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Original research article

The Effect of locally administered retropharyngeal steroid on post-operative Prevertebral Soft Tissue Swelling (PSTS) and dysphagia following Anterior Cervical Discectomy and Fusion Surgery (ACDF)

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Abstract

Study design: A prospective, randomized study.
Objective: To analyze the effect of local retropharyngeal steroid to reduce prevertebral soft tissue swelling (PSTS) after anterior cervical discectomy and fusion (ACDF).
Methods: We conducted a Prospective randomized study involving 50 patients (25 cases/25 controls) undergoing Single level surgery with identical plate (thickness) and cage inserted (ACDF). Study was conducted at Artemis Hospital, Delhi NCR, India from July 2019 to March 2021. All the patients were operated using standard Smith Robinson approach (left sided approach) by single surgical team. All the patients were between the age group of 18-60 years with symptoms of neck pain and radicular pain. Standard ACDF procedure was carried out using cage and plate. In 25 patients, a Gelfoam with methylprednisolone 80 mg was placed in the retropharyngeal space over the plate before wound closure. For the control group, the other 25 cases received the operation without steroid. We measured the PSTS ratio to vertebral body from C3 to 5 on cervical spine. Simple lateral radiographs were taken preoperatively, at postoperative 2 days, 7 days, 2 weeks. To compare the groups, the average value of PSTS at C3, C4, and C5 is observed and measured in millimeters (mm). Dysphagia was evaluated in the same way using Bazaz Dysphagia Score.
Result: The mean age in case group was 49.40 years whereas in control group was 50.20 years. In case group, there were 11 male and 14 females, while in control group 10 patients were male and 15 patients were female. Preoperatively there was no statistical difference between the prevertebral soft tissue swelling (in mm) in both the groups at C3, C4, C5. However, In the post-operative period (2nd and 7th day), there was significant difference (p-values of less than 0.05) between the prevertebral soft tissue swelling at C3,C4 and C5. On 14th post-operative day the prevertebral soft tissue swelling at C3, C4 and C5 was not significant with the p-values of more than 0.05. We used Dysphagia-BAZAZ SCORE: On the post-operative day 2, there was a statistically significant difference between the two groups based on 'BAZAZ score' for both liquids and solids (p value 0.016 for liquids and 0.045 for solids). On the 7th day also, there was a statistically significant difference between the two groups based on 'BAZAZ score' for both liquids and solids (p-value 0.045 for liquids and 0.035 for solids). The last follow-up showed no significant difference in the radiological and clinical outcome.
Conclusion: There is significant decrease in the prevertebral soft tissue swelling and post-operative dysphagia by administrating local steroid before closure of surgical incision. This method may be considered a simple and effective method to decrease PSTS following anterior cervical spine surgery.
Keywords: Anterior, cervical spine, dysphagia, soft tissue edema, steroids

Introduction

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Anterior cervical spine surgery is one of the most commonly performed surgeries these days. Anterior cervical approaches allow the efficient management of a variety of spinal pathology [1] like trauma, tumour and degenerative spinal disease. The most common complication following the anterior cervical spine surgery is dysphagia[2, 3]. According to published studies, the reported incidence of dysphagia varies from 4.8%-71%[4-6]. However, we feel the incidence of Dysphagia in different studies vary largely due to different definitions of dysphagia and variable lengths of follow-up in different studies.

Several potential risk factors associated with the high incidence of postoperative dysphagia, including female gender, advanced age, more than 3 level surgery, surgery at C4-C5 and C5-C6 levels, vertical incision, prolonged surgical time (> 2.5 hours), and revision procedures [4, 7, 8, 9]. This is because of swelling of the soft tissues in the retropharyngeal space due internal edema of the tissues, that may cause compression of esophagus leading to dysphagia [4].

Anatomically, excessive dissection or retraction of longismus colli muscle may lead to muscular and subperiosteal bleeding, resulting in hematoma formation[10]. This hematoma causes pressure on the aerodigestive tract ultimately leading to dysphagia. There can be a direct esophageal injury as well while retracting or doing instrumentation. Anterior cervical plate thickness and its anterior surface texture also can sometimes lead to irritation of the esophagus leading to dysphagia [11]. Also, the use of bone morphogenic protein can cause dysphagia as it can cause early and severe inflammatory response to the bone morphogenic protein [12].

