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Comparative Study between Anterior Cervical Discectomy and Fusion with Posterior Laminectomy and Lateral Mass Fixation in Management of Subaxial Cervical Cord Myelopathy

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Abstract

The most frequent reason for spinal cord dysfunction is cervical spondylotic myelopathy. To compare anterior cervical discectomy and fusion with posterior laminectomy and lateral mass fixation for managing subaxial multiple-level cervical cord myelopathy, reporting clinical, imaging, and surgical outcomes for at least one and a half years, The present research has been performed prospectively on thirty cases with multiple-level cervical canal stenosis not responding to conservative medical treatment operated in the Neurosurgery department in Al-Zahraa University Hospital started from 2021 to 2023. Clinical examination showed motor deficits in the upper limbs in 93.3% of patients, with 63.3% involving both limbs, spasticity in 60%, hyperreflexia in 66.7%, positive Babinski in 70%, Hoffman in 60%, and ankle clonus in 46.7%. Blood loss averaged 252.3±80.8 mL (Group A) and 550.15±35.4 mL (Group B). Preoperative mJOA scores were 13.03±2.92 (Group A) and 11.8±2.91 (Group B), improving to 15.4±2.63 and 14.33±2.92 postoperatively, with changes of 1.60±1.99 and 2.53±1.6. Complications included dural tears, dysphagia, hoarseness, and weakness in 3.3% each in Group A, while Group B had one C5 palsy (3.3%), two wound infections (13%), and two system failures (13%). Both anterior and posterior approaches effectively manage cervical spondylotic myelopathy, with the anterior approach offering shorter operative times and less blood loss, while the posterior approach is suitable for multilevel disease, improving clinical outcomes and quality of life.

Keywords: Fusion with Posterior Laminectomy, Anterior Cervical Discectomy, Lateral Mass Fixation, Subaxial Cervical Myelopathy

1. Introduction

The most frequent reason for spinal cord dysfunction is cervical spondylotic myelopathy (CSM). [1] Additionally, CSM is the main reason for spinal cord-correlated disability in the elderly. The spinal cord becomes compressed in a gradual, progressive manner as a consequence of the degenerative narrowing

of the spinal canal. Heterogeneous occurs in the location and spinal cord compression degree. Ventral pathologies, including disc osteophyte and herniated disc complexes, or dorsal compression from facet and ligamentum flavum hypertrophy, may lead to spinal cord compression. These alterations may be confined to a single level or could include numerous levels. Cervical spondylotic myelopathy is the most frequent reason for myelopathy in adults over the age of fifty-five, impairing quality of life and leading to progressive disability. [2]. The diagnosis necessitates the interpretation of imaging and clinical evaluation. Cervical spondylotic myelopathy may be diagnosed utilizing computed tomography (CT), MRI, and X-rays, which provide a quantitative evaluation of narrowing of the central canal [3]. While MRI is more effective in obtaining intramedullary detail of spinal cord pathology, nevertheless, computed tomography images of bone and other calcified tissues are preferable. Because it's noninvasive, magnetic resonance imaging is generally regarded as the optimal method for diagnosing cervical cord myelopathy [4]. Surgical options for cervical myelopathy remain controversial. Various kinds of operating methods are variable depending on the surgical experts of the surgeon's, surgical facilities, site, types, and extension of the pathology. They are classified as either posterior or anterior approaches. Laminectomy, laminectomy with lateral mass fusion, and laminoplasty are posterior methods. Anterior methods consist of anterior cervical discectomy with fusion with or without supplemental instrumentation, anterior cervical corpectomy and fusion with or without instrumentation, and anterior cervical discectomy without fusion. [5]. This study aimed to compare anterior cervical discectomy and fusion with posterior laminectomy and lateral mass fixation in the management of subaxial multiple-level cervical cord myelopathy and to report it with complete fairness regarding clinical, imaging, and surgical outcomes for at least one and a half years.

