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Original article

Multiple Anterior Cervical Discectomy and Fusion Versus Posterior Cervical Decompression for Degenerative Cervical Myelopathy

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Abstract

Background: Cervical spondylotic myelopathy (CSM) is a malfunction of the spinal cord caused by spinal canal constriction. Spondylosis, congenital stenosis and disc herniation are frequent causes, often occurring in conjunction. **The study aimed to** compare radiological and clinical results following multiple level ACDF versus posterior cervical decompression for degenerative cervical myelopathy treatment. **Methods:** This study was conducted on 40 participants suffering degenerative CSM because of multi-level cervical spondyolosis and subjected to surgical treatment. 20 patients with multiple ACDF as A group and 20 participants suffering posterior cervical decompression as B Group. Clinical and radiological outcomes of both groups were compared together. **Results**: The difference between Group A and Group B was not statistically critical concerning improvement of both post-operative mJOA scale and myelopathy scale as the median of preop (mJOA) was 12 (9-13) while post-operative (mJOA) scale was 16 (14-17) among Group A and was 8 (6-9) preoperatively then became 13.5 (12.25-14.75) postoperatively among Group B. The difference between anterior and posterior approach groups was statistically critical regarding post-operative cervical lordosis angle ($P<0.04$). As, post-operative cervical lordosis angle among Group B was with (mean ± SD= 16.5±5.98°) but the mean of Group A was (20.37±3.49). **Conclusion:** ACDF and PL are effective surgical treatments for multilevel CSM with favorable clinical outcomes; nevertheless, when compared together, A statistically significant difference existed favoring ACDF considering postoperative Cobb's angle improvement. cervical canal diameter increased more after PL, but post operative myelopathy scale and the median of mJOA score shows no difference between both groups.

Keywords: Anterior Cervical Discectomy& Fusion, Posterior Cervical Decompression, Degenerative Cervical Myelopathy

Introduction

CSM is a malfunction of the spinal cord produced by compression owing to spinal canal narrowing. Spondylosis, congenital stenosis and disc herniation are common reasons, frequently occurring in conjunction. The compression generates symptoms of upper and lower motor neuron dysfunction in the arms and legs. The beginning is often subtle (1).

CSM is the most prevalent condition of the spinal cord in those over 55 years old. Radiologic spondylotic alterations rise with patient age; 90 percent of asymptomatic individuals over 70 years show some sort of cervical degenerative change. Males appear to be overrepresented in several of the major DCM cohorts (representing roughly two-thirds of patients in the worldwide AOSpine study of operated DCM patients), 36 indicating that males may be at a greater risk for developing DCM. This is confirmed by large Taiwanese research indicating that the peak prevalence of DCM in both men and females happened in their 70s, with a substantial difference in prevalence rate between the sexes (28.9 for males vs 15.3 for females per 100 000 person-years). This may be attributed to anatomical variances in canal/vertebral-body ratio, according to some study, however there are few studies on this topic (2).

Taking into account all surgical objectives, the essential components of the most popular surgical techniques used to treat DCM are two procedures: A. Anterior cervical approaches, which include Discectomy(ies) with cage fusion, Corpectomy(ies) or Combined discectomy(ies) and corpectomy(ies). B. Posterior cervical approaches, which include only laminectomy, laminectomy and fusion or laminoplasty (3).

The decision of surgical method and strategy to enhance patient outcome continues to be contentious. Numerous surgeons consider repeated anterior cervical discectomy and/or corpectomy with fusion to be the most effective treatment for CCS; Others, on the other hand, consider that ACDF is not the optimal surgical treatment for multilevel CSM due to the increased risk of inadequate decompression beyond the mid-vertebral column (4).

body and higher risk of pseudarthrosis due to a rise in graft–host interactions, particularly

in multilayer CSM. In general, anterior operations, such as discectomy or corpectomy, are performed on younger patients, while posterior procedures, such as laminectomy or laminoplasty, are performed on older patients with persistent lordosis and poor fusion prospects. Except for the danger of intraoperative damage to the recurrent laryngeal nerve, which is unique to the anterior surgery, the posterior approach poses a greater risk of infection and postoperative neurological impairment (5).

Present research aimed to compare clinical and radiological outcome after multiple level anterior cervical discectomy and fusion versus posterior cervical decompression for DCM treatment.

