

To Determine the Surgical Outcome of Anterior Cervical Corpectomy and Fusion without Fixation for Ossification of Posterior Longitudinal Ligament

Abstract

Aims: The purpose of our study is to evaluate the surgical outcome in patients undergoing anterior cervical corpectomy without fixation with plates and screws for the treatment of ossification of posterior longitudinal ligament (OPLL). **Subjects and Methods:** The type of study was case series and was conducted from January 2015 to December 2015 for 1-year duration at the Department of Neurosurgery at a Tertiary Care hospital in Karachi, Pakistan. A total of $n = 20$ patients (16 men and 4 women; mean age of 57.45 ± 6.4 years [range: 45–68 years]) were included after thorough clinical history and physical examination. Neurological evaluation was done using the Japanese Orthopedic Association (JOA) scoring system. The pre- and post-operative JOA scores were used to calculate recovery rate (RR) of the patients. Radiographic assessment was done using various modalities such as X-ray, computed tomography scan, and magnetic resonance imaging. Surgical outcome and complications were studied and the data were analyzed using SPSS 21. **Results:** After the uniform follow-up period of 12 months, mean JOA scores improved from 9.1 ± 1.37 preoperatively to 14.3 ± 1.69 postoperatively and mean RR was $67.01 \pm 15.5\%$. All the patients showed successful osseous fusion while one patient did not. Two patients developed cerebrospinal fluid leakage, one patient developed recurrent laryngeal nerve palsy, and one expired due to iatrogenic neurological deterioration. **Conclusion:** Anterior cervical corpectomy without fixation with plates and screws is an effective surgical procedure for the treatment of OPLL (for up to three cervical levels of OPLL). It gives good neurological recovery with fewer postoperative complications.

Keywords: Anterior cervical corpectomy, hyperostosis, ossification of posterior longitudinal ligament, spinal fusion, surgical outcome

Introduction

Ossification of posterior longitudinal ligament (OPLL) is a hyperostotic condition that leads to ectopic calcification of posterior longitudinal ligament^[1] and has been recognized as an important cause of cervical myelopathy. A number of studies have been done on OPLL related to its genetics and bony physiology, but the actual process behind the ossification had never been elucidated clearly.^[2] OPLL causes compression of spinal cord, which leads to neurological symptoms and patients with severe neurological deficits require surgical intervention. Available surgical options are anterior and posterior approach. Anterior corpectomy and resection of OPLL enable complete decompression of the cord and give satisfactory results. However, this approach demands more technical skills and is associated with increased incidence

of surgery-related complications, and this approach cannot be used for multisegmental OPLL. There is still some controversy regarding which technique would give the best surgical outcome. Many studies in the past have been done regarding anterior cervical corpectomy and fusion with plates. It is important to note that the use of these plates adds to surgical time and cost and makes revision surgery if needed much difficult to perform. They also cause damage to adjacent discs, nerve roots, and vertebral arteries. In this study, we aim to find out the surgical outcome of corpectomy without fixation (with plates and screws) and to assess the stability of the spine at 6-month follow-up without the use of implants.

Subjects and Methods

Between January 2015 and December 2015, a total of $n = 20$ consecutive patients with

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cervical myelopathy following OPLL underwent anterior corpectomy and fusion without fixation. The study was approved by the Hospital Ethics Committee. After taking due informed consent from all the research participants, the patients were carefully evaluated both clinically and radiographically. Clinical evaluation included a thorough medical history and physical examination. Computed tomography (CT) scan, magnetic resonance imaging (MRI), and standard anterior-posterior and lateral view X-rays were used for radiological assessment. The inclusion criteria were a diagnosis of OPLL with cervical myelopathy due to compression and only those patients who had OPLL up to three cervical levels were included in the study. The exclusion criteria included any history of trauma or previous cervical spine surgery, OPLL of more than three cervical levels, infection, tumor, congenital malformation of the central nervous system, or any chronic systemic disease such as rheumatoid arthritis or neurodegenerative disease. The Japanese Orthopaedic Association scoring system was used to assess the pre- and post-operative severity of cervical myelopathy. CT scan was used to identify dural ossification which is seen as anterior and posterior rims of hyperdense area with central hypodensity. MRI showed cord compression and signal changes in the spinal cord with hyperintensity on T2-weighted imaging. These signal changes indicated severe damage to the cord. The patients were discharged from the hospital after about 4–6 days postoperatively. The physical therapist instructed the patient on mobilization techniques and the use of the cervical collar, necessary for appropriate healing of the bone.

