

# Effect of Local Steroid Injection on Prevertebral Soft Tissue Swelling Following Anterior Cervical Discectomy and Fusion

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## ABSTRACT

**Background:** Prevertebral soft tissue swelling (PSTS) following anterior cervical surgery, may proceed to airway compromise which is potentially lethal. We plan to evaluate the effect of local steroid injection to reduce PSTS after anterior cervical discectomy and fusion (ACDF).

**Methods:** In a randomized clinical trial 66 patients who underwent ACDF involving one to three segments due to radiculopathy or myelopathy were enrolled and randomly divided to two groups of 38 with local injection of 80 mg methylprednisolone in operation site, and control. Prevertebral soft tissue thickness to mid anteroposterior vertebral body diameter (S/V) ratio was defined to assess PSTS. In addition, dysphagia and pain at surgery site was evaluated using Bazaz dysphagia scale and Visual Analogue Scale (VAS) respectively, at 1<sup>st</sup>, 5<sup>th</sup> and 10<sup>th</sup> post-operative days.

**Results:** We have observed significantly lower S/V ratio in all studied vertebrae, except C6 on second postoperative day in case group. At the end of the 6<sup>th</sup> month, there was no significant difference for S/V ratio in any level in two groups. Severity of dysphagia was significantly lower in 1<sup>st</sup>, 5<sup>th</sup> and 10<sup>th</sup> post-operative day in patients in case group. (P value<0.05) Also, patients in case group experienced significantly less severe odynophagia at 1<sup>st</sup>, 5<sup>th</sup> and 10<sup>th</sup> post-operative day, which was assessed by VAS. (P value<0.05)

**Conclusions:** The use of local methyl prednisolone in prevertebral space is a simple and effective method to reduce PSTS and severity of dysphagia and odynophagia. Furthermore, this method was not associated with any adverse effects.

**Keywords:** Prevertebral soft tissue swelling; Anterior discectomy and fusion; Steroid; Visual Analogue Scale; dysphagia

## INTRODUCTION

Cervical degenerative disc disease can cause variety of symptoms from neck stiffness and decreased quality of life to radiculopathy and myelopathy which sometimes require surgery<sup>1,2</sup>. Conservative management such as McKenzie approach and cervicothoracic stabilization, is advised to most of the patients with cervical disc disease<sup>3</sup>. Failure to improve with rehabilitation programs, as

well as deteriorating neurological deficits and new onset of neurogenic bowel or bladder warrants operative intervention<sup>4</sup>.

Anterior cervical discectomy and fusion (ACDF) is one of the most commonly performed procedures which has satisfactory results in most of the cases<sup>5</sup>. Of all potential complications of ACDF, airway compromise and subsequent respiratory distress caused by prevertebral

soft tissue swelling (PSTS) and retropharyngeal hematoma is one of the most catastrophic events which may require emergent endotracheal intubation or tracheostomy <sup>6-8</sup>.

Treatment of PSTS is mandatory to prevent unwanted complications. It is well known that steroid therapy can reduce platelet activating factor and inflammatory cytokines, which results in decreased inflammation and soft tissue swelling <sup>9</sup>. Although positive effects of intravenous administration of steroid and triamcinolone soaked surgical on pharyngeal and laryngeal edema, dysphagia, odynophagia and dysphonia has been shown <sup>10</sup>, few evidence about beneficial effect of local steroid injection on PSTS after anterior neck operation is available in literature <sup>11</sup>. In this study, authors aim to investigate detailed effect of local steroid injection on PSTS after ACDF dysphagia assessment.

## MATERIALS AND METHODS

This randomized clinical trial was conducted in Shohada Tajrish hospital between February 2015 to December 2015. In this time period, 90 patients were admitted for ACDF procedure. Seventy-six patients who were candidate for ACDF for 1 to 3 segments and signed the written informed consent were included in the study. Intervention for more than 3 segments, need for corpectomy, history of cervical trauma, cervical vertebrae with infection or tumor infiltration, active malignancy, psychological disorders that could affect assessment scales and metabolic diseases such as rheumatoid arthritis were defined as exclusion criteria.