Patients and methods

This research was conducted on 40 participants admitted at Benha neurosurgery department at Benha university hospital with DCM owing to multi-level cervical spondyolosis. Patients were classified according to the surgical approach into 2 groups: group A includes 20 participants with multiple ACDF and group B includes: Twenty patients with posterior cervical decompression. The cases have been collected prospectively and retrospectively and followed up postoperative for 6-12 months., Medical records including clinical and radiological as well as intraoperative findings for all participants were examined before and after surgery. The study was done after being supported by the institution's ethics committee and informed permission was acquired from all patients investigated.

Inclusion Criteria Includes adult patients with cervical myelopathy. CSM patients resulting from multi-segmental spinal stenosis (2 segments or more) due to degenerative etiology.

Exclusion Criteria were 1. isolated cervical radiculopathy patients and single level of herniated intervertebral disc. 2. Patients with concurrent neurological conditions i.e., stroke, cerebrovascular accidents, peripheral neuropathy and motor neuron diseases. 3. previous cervical spine surgery, cervical deformity. 4. unfit patient regarding general condition for general anesthesia. 5. other causes of myelopathy as e.g., traumatic, neoplastic, infection, vascular and congenital causes.

Patients were subjected to following 1- History taking: With special attention to Symptoms of motor, sensory and sphincter affection. **Clinical Examination:** 1- General

Examination, 2- Neurological Examination: with special attention to motor power, sensory examination, deep tendons reflexes and pathological reflexes, 3- To assess myelopathy severity: 1) Preoperative mJOA scale was used. This scale includes motor power of upper and lower extremities, sensation of upper limbs, urinary dysfunction, and balance of movement .18 is the maximum score while 0. 2 is the minimum. Preoperative Myelopathy scale (MS) is a 10-point scale based on five primary indicators of myelopathy (Hoffman sign, Babinski sign, reflexes, proprioception, and clonus), with a score of 0 if the sign is absent, 1 if it is unilateral, and 2 if it is bilateral. The highest possible score is 10 and the lowest is 0.

2- Investigations: Routine laboratory investigations for all cases, radiological: Plain X-ray cervical or CT scan with measuring of cervical spine lordotic angle (Cobb's angle) **fig (3) This is calculated by combining perpendiculars to parallel lines drawn to C2 and C7's lower end plates**. Cerical canal diameter fig (4) which is the distance between inner surfaces of both vertebral body and lamina. MRI cervical for all cases.

3- Management: Surgical management:

Anterior approach (multiple ACDF) Patients underwent general anesthesia in the supine position. ACDF was carried out with the Smith-Robinson approach. After radiographic confirmation and exposure of the vertebral levels corresponding to the compressive components, a discectomy and excision of the anterior and posterior bony spurs as well as the cervical posterior longitudinal ligament (PLL) were performed. PLL was extracted by grinding and thinning it with a drill, then removing it with a hook from the dura.

To guarantee appropriate dural and neural decompression, the PLL was dissected and additional compressive materials, including posterior osteophytes, were removed. Using trial spacers, the appropriate size of the polyetheretherketone (PEEK) cage was determined. The cage was put into the middle of the disc area using an impactor. **Posterior approach (posterior laminectomy)** done with patient in prone position At the suitable location, a midline back incision was made, the paracervical muscle was separated from the lamina, and the open side of the lamina was decided based on the side of the primary symptoms and results of the preoperative radiologic scan.

During laminectomy, a high-speed electric drill was utilized to create a gutter and remove the supraspinous, interspinous, and yellow ligaments.

Postoperative follow up: All patients were followed up for neck pain, brachialgia, blood loss, CSF leakage, motor power. post operative infection and neck rigidity, motor power, pathological reflexes, sphincters control, cervical spine stability and range of movement. 1) Since it evaluates upper and lower limbs, sensory function, and bladder function, the postoperative mJOA scoring system is a more exact technique of identifying the severity of cervical myelopathy. In this research, the severity of CSM was measured using the mJOA scale and Myelopathy Scale before surgery and 9 months postoperatively. Radiological follow up after 6-12 months: Plain X ray or CT cervical spine. MRI cervical spine for cervical lordotic angle and cervical canal diameter.