Surgical intervention was done through a right-sided oblique incision just along the anterior border of sternocleidomastoid. Level was identified using image intensifier. Trenches procedure of 1.2 cm width (rather than 1.7 cm) was used to perform the corpectomy [Table 1]; we used a high-speed drill until the OPLL was thinned out. The longitudinal extent of corpectomy depends on the number of segments involved. Posterior longitudinal ligament was incised after passing the blunt hook at the junction of diseased and normal segment. Then, the OPLL was removed using Kerrison punch. Undercutting of OPLL was also performed laterally beyond 1.2 cm trench. Since the trench width in our case series was small, we neither used the graft alone to fuse nor the graft with fixation [Figures 1-3].

Following operative procedure, the patients used the Philadelphia collar for at least 6 weeks duration and were allowed to mobilize as soon as patients were able to move.

Postoperative follow-up

The patients were asked for follow-up at 3 months, 6 months, and 12 months. In Table 2, all the patients were asked to get their standard anteroposterior, lateral full

Table 1: Clinical details of the patient population

Characteristics	Frequency (%)
Age (years)	
45-55	6 (30.0)
>55	14 (70.0)
Mean age	57.45±6.4
Gender	
Female	4 (20.0)
Male	16 (80.0)
Duration of symptoms (months)	
<20	12 (60.0)
≥20	8 (40.0)
Mean duration of symptoms	19.7±8.1
OPLL classification	
Continuous	18 (90.0)
Segmental	2 (10.0)
Level involved	
C3	1 (5.0)
C3, C4, C5	1 (5.0)
C3, C4	4 (20.0)
C3, C4, C5	1 (5.0)
C4	1 (5.0)
C4, C5	12 (60.0)
Complications	
None	17 (85.0)
CSFL	2 (5.0)
Neurological deterioration	1 (5.0)
RLN palsy	1 (5.0)
Preoperative JOA Score	9.10±1.37
Postoperative JOA Score	14.3±1.69

JOA – Japanese Orthopedic Association; RLN – Recurrent laryngeal nerve; CSFL – Cerebrospinal fluid leakage; OPLL – Ossification of posterior longitudinal ligament

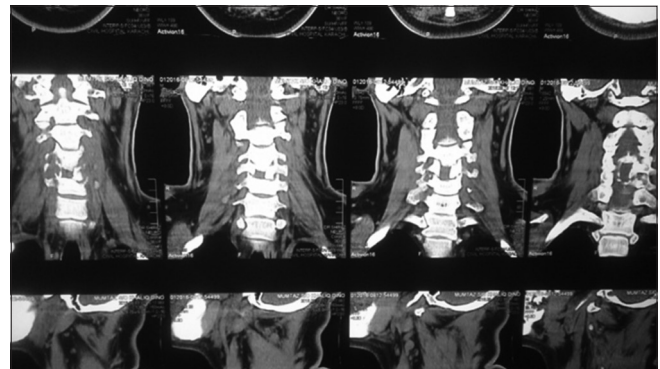


Figure 1: Postoperative magnetic resonance imaging showing trench coronal cuts

flexion-extension X-ray of cervical spine to assess fusion. Fusion was defined by identifying bony trabeculations without bone lucency and the absence of motion at the fused segment. Evaluation of postoperative improvement in symptoms was done by calculating the recovery rate (RR) with the use of Japanese Orthopedic Association (JOA) scores as proposed by Hirabayashi *et al.*^[3]

Table 2: Pre- and post-operative mean Japanese Orthopedic Association score difference with age, gender, and duration of disease symptoms using Wilcoxon signed-ranks test

Characteristics	Mean±SD		Wilcoxon signed-ranks test	P
	Preoperative JOA score	Postoperative JOA score		
Age (years)				
45-55	9.1667±1.32916	15.0000±1.09545	-2.23	0.026*
>55	9.0714±1.43925	14.0000±1.83973	-3.32	0.001*
Gender				
Female	9.0000±1.41421	14.0000±2.70801	-1.84	0.066
Male	9.1250±1.40831	14.3750±1.45488	-3.54	<0.001*
Duration of symptoms (months)				
<20	9.2500±1.21543	14.6667±0.98473	-3.08	0.002*
≥20	8.8750±1.64208	13.7500±2.37547	-2.55	0.011*

*P-value significant at <0.0. SD – Standard deviation; JOA – Japanese Orthopedic Association