Patients were randomly divided into case (N=38) and control (N=38) group. Demographic data including age, sex, smoking and level of vertebral involvement was recorded for both groups. Patients underwent lateral cervical radiography before operation to measure prevertebral soft tissue thickness and mid vertebra anteroposterior diameter with standard ruler by a single radiologist. After Smith-Robinson microscopic discectomy and decompression with the use of cage and bone graft, anterior fusion for intended vertebrae was done and the site was irrigated with 200 ml saline. Case group received 80 mg methyl prednisolone, injected bilaterally in longus coli muscle and semi laterally in sternocleidomastoid muscle before wound dressing at the end of the operation. Prevertebral soft tissue thickness to mid anteroposterior vertebral body diameter (S/V ratio) was defined to assess and monitor PSTS course immediately after operation, and also in 1<sup>st</sup>, 2<sup>nd</sup>, 5<sup>th</sup>, 7<sup>th</sup> and 14<sup>th</sup> post-operative days, as well as 6 months after operation. The quality of dysphagia was evaluated based

**Table 1.** Bazaz scale for dysphagia grading.

Severity (Score)	Problems swallowing liquids	Problems swallowing solids
None (0)	None	None
Mild (1)	None	Rare
Moderate (2)	None/rare	Occasionally (only with specific foods)
Severe (3)	None/rare	Frequent (majority of foods)

on Bazaz dysphagia scale on 2<sup>nd</sup>, 5<sup>th</sup> and 10<sup>th</sup> post-operative days in both groups. (Table 1) In addition, severity of odynophagia was evaluated by Visual Analogue Scale (VAS) at above dates.

Authors performed statistical analysis with SPSS (version 19, SPSS Statistics/IBM Corp, Chicago IL, USA) using Mann-Whitney, Student's t-test and Chi-square tests. Also, Tukey-Kramer method was used to compare PSTS at different time points. This clinical trial was conducted under the principles of the Helsinki Declaration and approved by the Ethics Committee of Shohada Tajrish hospital.

## RESULTS

The mean age of the patients in case and control group was 49.3 and 50.2 years respectively. One level ACDF was performed in 17 and 19 patients and double level 13 and 12 patients in case and control group respectively. Also, 8 patients from case group and 7 patients from control group underwent 3-level ACDF. Recorded mean operation time was 114.5 and 118 minutes in case and control group respectively. In addition, patients in case group were hospitalized for mean 2.2 days, while mean hospitalization days was 2.5 for control group. The mean age, sex, smoking status, level of cervical vertebral involvement, operation time and hospitalization days were not statistically different between two groups (P value>0.05) (Table 2).

PSTS difference at pre-operative evaluation was not statistically different between two groups at all vertebral levels. Immediately after operation, PSTS ratio at C3 was 0.45 and 0.56 for case and control group, respectively (P value<0.05). Also, recorded value for PSTS ratio at C4 was 0.54 and 0.68 for case and control group, respectively (P value<0.05). Although difference of PSTS ratio was significant at C3 and C4 between two groups, no similar results were found at C5, C6 and C7 levels. PSTS ratio was significantly lower at C3 (0.55 vs. 0.71), C4 (0.63 vs. 0.77) and C5 (0.89 vs. 1.02) in first post-operative day in case versus control group (P value<0.05). Although mentioned ratio was lower at C6 and C7 in case group,

**Table 2.** Patient’s demographic data.

	Case	Control	P value
Age (Year) (±SD)	49.3±3.5	50.2±3.3	0.33
Sex			
Male	18	16	0.29
Female	20	22	
Smoking			
Male	7	6	0.45
Female	2	1	
Vertebral involvement			
One level			
C4	5	6	0.3
C5	6	6	
C6	6	7	
Two level			
C3/C4	2	3	
C4/C5	4	4	
C5/C6	4	3	
C6/C7	3	2	
Three level			
C4/C5/C6	5	4	
C5/C6/C7	3	3	
Operation time (minute) (mean±SD)	114.5±2.5	118±3	0.57
Hospitalization (day) (mean±SD)	2.2±0.6	2.5±0.7	0.21

but difference was not statistically significant. The most statistically significant difference between PSTS ratio of case and control group was observed in second post-operative day. PSTS ratio for case and control group was 0.6 vs. 0.88 at C3, 0.6 vs. 0.84 at C4, 0.93 vs. 1.06 at C5 and 0.79 vs. 0.9 at C7 (P value<0.05).