Statistical analysis

SPSS version 25 was utilized for statistical analysis (IBM Inc., Chicago, IL, USA). Using the Kolmogorov-Smirnov test, the normality of distribution of the variables under consideration was determined. When applicable, the gathered data were summarized using the mean standard deviation for parametric data, the median and interquartile range for nonparametric data, and the number and proportion for qualitative data. Chi-square was used to compare qualitative data (number and percentage) where applicable; one-way ANOVA was used to compare parametric quantitative data (mean and standard deviation); and Kruskal-Wallis was used to compare non-parametric quantitative data. The Benferroni test was performed post hoc. For comparing parametric and nonparametric paired data, the Paired t test and Wilcoxon were used, respectively. Spearman and Pearson correlations were determined between nonparametric qualitative data and parametric qualitative data, respectively. Using the ROC Curve, the sensitivity, specificity, and Area under the curve (AUC) of anterior and posterior approach improvement prediction were determined. Considered statistically significant was a P value with two tails less than 0.05.

Results

Differences between both groups regarding basic characteristics, clinical data and operative data were illustrated in Table 1. Post-operative mJOA scale was significantly different between group A and B ($P<0.05$),

Yet, post-operative Myelopathy scale was insignificantly different between both studied group (P>0.05). Table 2

80 % of the studied patients improved after surgery 70% of group A and 90% of group B. Only 30% of the studied patients of group A have postoperative complications compared to 35% for group B and 10 % of patients of group A with complications need posterior session. Variant complications occur as C5 Palsy 1 (2.5%), Dural tear 1 (2.5%), Lt vertebral artery injury 1 (2.5%), Kyphosis 2 (5%) with group B, needs posterior session 4 (10%), Persistent Neck pain 2 (5%), Resp Affection associated with cord compression 1 (2.5%) with group B. Table 2

There was a significant different between anterior and posterior approach groups post-operative cervical lordosis angle (P<0.04). The post-operative cervical lordosis angle among the studied posterior laminectomy group was the smaller (mean ± SD= 16.5±5.98^{o}). Table 3 and 4

There were significant differences between pre and post operative mJOA scale and MS scale, among studied group A (P<0.01). As for mJOA scale, MS scale, have improved post-operative (median = 16(14-17), 5(4-5) respectively). Improvement rate and complications rate were insignificantly different between the studied groups (P>0.05). Table 3

There were significant differences between pre and post operative average C2-7 canal diameter among group A (P<0.03). As average C2-7 canal diameter and cervical lordotic angle have improved post-operative Mean± SD 9.96 (9.1-10.27) and 20.37±3.49 respectively). There was statistically significant difference between anterior and posterior approach groups post-operative cervical canal diameter (P<0.01). As, post-operative cervical canal diameter among studied group B was longer (mean ± SD= 10.64(9.87-11.11) mm). There were significant differences between pre and post operative average C2-7 canal diameter among group B (P<0.03). As, average C2-7 canal diameter has improved post-operative **(Mean± SD)** 10.64(9.87-11.11), pre and post operative cervical lordotic angle were insignificantly different between both studied groups (p>.05). Table 4

There were significant negative correlations between recovery rate with age, symptoms duration, and MS scale (p<0.05). There were significant positive correlations between recovery rate with mJOA scale and average

C2-7 canal diameter (p<0.05). Figure 3 and Table 5.

Statistical analysis and ROC shows that the anterior and posterior approach techniques have non-significant predictive value of patient improvement (p<0.05). Figure 4 and 5

Table 1: Differences between both groups regarding basic characteristics, clinical data and operative data.

Variable		Group A	Group B	
		Median (IQR)	Median (IQR)	
Age (years)		61.5 (48.75-64.75)	63.5 (50.25-68)	
Duration of symptoms (months)		15.50(12.25- 28.75	33.5 (15.25-41)	
Variable		**Anterior approach group N=20 No. (%)**	**Posterior laminectomy group N=20 No. (%)**	
Gender	**Female**	4 (20)	2(10)	
	Male	16 (80)	18 (90)	
Operative data		**Group A Median (IQR)**	**Group B Median (IQR)**	P- Value
Number of operated cervical levels		3	4(3-4)	.03 (S)

Table 2: Operative and Post-operative neurological and radiological, Post-operative outcome data among studied cervical spondylotic myelopathy patients.