This is because of swelling of the soft tissues in the retropharyngeal space due internal edema of the tissues, which may cause compression of esophagus leading to dysphagia [4]. The rationale of using local steroid is based on inhibition of prostaglandins and cytokine formation responsible for the inflammatory reaction and swelling leading to Dysphagia[13].

The purpose of this study was to check effect of local steroid on prevertebral soft tissue swelling (PSTS) and dysphagia following anterior cervical discectomy and fusion surgery.

Materials &Methods

We conducted a Prospective randomized study involving 20 patients (10 cases/10 controls) undergoing Single level surgery with identical plate (thickness) and cage inserted (ACDF). All the patients were between the age group of 18-60 years with symptoms of neck pain and radicular pain. Also, all were operated under Single attempt fiberoptic intubation (for anesthesia) and cuff pressure was well monitored during surgery (20-30 cm H_20). Exclusion criteria included-Two level surgery, patients with complain of dysphagia preoperatively, revision surgery, trauma, infection, Patient given IV steroids or taking oral steroids, Systemic inflammatory disorders and Surgery time > 2.5 hours.

Study was conducted at Department of Orthopaedics Shyam Shah Medical College and associated SGMH Hospital Rewa, Madhya Pradesh, India from July 2019 to June 2021. All the patients were operated using standard Smith Robinson approach (left sided approach) by single surgical team. Standard ACDF procedure was carried out using cage and plate. In 10 patients, a Gelfoam with methylprednisolone 80 mg was placed in the retropharyngeal space over the plate.

All the Patients were positioned supine on OT table. After the fibreoptic intubation proper scrubbing, painting and draping was done to prepare the operative site. Left sided transverse incision was taken at the marked operative level (after C-arm confirmation). After the transverse incision along the medial border of sternocleidomastoid, subcutaneous layer over the playtsma muscle was dissected, and the platysma was divided vertically till the medial border of sternocleidomastoid is reached. Carotid sheath palpated and pretracheal fascia divided sharply, medial to carotid sheath. Prevertebral space dissected using blunt finger dissection medially and posteriorly. Longus colli muscle is exposed and then subperiosteally elevated. We used non tooth self-retaining retractor blades to put under longissimus coli. At this stage we again confirm the operative level under the microscope. After the identification of proper cervical spine level, discectomy is done using a microscope. Special attention is given to both foramen and any loose fragment posterior to posterior longitudinal ligament. The cartilage and the endplates are removed using burr till the subchondral bone is exposed. Next step is to take the size of cage to be inserted. It is done by inserting serial progressive sizers till one of them fits snugly. The same size cage is opened and filled with bone graft. The cage is inserted and position confirmed in AP and Lateral X-ray. Finally, the plating is done by securing the plate using screws. The plate is put well clear of adjacent discs and flush to the bone. Meticulous Hemostasis achieved before closure. The final position of plate and cage is seen under x-ray vision and thorough wash is given. Now a Gelfoam with methylprednisolone 80 mg steroid is placed in the retropharyngeal space over the plate (only in 10 patients). The platysma was closed in single layer followed by tight continuous subcutaneous closure. A thin sterile dressing was applied over the wound. Routine IV antibiotics were given postoperatively and patients were given a hard-cervical collar for 10 weeks.

Data Analysis

Data Collection was done by same independent observer in all patients; preoperatively as well as postoperative on 2nd, 7th and 14th day. None of the patient had any recurrent laryngeal nerve or superior