2. Patients and Methods

The present research has been performed prospectively on thirty cases with multiple-level cervical canal stenosis not responding to conservative medical treatment operated in the Neurosurgery department in Al-Zahraa University Hospital started from 2021 to 2023. Cases have been classified into both groups regarding the surgical approach: Group (A): Included 15 cases have been managed with anterior cervical discectomy operation and fusion by cages, bone grafts with or without plate and screws fixation. (anterior group) and Group (B): Involved fifteen cases were treated with bilateral mass fixation and wide posterior laminectomy (posterior group).

2.1 Inclusion Criteria

Cervical myelopathy caused by multi-segmental cervical canal stenosis (≥2 segments) between C3-C7, no prior cervical surgeries, symptomatic cervical myelopathy/radiculomyelopathy, and medically fit for surgery.

2.2 Exclusion Criteria

Cervical myelopathy caused by single-segmental spinal stenosis; cases undergoing combined posterior and anterior approaches; other causes of cervical cord pathologies, e.g., trauma, infection, and medically unfit for surgery.

2.3 Methods

All cases have been exposed to the following:

2.3.1 Motor System Investigation

Inspection, Tone: Muscle tone and spasticity were evaluated according to the Modified Ashworth Scale (MAS) [6]. Power: Muscle power was graded using the British Medical Research Council (MRC) (zero to five strength scale), strength [6], Reflexes: Elicited in a comparable fashion, starting with the normal side (if present).

Sensory system examination: Sensory modalities are divided into the following two groups: Superficial sensation: pain, temperature, light touch, and Deep sensation: muscle and joint position, deep pain, vibration, Myelopathy (Functional state assessment): The preoperative grade of myelopathy and functional state were determined using the modified Japanese orthopedic association (mJAO) induce score. [7].

2.3.2 Local Examination

Neck pain preoperative and postoperative was assessed by visual analogue scale.

2.3.3 Investigations

Routine laboratory investigations and radiological evaluation: All cases have been submitted to plain X-ray (AP, lateral), CT cervical, and magnetic resonance imaging.

2.3.4 Operative Technique

2.3.4.1 Group (A): Anterior cervical discectomy and fusion (ACDF Group)

The patient underwent neck surgery under general anesthesia, with the head in mild extension. The patient's shoulders have been draped down to facilitate intraoperative C-arm usage. A skin incision has been done on the neck's right, and the platysma was split in line with the incision. Retractors have been utilized to retract midline tissues, facilitating direct visibility of the prevertebral fascia, the underlying longus colli muscles, and disc spaces. The disc has been incised and removed utilizing a disc punch, Kerrison rongeur, and an angled curette. A surgical microscope has been utilized, and a high-speed drill has been utilized to perform the discectomy and reveal the posterior longitudinal ligament (PLL). The foramina have been assessed to confirm adequate decompression and the presence of any remaining loose disc fragments. The disc space has been assessed, and a suitably sized graft has been determined. An interbody PEEK fusion cage has been inserted into the evacuated disc space to prevent disc space collapse and stimulate fusion. The wound has been carefully irrigated and assessed for hemostasis, frequently utilizing a drain, although the site appears dry. The platysma muscle and subcutaneous tissue have been sutured using interrupted absorbable sutures, followed by a running subcuticular suture layer and the application of a sterile dressing.

2.3.4.2 Group (B): Posterior laminectomy with lateral mass fixation (posterior Group)

The procedure was done under general anesthesia; endotracheal intubation was done without neck hyperextension, which may harm a spinal cord already compromised by a spondylotic canal. The case is positioned in a prone position with a three-pin head holder, Mayfield, or a horseshoe headrest. Making sure that there is no undue pressure placed on the eyes if a horseshoe headrest was used. Antibiotics were given before skin incision in all cases.

2.3.5 Surgical Procedure

2.3.5.1 The Incision

A linear midline skin incision sufficient to subject the cervical vertebrae from C2 to C7 is performed.

2.3.5.2 Exposure of Bony Anatomy

The musculature has been dissected from the midline laterally to expose the total lateral mass of the vertebrae for fixation with lateral mass screws, and self-retaining retractors were applied. The exposure level (C2-C7) may typically be accurately determined intraoperatively through the bony anatomy of the spinous process and verified by a lateral radiograph.