Variables			Frequency N. (%)
Number of operated cervical levels			**Median (IQR)** 3 (3)
Buckling of ligamentum flavum **		**+ve**	**6 (30)**
Cage position *		**Accepted**	**18 (90)**
		malposition	2 (10)
Variables			**Median (IQR)**
mJOA scale			14 (13-16)
Mylopathy scale			5 (4-6)
Cervical lordosis angle (degrees)			**Mean ± SD=** 18.44±5.2
Average C2-7 canal diameter (mm)			10.2 (9.2-10.7)
Variables (N.=40)			**N. (%)**
Improvement rate (+ve)			**32(80%)**
Complications rate (+ve)			**13 (32.5%)**
Type of* Complications	**C5 Palsy**		1 (2.5%)
	Dural tear		1 (2.5%)
	Lt vertebral artery injury		1 (2.5%)
	Kyphosis		2 (5%)
	Needs posterior session (Not improved)		**4 (10%)**
	Persistent Neck pain		2(5%)
	Resp Affection+ cord compromise		1(2.5%)

Table 3: Differences between the anterior approach, posterior laminectomy groups regarding postoperative neurological and radiological data, postoperative outcome data

Variable	Group A	Group B	Mann-Whitney test	P value
	Median (IQR)	Median (IQR)		
mJOA scale	16(14-17)	13.5(12.25-14.75)	2.725	.006**(HS)**
MS scale	5 (4-5)	5.5(4.25-6)	1.66	.114
Cervical lordosis angle (degrees)	**Mean± SD**	**Mean± SD**	**Student t-test=**	.04 (S)
	20.37±3.49	16.5±5.98	2.5	
Average C2-7 canal diameter (mm)	9.96 (9.17-10.27)	10.64(9.87-11.11)	2.38	.01 (S)
Variable	**Group A N=20 No. (%) ***	**Group B N=20 No. (%) ***	**Chi square Test**	**P value**
Improvement rate	14 (70%)	18 (90%)	2.5	.114
Complications rate	6 (30%)	7 (35%)	.114	.736

*Percentage of Column.

Table 4: Differences between pre-operative and post-operative neurological and radiological data of Group B of patients

Variable	Preoperative assessment	Postoperative assessment	Wilcoxon test	P value
	Median (IQR)	Median (IQR)		
mJOA scale	12 (9-13)	16(14-17)	3.794	<.001 **(HS)**
MS scale	5(5-6)	5(4-5)	2.970	.003**(HS)**
Cervical lordosis angle (degrees)	**Mean± SD**	**Mean± SD**	**Paired t test=**1.48	.077
	19.39±3.18	20.37±3.49		
Average C2-7 canal diameter (mm)	9.3(9-9.6)	9.96(9.1-10.27)	2.949	.003**(HS)**
Variable	**Preoperative assessment**	**Postoperative assessment**	**Wilcoxon test**	**P value**
	Median (IQR)	Median (IQR)		
mJOA scale	8 (6-9)	13.5(12.25-14.75)	3.93	**<.001(HS)**
MS scale	7 (6-8)	5.5(4.25-6)	3.118	**.002(HS)**
Cervical lordosis angle (degrees)		**Mean± SD**	**Paired t test=**	.475
Mean± SD	**(Mean± SD)** 16.44± 6.9	16.5±5.98	.06	
Average C2-7 canal diameter (mm)	8.49 (7.73- 9.17)	10.64(9.87-11.11)	3.51	**.001(HS)**

Table 5: Correlation analysis for pre-operative factors and studied patients' recovery rate.

Associated Factor	Recovery rate	
	Spearman Correlation coefficient	**P**
Age **(years)**	-.314	**.048(S)**
Duration of symptoms **(months)**	-.444	**.004(HS)**
Grade of muscle weakness	.186	.251
mJOA scale	.459	**.003(HS)**
MS scale	-.423	**.007(HS)**
Cervical lordosis angle **(degrees)** *	.188	.246
Average C2-7 canal diameter **(mm)**	.339	**.032(S)**
Number of operated cervical levels	-.318	**.046(S)**

***** Pearson's correlation coefficient

Fig (1) Case 2. Pre op. MRI cervical spine shows multilevel CCS for a myelopathic patient.