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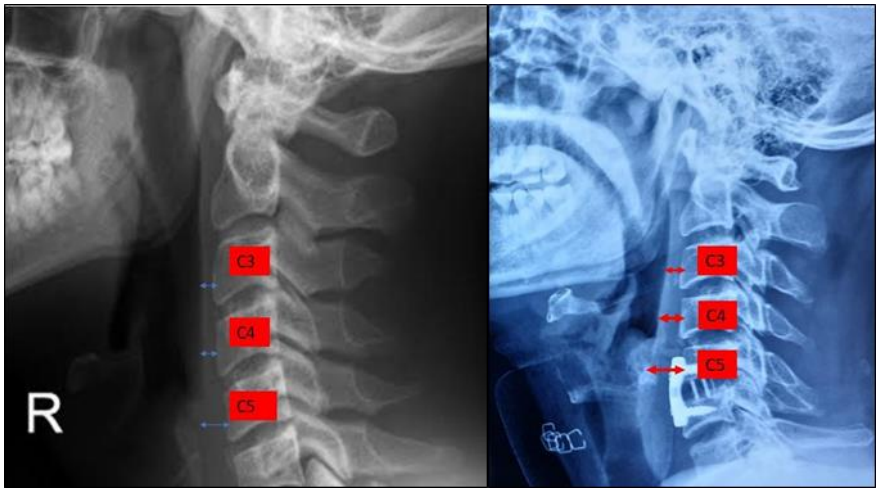
laryngeal nerve palsy post-surgery. We measured Prevertebral soft tissue swelling (PSTS)-On lateral x-ray. Measurements were taken from anterior point of the plate to the posterior point of pharynx (Figure 1.1). To compare the groups, the average value of PSTS at C3, C4, and C5 is observed and measured in millimeters (mm). Dysphagia was evaluated in the same way using Bazaz Dysphagia Score.



Pre-Operative **Post-Operative**

Fig 1.1

Dysphagia was Evaluated through Bazaz Dysphagia Score [14].

Table 1.1

	Episodes of swallowing difficulty (by patient report)	
Severity of Dysphagia	Liquid	Solid
None	None	None
Mild	None	Rare
Moderate	None or Rare	Occasional (Only with specific food like bread or meat)
Severe	Present	Frequent (and with majority of solids)

Patient Proforma-Prevertebral Soft Tissue Swelling (Example)

Results

Age, Sex &Surgical Time

There was no major difference between age or sex between case and control group. The mean age in case group was 49.40 years whereas in control group was 50.20 years. In case group, there were 06 male and 04 females, while in control group 05 patients were male and 05 patients were female. Similarly there was no statistically significant difference between both groups with regard to surgical time which averaged around 2 hours in both groups.

Table 2.1

Parameter	**Case**	**Control**	**P-value**
Age	49.40 ±6.06	50.20±6.51	0.654
Surgical Time	120.40±6.07	118.40±17.95	0.696

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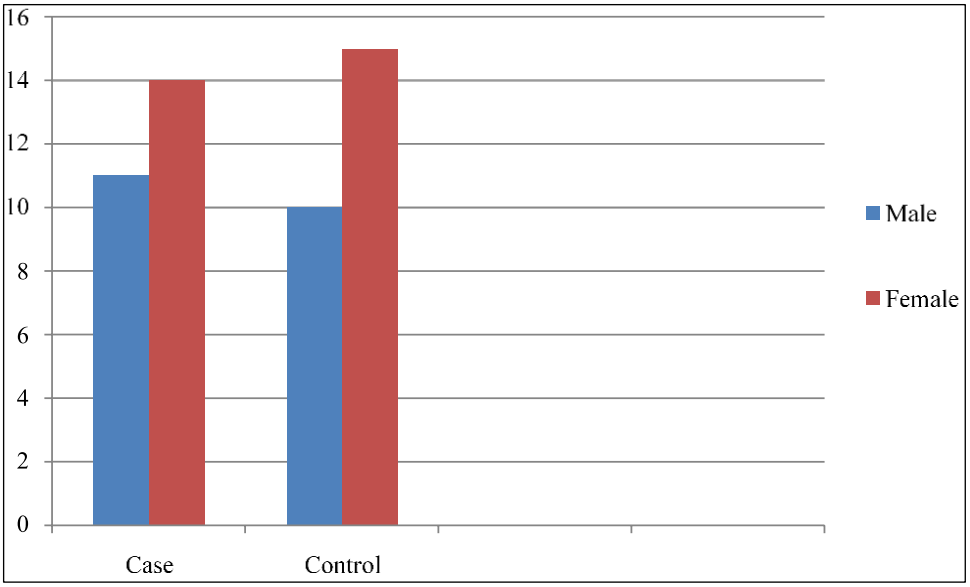