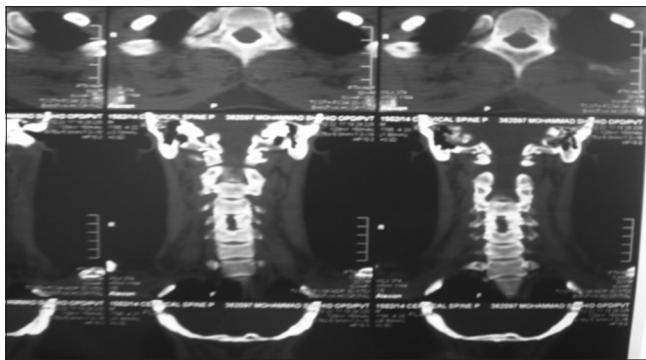


Figure 2: Different patient postoperative magnetic resonance imaging

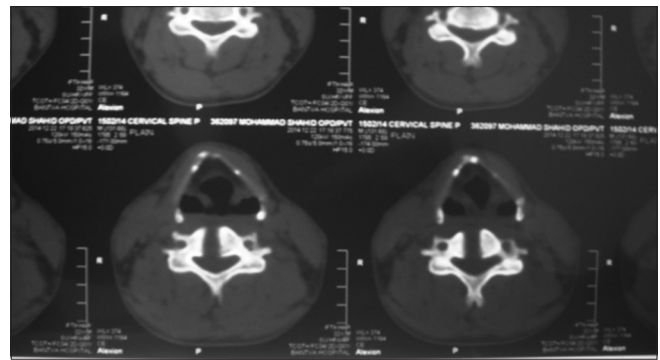


Figure 3: Axial magnetic resonance imaging cuts

$$RR = \frac{\text{Postoperative JOA score} - \text{Preoperative JOA score}}{17 - \text{Preoperative JOA score}} \times 100$$

RRs were used to assess the surgical outcome by grading as follows: excellent, ≥75%; good, ≥50% but <75%; fair, ≥25% but <50%; or poor.

Statistical analysis

Data analysis was done using SPSS 21 (IBM Corp, Armonk, NY). Wilcoxon signed-ranked test was used to evaluate effect of included factors on pre- and post-operative JOA scores. The P < 0.05 was considered statistically significant.

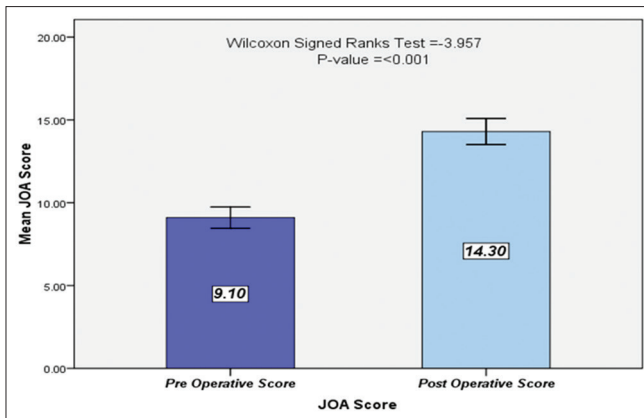
Results

A total of 16 males and 4 females, with a mean age of 57.45 ± 6.4 years (range: 45–68 years), completed 12-month follow-up period. The mean duration of symptoms was 19.1 ± 8.1 months (range: 6–36 months). The overall average JOA score improved from 9.1 ± 1.37 preoperatively to 14.3 ± 1.69 postoperatively (P < 0.05) with RR of about 67.01 ± 15.5% refer to Graph 1. The types of OPLL seen were continuous 90% (n = 18) and segmental 20% (n = 2).

Adequate decompression of the cord was seen in all the patients and was confirmed by MRI. Osseous union was

seen in all of our patients after a period of 6 months postoperatively, except for one patient who expired.

The complications seen in our patients were cerebrospinal fluid leakage (CSFL), hoarseness of voice, and iatrogenic neurological deterioration. Intraoperatively, cerebrospinal fluid leak occurred in two patients after dural tearing because of tight adherence with the dura. Both of them were managed conservatively with complete bed rest for 4–6 days and administration of oral acetazolamide. One patient developed hoarseness of voice secondary to recurrent laryngeal nerve (RLN) palsy but recovered spontaneously within a week. One patient expired while in surgical Intensive Care Unit due to iatrogenic neurological deterioration. None of the patients developed graft-related complications such as pseudoarthrosis, graft migration, kyphosis, or graft displacement [Table 1]. The Wilcoxon signed-ranked test showed that mean postoperative JOA scores were significantly higher than the median preoperative JOA score for both the age groups of 45–55 years and more than 55 years (P = 0.026 and P = 0.001, respectively). The difference between these scores was significant in male patients (P ≤ 0.001) but not in female patients (P = 0.066). The test also showed a significant difference in JOA scores for both the groups according to the duration of symptoms (<20 months P = 0.002, ≥20 months P = 0.011).



Graph 1: Comparison of pre- and post-operative Japanese Orthopaedic Association scores

Neurological outcome was evaluated from the rates of recovery. Forty percent of the patients had excellent RRs, 50% had good RR, and fair RRs were seen in 10% of patients as illustrated in Table 2. None of patients had a poor outcome [Table 3].