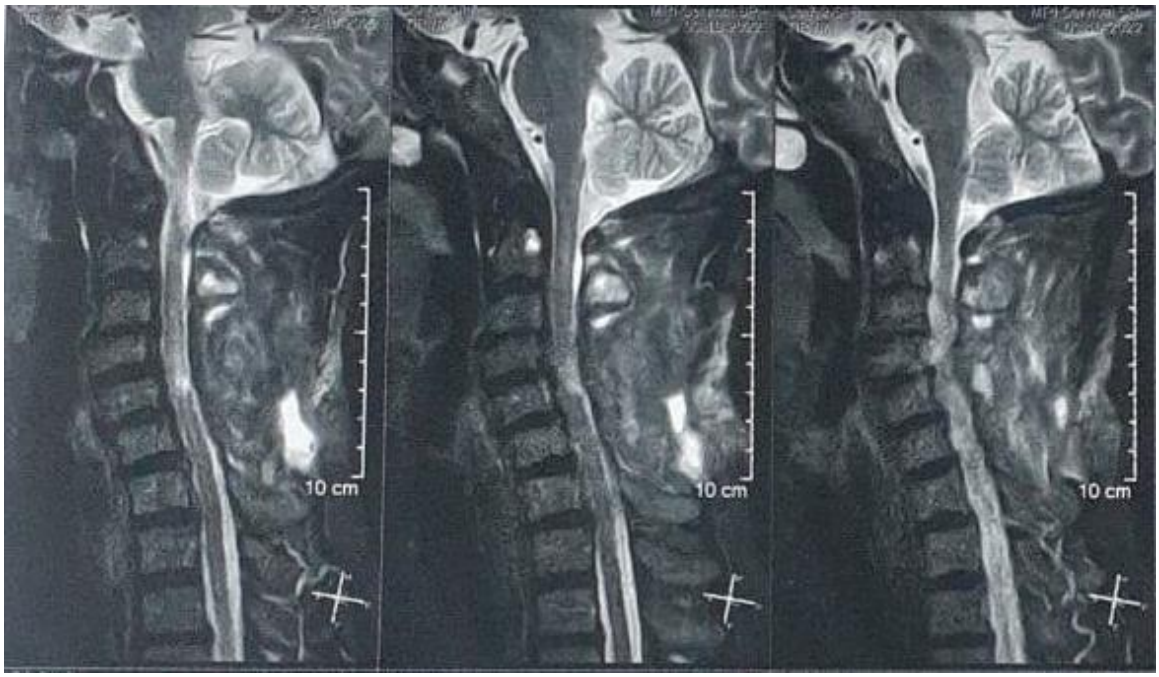

Fig (2): Case2. Postop. MRI cervical spine shows adequate decompression of CCS

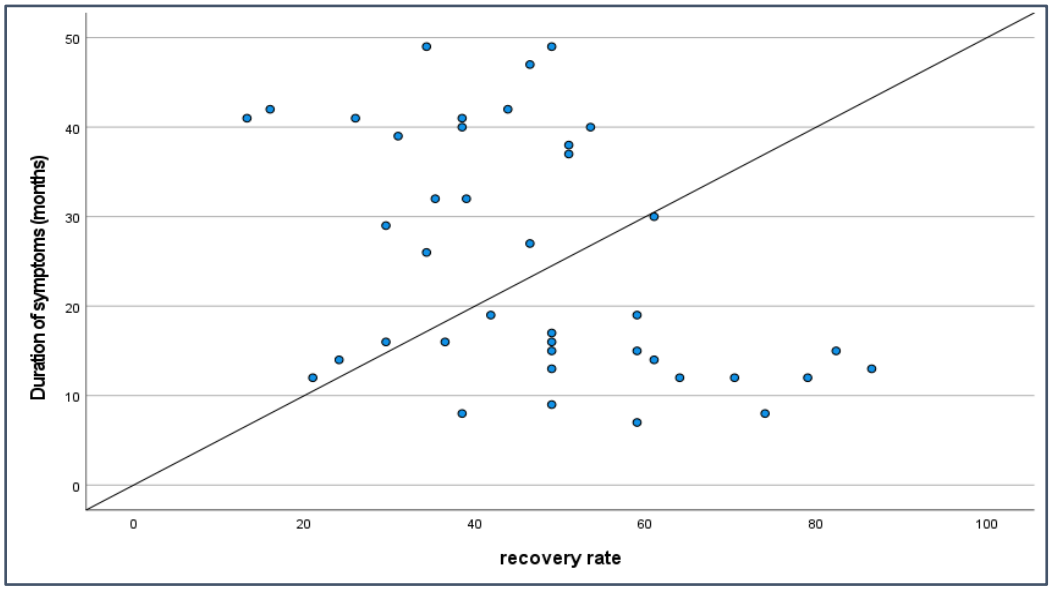

Figure 3: Correlation between recovery rate and duration of symptoms among studied patients