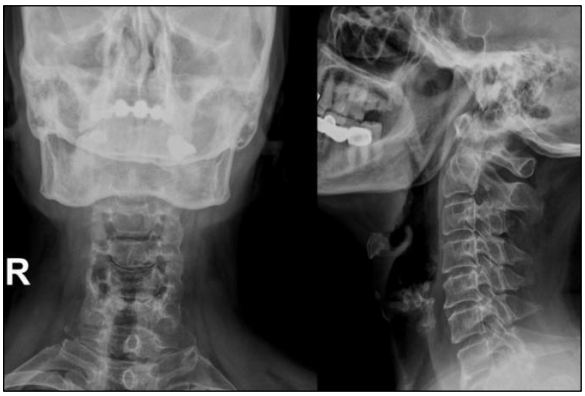
Chart 1: Gender

Prevertebral Soft Tissue Shadow

Preoperatively there was no statistical difference between the prevertebral soft tissue swelling (in mm) in both the groups at C3, C4, C5.

Table 2.2

Pre-op	Case	Control	P-value
C3	5.10 ± 0.50	5.12 ± 0.57	0.895
C4	7.92 ± 0.58	8.18 ± 0.64	0.138
C5	15.23 ± 0.81	15.18 ± 1.64	0.887



Preop AP & Lateral Xray

However, In the post-operative period (2nd and 7th day), there was significant difference (p- values of less than 0.05) between the prevertebral soft tissue swelling at C3,C4 and C5.

Table 2.3: 2nd Day

2nd Day	Case	Control	P-value
C3	8.19 ± 1.03	9.33 ± 0.95	0.0002
C4	10.14 ± 1.07	14.07 ± 1.58	0.0001
C5	19.30 ± 1.89	24.61 ± 1.85	0.0001

Table 2.4: 7th Day

7th Day	Case	Control	P-value
C3	7.83 ± 1.06	9.23 ± 1.43	0.0003
C4	9.48 ± 1.00	12.09 ± 1.42	0.0001
C5	17.13 ± 1.26	12.09 ± 1.42	0.0001

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On 14th post-operative day the prevertebral soft tissue swelling at C3, C4 and C5 was not significant with the p-values of more than 0.05.

Table 2.5:14th Day

14th Day	Case	Control	P-value
C3	6.10 ± 0.70	5.97 ± 0.57	0.482
C4	9.05 ± 1.06	9.52 ± 0.79	0.086
C5	16.63 ± 1.34	17.16 ± 1.08	0.135

Preop **2nd Postop Day** **3rd Postop Day** **14th Postop Day**

Dysphagia-Bazaz Score

On the post-operative day 2, there was a statistically significant difference between the two groups based on 'BAZAZ score' for both liquids and solids (p value 0.016 for liquids and 0.045 for solids)

Table 2.6: 2nd Day

2nd Day (Liquid)	Case	Control	p-value
Mild	7	4	0.016
Moderate	2	5	
Severe	1	1	
2nd Day (Solid)	**Case**	**Control**	**p-value**
Mild	6	3	0.045
Moderate	3	5	
Severe	1	2	

On the 7th day also, there was a statistically significant difference between the two groups based on 'BAZAZ score' for both liquids and solids (p-value 0.045 for liquids and 0.035 for solids).

Table 2.7

7th Day (Liquid)	Case	Control	p-value
Mild	4	2	0.045
Moderate	5	6	
Severe	1	2	

Table 2.8

7th Day (Solid)	Case	Control	p-value
Mild	7	2	0.035
Moderate	2	6	
Severe	1	2	

On the 14th day there was no statistical difference between the two groups based on 'BAZAZ score' for both liquids and solids (p-value 0.833 for liquids and 0.930 for solids).

Table 2.9

14th Day (Liquid)	Case	Control	p-value
Mild	1	3	0.833
Moderate	0	2	
Severe	0	0	

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Table 2.10

14th Day (Solid)	Case	Control	p-value
Mild	2	4	0.930
Moderate	1	2	
Severe	0	1	

Discussion

ACDF is the most commonly performed procedure in the cervical spine these days. However, Post surgery dysphagia still remains a challenge.

In our study we installed local steroid in the retropharyngeal space before closure, to reduce the prevertebral soft tissue swelling (PSTS) following ACDF. We hypothesized that installation of local steroids in the retropharyngeal space following ACDF would reduce the inflammatory response and subsequently reduces the prevertebral soft tissue swelling and dysphagia for post-surgery.