Discussion

OPLL is a rare disease occurring as a result of abnormal ossification, which leads to progressive myeloradiculopathy. The chronic compression from ossification of the ligament reduces the canal diameter and contributes to myelopathy and severe neurological disability. The incidence of OPLL has been estimated to be about 1.9%–4.3% in Japanese and Asian countries among individuals more than 30 years of age and in white people, it is 0.10%–1.8%, respectively.^[4-9] Another study done in China showed that OPLL was predominantly seen in the middle age and this incidence reached up to 5.6% among the people over 50 years of age.^[10] However, no such studies have been conducted in Pakistan regarding the incidence of OPLL.

Surgical techniques available for OPLL include the anterior approach and the posterior. Anterior approach includes discectomy and corpectomy with or without fusion, and posterior approach includes laminectomy or laminoplasty. Anterior approach is associated with better postoperative neurological outcome than the posterior approach for the management of cervical myelopathy associated with OPLL.^[11] Many studies have shown that the anterior approach is not associated with a higher risk of surgical trauma and increased incidence of surgery-related complications.

In this study, we did trench procedure by making trench of 1.2 cm without using cervical plates (rather than 1.7 cm with plates), and the final outcome when recovery of the patients is concerned is as satisfactory as with fixation. To stabilize the graft, patients were asked to wear Philadelphia collar for 6 weeks. The results of the study showed that anterior cervical corpectomy and fusion without plate

Table 3: Surgical outcome from recovery rates

Overall outcome	Frequency	Recovery rates (%)
Excellent	8	40
Good	10	50
Fair	2	10
Poor	-	-

fixation were an effective procedure, with improved mean postoperative JOA score and successful fusion at 6 months. In a study with a long follow-up period of about 5 years showed that anterior approach gave higher JOA score postoperatively and RRs than the posterior approach.^[12]

Complications commonly associated with surgeries of OPLL include CSFL, hoarseness of voice, epidural hematoma, cranial nerve five palsy, and dysphagia. The most common complication seen after corpectomy is CSFL with its incidence rate between 4.6% and 32%. Improper management of CSFL leads to purulent meningitis, wound infection and is also associated with mortality.^[13,14] In the case of OPLL, CSF leakage occurs either due to the tight adherence of dura or when the ossified dura fuses with the ligament, which increases the risk of CSF leakage when surgical intervention for the removal of the ossified mass is done. Ossification of the dura can be seen on the bone window of preoperative CT scans as single- or double-layer sign.^[15,16] In this study, two patients reported to have CSF leakage due to tight adherence of dura and no signs of dural ossification were seen on CT scans. They were managed conservatively leading to complete recovery. Postoperative hoarseness following anterior cervical surgeries can be due to RLN or superior laryngeal nerve injury, hematoma and edema, laryngeal and pharyngeal trauma, or arytenoid dislocation. Injury to RLN is commonly due to its compression against endotracheal tube. Our one patient developed hoarseness secondary to RLN palsy but recovered spontaneously after a week.

Various studies have been done relating the outcome of corpectomy and prognostic factors such as sex, age, type of ossification, duration of symptoms, number of levels involved, history of diabetes, preoperative JOA score, and other related radiographic parameters. Among these factors, many are considered to be key predictors too. Patients with longer duration of symptoms (≥ 24 months), more number of corpectomies (≥ 3), or lower preoperative JOA score (< 9 points) were prone to have poor surgical outcome.^[17] Another study reported that longer duration of symptoms, T1 hypointensity on MRI, and a history of minor trauma were highly indicative of a poor surgical outcome.^[18] Older age was found to be associated with poor long-term surgical outcome.^[19] The Wilcoxon signed-ranked test showed that the difference in pre- and post-operative JOA scores was significant for age (45–55 years $P = 0.026$ and > 55 years $P = 0.001$),

male gender ($P = 0.000$), and duration of symptoms (<20 months $P = 0.002$ and ≥ 20 months $P = 0.011$). The significant increase in JOA score from 9.10 ± 1.37 preoperatively to 14.3 ± 1.69 postoperatively ($P \leq 0.05$) with RR of $67.01 \pm 15.5\%$ showed that this procedure is effective for treating patients with myelopathy secondary to OPLL. Our study revealed that anterior cervical corpectomy and fusion without fixation with plates and screws has a good surgical outcome at 6-month follow-up.

The current study has some limitations. First, a limited number of 20 patients were recruited due to the rarity of this condition which is a very low number of cases. Second, our follow-up period was short, that is, 6 months in duration. Third, financial constraints did not allow the authors to investigate all the factors that might be related to the outcome of anterior cervical corpectomy as shown by international studies. Fourth, there was no control group from which to compare the outcome of the procedure. Hence, in the light of the aforementioned limitations, we propose that further studies be done to advance the use of this procedure.

Acknowledgment

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Conclusion

According to the results of our study, the anterior cervical corpectomy without fixation is an effective treatment for ossification of posterior longitudinal ligament for up to involvement of three cervical levels, it provide good outcome post operatively with significant neurological recovery.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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