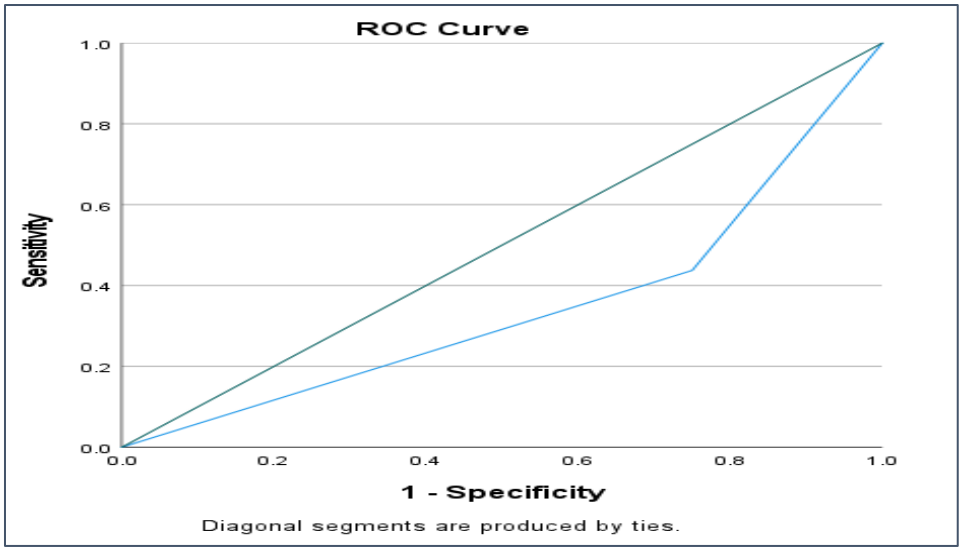

Figure 4: Roc-curve of anterior approach to predict patient's improvement.

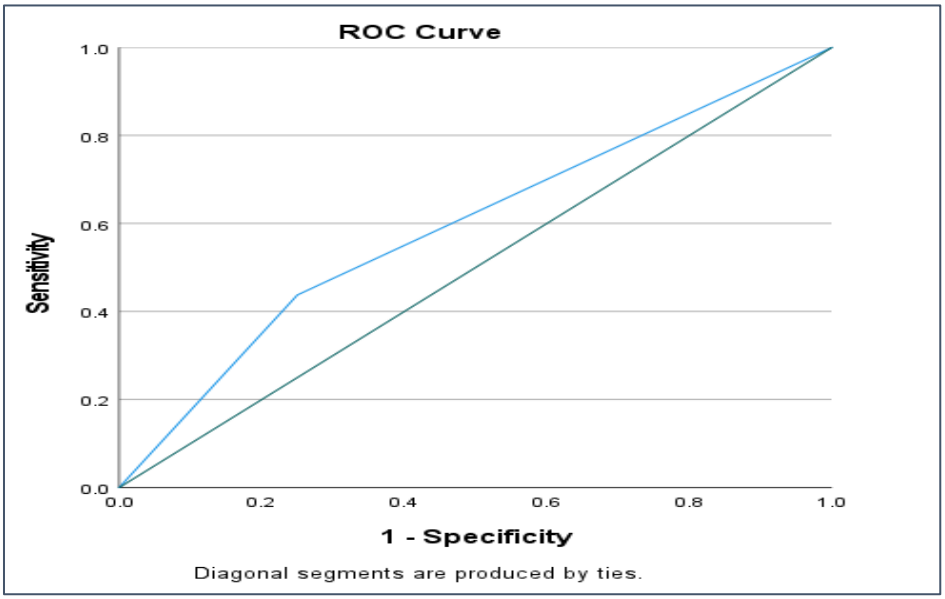

Figure 5: Roc-curve of posterior approach to predict patient's improvement.