In our study we found that there is reduction in the prevertebral soft tissue swelling following ACDF in cases where local retropharyngeal steroid was given as compared to 'control group' where steroid was not installed. Results were particularly significant on post-operative day 2 and day 7, causing a significant reduction in the prevertebral soft tissue swelling and lower dysphagia for patients.

Our results were very much in agreement with Sanfilippo *et al*. He also reported that prevertebral soft tissue swelling was maintained on the radiograph till second week post-surgery for less than 2 level ACDF procedures [15]. Also, Suk *et al*. analyzed cervical spine lateral radiographs consecutively from post-operative day 1 to day 5 after anterior ACDF and noted that the prevertebral soft tissue swelling was most severe on day 2 and day 3 which started reducing from day 4 onwards [16].In our study we found that prevertebral soft tissue swelling was highest on the post-operative day 2 in 'control group' and less in 'case group'. This result is very much in correlation with use of intravenous steroid prior to intubation given routinely at many centers around the world to reduce the prevertebral soft tissue swelling which may lead airway disturbances and severe complications.

The reported incidence of dysphagia is very variable due to non-identical methods used for evaluation of dysphagia [3]and variable length of follow up. Bazaz score has become most commonly used method to evaluate post-operative dysphagia since its introduction in 2002 [6]. Bazaz *et al*.[6]followed up a series of 249 consecutive patients undergoing anterior cercival spine surgery (ACSS) for 12 months, and found that the dysphagia incidences were 50.2%, 32.2%, 17.8% and 12.5% at 1, 2, 6, and 12 months, respectively. Kalb *et al*.[4]retrospectively analysed medical records of 249 patients who underwent ACSS and reported that occurrence of dysphagia at 6 weeks was 88.8%. However, almost all previous studies reported incidence of long-term dysphagia and very less studies analysed acute incidence. Moreover, the rate of dysphagia after ACDF was significantly under-reported if it was analyzed based on the medical records[17].Incidence of dysphagia has also varied with report of variable profiles of plate used for fixation. Jagannathan *et al*.[18],reported a relatively lower rate of dysphagia in their series without the use of any plating. Only 9% of patients had dysphagia in the postoperative period with only 3% of patients complaining of dysphagia at a 3-month follow-up. Similarly, Scholz *et al*. [19]used a zero-profile device and reported a low incidence of dysphagia (3%) at a 3-month follow-up. They, however, had a very high incidence of early dysphagia (62%).

In our study we did short term follow up and with identical plate used in all patients and analysed the effect of local steroid on PSTS and dysphagia. Results were very significant on 2nd and 7th day of follow up but not statistically significant on 14th day post-surgery. We did not allow any use of intravenous steroids during and after surgery as it would induce an error in results. 'Bazaz score' also during our study correlated well with the PSTS findings. On 14th day post-surgery both PSTS and Bazaz score were not statistically significant showing that by 14th day both groups reached almost the same level radiologically (PSTS) and clinically (dysphagia).

Limitations of this study were smaller sample size (20 patients) and all patients undergoing only single anterior cervical discectomy and fusion. Thus, further studies are required on a large scale involving larger number of patients and more extensive surgery including multilevel discectomies and corpectomies for validation. Duration of follow up was 2 weeks which did not allow us to identifying any possible long-term complication like non-union or infection.

We can now surely say based on our results that local steroid reduces the local inflammatory response ultimately reducing the prevertebral soft tissue swelling and dysphagia post-surgery. Thus, putting local retropharyngeal steroid following ACDF decreases the prevertebral soft tissue swelling and also makes the patient more comfortable, in terms of post-operative oral feeds by reducing the incidence and severity of dysphagia.

Summary

In our study, we found that there is a statistically significant reduction in the prevertebral soft tissue swelling (PSTS) in cases where steroid was given as compared to 'control group' where steroid was not used on 2nd and 7th day post-surgery, but not on 14th day. Also, there was a significant reduction in the

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incidence and severity of dysphagia post-surgery, in patients where local steroid was administered. BAZAZ score was also significantly different between the two groups on 2nd and 7th day post-surgery, but not on 14th day which correlated well with PSTS findings as well.

Conclusion

There is significant decrease in the prevertebral soft tissue swelling and post-operative dysphagia by administrating local steroid before closure of surgical incision. This method might be a simple and effective way of reducing the complications arising due to excessive prevertebral soft tissue swelling following ACDF surgery.

Declaration of Interest: None.

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