001$ ) and 3-month time points ( $P=0.002$ ).

## DISCUSSION

ACDF surgery for degenerative cervical spine conditions is a commonly utilized and highly successful operation. However, dysphagia remains a significant concern following surgery, particularly for multilevel surgery. The purpose of this study was to identify the effects of steroids placed in the retropharyngeal space at the time of surgery on radiographic and clinical outcomes following multilevel ACDF. We hypothesized that the presence of steroids in the retropharyngeal space will decrease rates of dysphasia compared with the absence of steroids and will not have a deleterious impact on clinical outcomes and complication rates.

Lee *et al*<sup>10</sup> previously demonstrated significant results in reducing postoperative PSTS and odynophagia (painful swallowing) in 1- and 2-level surgery with the use of retropharyngeal steroids. However, dysphagia does not necessarily have to constitute *painful* swallowing. We demonstrated that the use of retropharyngeal steroids results in significant improvements in postoperative dysphagia, as measured by the Bazaz–Yoo and EAT-10 scores, at both immediate and short-term follow-up time frames in patients undergoing 2-, 3-, and 4-level ACDF.

The effect of PSTS on postoperative dysphagia is still a matter of debate. Song *et al*<sup>12</sup> found a relationship between marked PSTS and dysphagia 3 months after anterior cervical spine surgery. However, Stachniak *et al*<sup>13</sup> found no correlation between PSTS and dysphagia 2 weeks after the procedure. In a 12-week follow-up study, Khaki *et al*<sup>14</sup>

**TABLE 3. Percentage of Patients From Each Group Within Each EAT-10 Score Category at all Pre- and Postoperative Time Points**

	Steroid Group			Control Group		
	Pre-Op	6 Weeks Post-Op	3 Months Post-Op	Pre-Op	6 Weeks Post-Op	3 Months Post-Op
Normal	86.4	59.1	81.8	95.2	28.6	42.9
Abnormal	13.6	40.9	18.2	4.8	71.4	57.1

failed to show a relationship between PSTS and the development of chronic dysphagia in a cohort of 67 patients undergoing multilevel surgery. Our results did demonstrate a trend toward a reduction in immediate postoperative PSTS, although this difference was no longer evident at the 6-week postoperative visit. We do not feel that this slight reduction in PSTS in the immediate postoperative phase would account for the substantial decrease in dysphagia seen in our study.

NDI scores were not significantly affected by the use of retropharyngeal steroids in our study. We postulate that informed consent regarding postoperative swallowing issues in the short-term postoperative period may temper a patient's perceived impact of dysphagia despite its presence. It may be that the effect of dysphagia on overall clinical outcome may not be evident unless chronic dysphagia (>12 months) becomes evident. In addition, it should be noted that the NDI itself does not specifically address dysphagia. Furthermore, NDI scores improved after surgery for both cohorts implying that surgical indications were correct and the pathology was addressed.

In contrast to many other studies, an advantage of this study is the utilization of 2 dysphagia scoring systems. The Bazaz–Yoo score, although frequently used, has yet to be validated or shown to be reliable. Because of this fact, the senior author (DKP) also had patients fill out the EAT-10 score, which are routinely collected as an internal measure of success of the procedure. This test has been shown to be valid and reliable for a wide array of swallowing disorders.<sup>11</sup>

Limitations in this study are those inherent to any retrospective review, including the inability to randomize patients into the 2 groups. Future work is underway to design a randomized, placebo-controlled trial to evaluate the effects of retropharyngeal steroids on the incidence and severity of dysphagia following ACDF. Also of note is the relatively short-term follow-up of this study, which may impact the ability to detect complications; however, no short-term complications were encountered with the use of both IV and local steroids. Computed tomography (CT) scans to assess fusion were not obtained in this study, but there were no revisions for pseudarthrosis or evidence of hardware loosening on dynamic radiographs at the 1-year follow-up for all patients. Although Lee *et al*<sup>10</sup> failed to show a positive correlation with the use of retropharyngeal steroids and development of pseudoarthrosis, longer follow-up as well as CT scans will be necessary to determine the effect of both IV and local steroids on fusion rates.

In conclusion, the use of retropharyngeal steroids reduced the rate of dysphagia in patients undergoing multilevel anterior cervical spine surgery in short-term follow-up. The use of both IV and retropharyngeal steroids in combination did not result in any additional complications. Prospective, randomized studies are needed to determine the effect of both IV and locally placed steroids used alone and in combination on clinical outcomes, dysphagia scores, and fusion rates.

## ➤ Key Points

- ❑ There are currently no published reports on the effect of retropharyngeal steroids on postoperative dysphagia scores following multilevel anterior cervical spine surgery.
- ❑ The use of retropharyngeal steroid decreased rates of postoperative dysphagia in multilevel anterior cervical spine surgery.
- ❑ Acute PSTS was reduced in patients who received retropharyngeal steroid in multilevel anterior cervical spine surgery.
- ❑ The use of retropharyngeal steroid together with IV steroids did not result in an increased rate of short-term complications.

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