Discussion

In recent years, several studies [14, 15] have investigated the surgical management of cervical spondylotic myelopathy, while the surgical treatment of multilayer CSM remains debatable. Anterior Cervical Discectomy and Fusion is an efficient technique for direct neural decompression with the objectives of restoring cervical

kyphotic alignment and preserving cervical spine stability [16].

Regarding our clinical data the median of preoperative mJOA score for group A and B were 12 (9-13) & 8 (6-9) respectively which improved to 16(14-17) and 13.5(12.25-14.75) postoperative. A study (6) showed that the preoperative mJOA score was with a mean of 12.7 ± 2.5 and the preoperative mJOA score was considerably more severe in the posterior group (11.8 ± 2.8). But zhu et al (19). mentioned in his study that mjoa score shows no difference between both groups, but the improvement rate was higher with anterior group .

Regarding number of operated cervical segments in anterior approach and posterior approach show that the median number of operated cervical levels was 3 (3-4), but another study (7) included patients undergoing single-level as well as multilevel anterior and posterior fusion. A study (17) reported that the mean number of operated cervical segments with anterior and posterior approach were 2.1 and 3.1 respectively. But with Piazza et al. they were 1.64 and 3.31 respectively.

Regarding postoperative complications in management of Degenerative Cervical Myelopathy complications of both approaches were (30%) for group A and (29.4%) for cases of group B, with only one case of respiratory affection (2.5%) occurs in one case of group A due to postoperative cord Compromise. 10 % of the studied patients of group A have cage malposition. No postoperative hematoma was present in our study.

A study (17) mentioned that posterior approach had more degrees of postoperative neck pain may be due to More extent of muscle dissection leading to postoperative pain scores but in our study Only 3 cases suffer from persistent postoperative neck pain during 12 month follow up. Regarding both groups no significant dysphagia happened with our patients also reoperation occurred only with group A due to buckling of ligaments or cervical cage malposition. regarding fusion-related complications in cases with group A, but a study (20) found that dysphagia and dysphonia occurs mainly with anterior group due to bone grafting.

Complications as surgical site infection, deep venous thrombosis and pulmonary embolism did not occur in our study. neurological deficit (1 (2.5%)) was present only in group A. CSF leak 1 (2.5%) %) occurs only in one case of group A which was managed by insertion of lumbar drain

for 5 days. Also, dural tear occurs only with posterior approach group in two cases 5% which was managed by primary repair which was enough to prevent CSF leak. Non improved axial pain occurred only with group B in two cases (5%). However, there was no significant difference between the two groups in the total rate of issues. C5 palsy after posterior laminectomy (1 (2.5 percent) due to spinal cord displacement after laminectomy; nevertheless, only four patients in group A required reoperation.

In a meta-analysis [21], patients with posterior decompression and fusion had a higher incidence of C5 palsy (11.0%) than those in the Anterior group (3.3 percent). A study found that clinical results did not differ between anterior and posterior approaches (9).

Two studies (18) and (15) found that the anterior approach has a higher improvement in mJOA scores and recovery rate during follow-up.

In our study, there is no great difference between postoperative improvement of mJOA and complications rates between the two approaches. However, the improvement of sagittal alignment with group A was better as cervical lordosis has an obvious effect on the clinical outcomes. We observed that both posterior and anterior operations resulted in significant decompression of the spinal cord, as assessed by AP diameter, with the posterior approach resulting in a higher decrease in canal diameter.

As regard cervical lordosis angle, Wang et al. detected that cervical lordosis improved with both approaches but more obvious with anterior one, which are the same with our results

Finally, our study in management of cervical spondylotic myelopathy was up to be comparable the most recent reports regarding all neurosurgical aspects including case clinical data, investigations, planning of surgical management, complications avoidance, radiological and clinical outcomes.

Conclusion

ACDF and PL are both effective methods for the surgical therapy of multilevel CSM with favorable clinical outcomes; however, there was a statistically significant difference favoring ACDF in terms of postoperative Cobb's angle improvement. cervical canal diameter increased more after PL; but post operative myelopathy scale and the median of mJOA score and shows no

difference between both groups. Axial neck pain was the commonest complication post operatively. However, there is no substantial difference between the two techniques in terms of post-operative recovery, improvement, or problems.

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