Measurement of PSTS ratio at C6 was failed to demonstrate statistically significant difference between two groups. Low values of PSTS ratio at C6 and C7 in case group was not significant compared to same vertebrae in control group. PSTS ratio measurement in case group revealed significantly lower values at C4 (0.51 vs. 0.64) and C6 (0.94 vs. 1.04) on 1<sup>st</sup> post-operative week, compared to control group (P value<0.05). Reduction of

PSTS on 2<sup>nd</sup> post-operative week in case group remained statistically significant compared to control group at above mentioned vertebrae. The ratio was 0.46 vs. 0.56 at C4 and 0.91 vs. 0.99 at C6 (P value<0.05). In addition, PSTS ratio showed lower value at C7 (0.72 vs. 0.8) in case group, compared to control group (P value<0.05). Patients underwent lateral cervical radiography 6 months after operation. PSTS ratio measurement did not show statistically significant difference between patients who received local steroid injection, compared to patients in control group (Table 3).

Severity of dysphagia was assessed by Bazaz dysphagia scale between two groups. Patients did not have any dysphagia before operation in both groups. No significant

**Table 3.** Prevertebral soft tissue swelling comparison in case and control group.

Level	Case								Control							
	Pre-operative	Post-operative							Pre-operative	Post-operative						
	Immediately	Day 1	Day 2	Day 5	Week 1	Week 2	6 Month		Immediately	Day 1	Day 2	Day 5	Week 1	Week 2	6 Month	
C3	0.31	0.45*	0.55*	0.6*	0.58*	0.49	0.44	0.32	0.29	0.56	0.71	0.88	0.68	0.55	0.47	0.32
C4	0.4	0.54*	0.63*	0.6*	0.62*	0.51*	0.46*	0.4	0.42	0.68	0.77	0.84	0.79	0.64	0.56	0.44
C5	0.8	0.84	0.89*	0.93*	0.89*	0.87	0.85	0.81	0.83	0.86	1.02	1.06	0.98	0.94	0.89	0.85
C6	0.87	0.94	1.01	1.05	1.03	0.94*	0.91*	0.88	0.88	0.94	1.04	1.13	1.1	1.04	0.99	0.9
C7	0.69	0.77	0.81	0.79*	0.81	0.78	0.72*	0.71	0.71	0.78	0.85	0.9	0.88	0.82	0.8	0.72

\*P value < 0.05

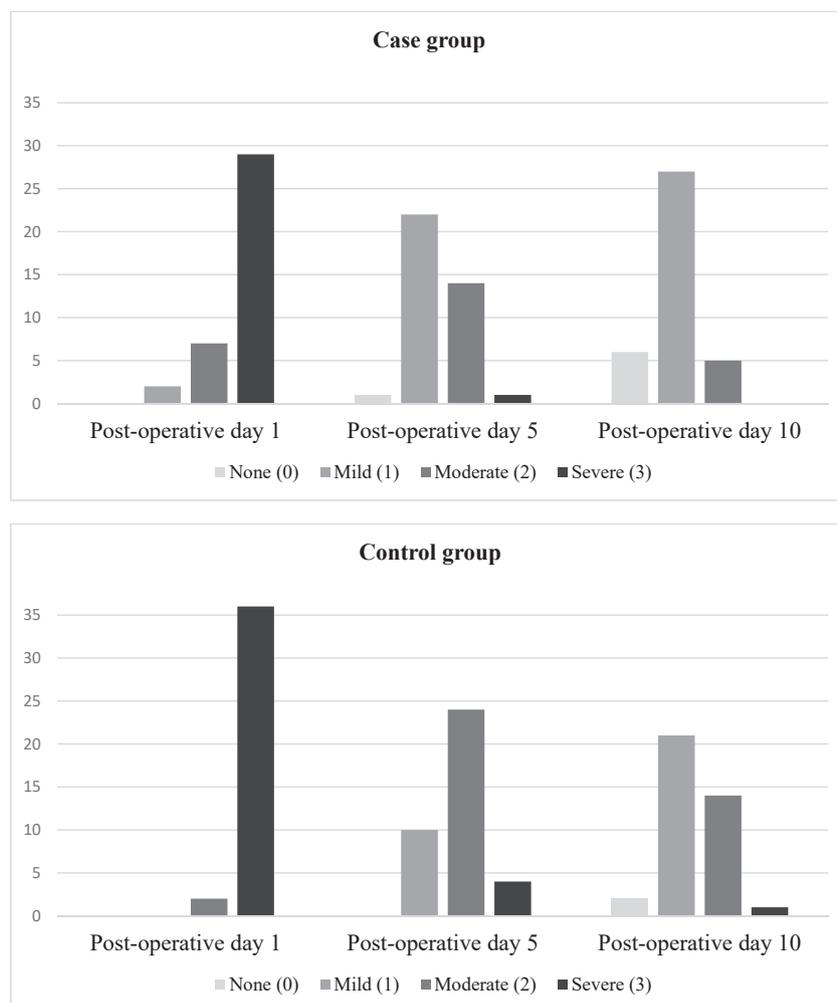
difference was observed between severity of dysphagia in both groups at 1<sup>st</sup> post-operative day. However, dysphagia assessment revealed significantly lower values in case group at 5<sup>th</sup> post-operative day (P value=0.022). Severity of dysphagia remained significantly lower in case group until 10<sup>th</sup> post-operative day (P value= 0.04) (Figure 1).

Severity of odynophagia was assessed by VAS between case and control group. At first post-operative day, 2.9 vs 6.2 was recorded as mean VAS for case and control group, respectively (P value=0.017). At 5<sup>th</sup> post-operative day, case group compliant less about odynophagia than control group (Mean VAS 2.1 vs. 5.3) (P value=0.029). Also at 10<sup>th</sup> post-operative day, odynophagia was less severe in case than control group (Mean VAS 1.4 vs. 3.9) (P value=0.036) (Figure 2). Mean VAS score for odynophagia was significantly lower in case group, at all of the mentioned dates.

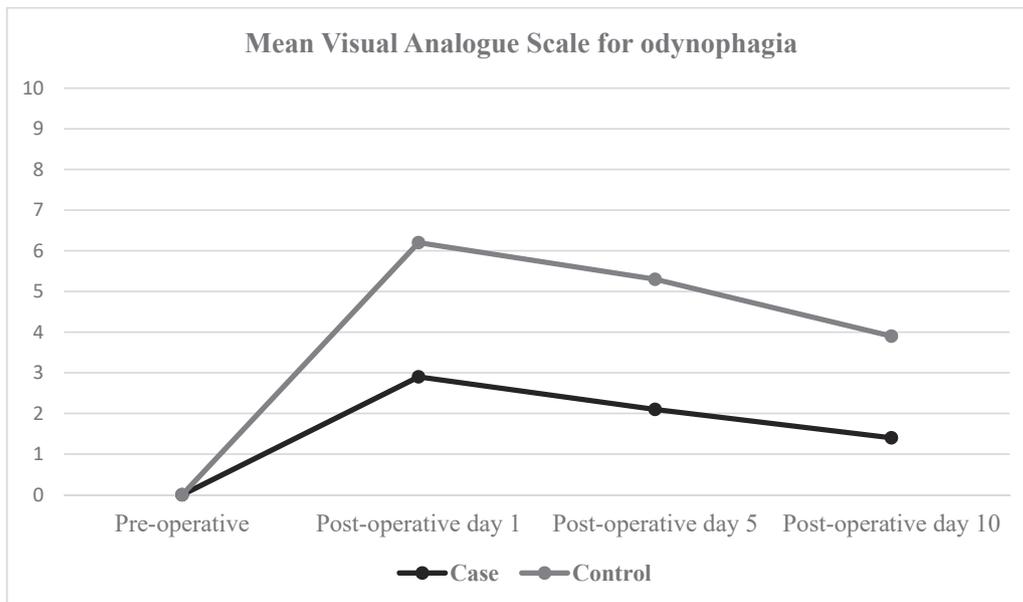
## DISCUSSION

With more than 5 million ACDF procedures performed between 1990-1999 in the United States, it remains the most commonly surgical intervention performed for the patients with cervical degenerative disc disease who fail to improve with conservative management<sup>12,13</sup>. Prevertebral soft tissue lies posterior to the retropharyngeal space, consist of muscles, ligaments and cervical fascia<sup>14</sup>. Techniques used for exposure in ACDF, such as esophageal traction and prevertebral tissue dissection, as well as dissection and traction of longus coli muscle, can lead to inflammation and subsequent edema of the manipulated structures<sup>15</sup>.

Potential complications following ACDF are excessive hemorrhage and wound hematoma, damage to adjacent vasculature and nerves, damage to superior and recurrent laryngeal nerves, and rarely, dural and spinal cord injury which can lead to cerebrospinal fluid leak and sensory



**Figure 1.** Comparison of dysphagia between case and control group using Bazaz dysphagia scale.



**Figure 2.** Comparison of odynophagia between case and control group using Visual Analogue Scale.

motor deficits<sup>16,17</sup>. Although ACDF candidates rarely require emergent interventions for life threatening events, such as airway compromise, with reported incidence of up to 2%, most of the cases complain from dysphagia and odynophagia<sup>18</sup>.

Intravenous administration of steroids was introduced as an effective management for reducing airway obstruction and laryngeal edema in intubated patients<sup>19,20</sup>, as steroids can control protein synthesis, inhibit polymorph nuclear leukocytes and fibroblasts migration, reduce capillary permeability and stabilize lysosomes in cellular level and inhibit or prevent further inflammation<sup>21</sup>. Although Pedram et al showed less complications in patients receiving IV methyl prednisolone following ACDF<sup>10</sup>, Nam et al failed to show effectiveness of intravenous dexamethasone on PSTS after anterior cervical surgery<sup>22</sup>. However, Lee et al showed promising results in PSTS reduction, with the use of retropharyngeal steroid injection, along with its less complications compared with systemic administration<sup>23</sup>. We hypothesized that local steroid injection following ACDF will decrease PSTS, along with dysphagia and odynophagia.

There are limited data regarding quantitative analysis of PSTS after ACDF in literature. Sanfilippo et al showed significant increase in PSTS following ACDF in 2<sup>nd</sup> post-operative week with local retropharyngeal steroid injection. In 6<sup>th</sup> post-operative week, PSTS was significantly reduced compared with 2<sup>nd</sup> week results. Maximum difference between pre- and 6<sup>th</sup> week post-operative PSTS was observed at C4, C6 and C7<sup>24</sup>. In our

study, patients in case group experienced significantly lower PSTS ratio at C3 and C4 continuously, from immediately after operation until 5<sup>th</sup> post-operative day, when the risk of PSTS-related complications was the highest. Also, PSTS ratio was significantly lower at C6 and C7 at the end of the 2<sup>nd</sup> post-operative week, while no significant difference was observed between two groups at the end of the 6<sup>th</sup> month.

Dysphagia is common after ACDF and there are several studies suggesting that occurrence and severity of post-operative dysphagia is related to degree of PSTS<sup>25-27</sup>. However, Stachniak et al and Khaki et al found no correlation between PSTS and severity of dysphagia in their studies<sup>28,29</sup>. In our series, patients were assessed for dysphagia and odynophagia by Bazaz dysphagia scale and VAS, respectively<sup>30</sup>. Values for severity of both dysphagia and odynophagia were significantly lower in 1<sup>st</sup>, 5<sup>th</sup> and 10<sup>th</sup> post-operative day in patients who received local pre-vertebral steroid injection.

This study has limitations. First, these results are from small number of cases, larger number of cases with longer follow-up is needed to evaluate long-term complications of local steroid injection such as soft tissue infection and impact on vertebral stability following ACDF. Second, the exact role of PSTS on dysphagia is a matter of debate, as other factors such as injury to the superior laryngeal nerve and denervation of the pharyngeal plexus by retractors during operation could lead to impaired supraglottic sensation and loss of normal swallowing coordination and occurrence of post-operative dysphagia<sup>31</sup>. Thus,

utilization of more invasive tests, such as barium swallow and video laryngoendoscopy could assist in etiology of post-operative dysphagia.

## CONCLUSION

In this study, we found that local methyl prednisolone injection in prevertebral space following ACDF is a simple method and can significantly reduce PSTS and its complications, as well as severity of dysphagia and odynophagia without post-operative complications and vertebral fusion rate.

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