2.3.5.3 Lateral Mass Fixation

The posterior elements were exposed, and shallow holes were made using an owl, then tapping has been utilized to drill holes one centimeter deep in the lateral masses bilaterally. Long screws were inserted, and levels were fused by 2 rods bilaterally with

screw caps. This technique was described by Magerl for preventing injury to the spinal nerve root and the vertebral artery.

2.3.5.4 Bone Removal

Decompressive laminectomy was performed using a bone nibbler, kerrison 1.2 mm, and high-speed drill to remove laminae and spinous processes, allowing the spinal cord to float backwards and removing bone spurs.

2.3.5.5 Intraoperative

All patients were assessed regarding time of operation and amount of blood loss.

2.3.6 Postoperative Management

2.3.6.1 Clinical Monitoring

Following surgery, the case has been examined as regards muscle tone, power, and functional status using (mJAO) immediately, after 2 weeks, then after one and six months. Assessment of residual neck pain for 2 groups using (VAS). Hospital stays and postoperative complications were assessed.

2.3.6.2 Radiological Monitoring:

Monitoring the cases utilizing CT scans or plain X-rays at discharge, 6 months post-operative for assessment of fixation system and cervical lordotic curvature, and by MRI cervical spine for assessment of decompression.

3. Results

As show in table 1 there were 30 cases suffering from CSM; 20 (66.7%) were males, and 10 (33.3%) were females. As show in table 2 the most frequent presenting symptom was neck pain occurring in 23 cases, followed by heaviness occurring in 22 cases, numbness in 20 patients, brachialgia in 17 patients, and sphincteric disturbance in 14 patients. As shown in table 3 regarding clinical examinations, motor deficits, including the upper limbs, have been observed in 28 patients (93.3%) of examined patients. Motor deficits, including upper and lower limbs, have been observed in 19 patients (63.3%) of cases, spasticity in 18 patients (60%), and hyperreflexia in 20 patients (66.7%). Positive Babinski sign in 21 (70%), Hoffman in 18 patients. (60%), and ankle clonus in 14 patients. (46.7%). As shown in table 4 there were 3 patients with calcified discs and 9 patients with OPLL. As shown in table 5, the average amount of blood loss in group A in our study was 252.3 ± 80.8, while in group B it was 550.15 ± 35.4. As show in table 6 and 7 for the functional outcome of the two cervical approaches among the two groups assessed by the modified Japanese orthopedic (mJAO) score. The mean of preoperative functional (mJAO) score in groups A & B was 13.03±2.92 and 11.8±2.91, correspondingly, and then postoperative scores were 15.4±2.63 and 14.33±2.92, respectively, while changes (after-before) were. 1.60±1.99 and 2.53±1.6, respectively. As show in table 8 Operative complications encountered in our study (dural tear, dysphagia, hoarseness, weakness) in group A were 1 (3.3%), 1 (3.3%), and 1 (3.3%), and 1 (3.3%), respectively, while in group B we had only one case with postoperative C5 palsy (3.3%), and 2 cases had wound infection (13%) and system failure in 2 (13%) cases

Table 1: Their age varied from 50 to 76 years, with a mean age of 59 years; the youngest age was 50 years, and the oldest one was 76 years old.

Total no. = thirty	
Sex	
• Female	10 (33.3%)
• Male	20 (66.7%)
Age	
• Mean ± SD	59.03 ± 7.34
• Range	50 – 76

Table 2: Clinical presentation

Duration in month	
• Median (IQR)	18 (8 – 24)
• Range	4 – 48
Neck pain	23 (76.7%)
Brachialgia	17 (56.7%)
Heaviness	22 (73.3%)
Numbness	20 (66.7%)
Urine priceptency (Sphincter)	14 (46.7%)

Table 3: Examinations of the studied patients.

Examination	**Total no. = 30**
Spasticity	18 (60.0%)
UL & LL weakness	19 (63.3%)
UL weakness	28 (93.3%)
Sensory disturbance	10 (33.3%)
Hyperreflexia	20 (66.7%)
Babinski	21 (70.0%)
Hoffman	18 (60.0%)
Ankle clonus	14 (46.7%)

Table 4: CT findings of the studied patients

CT	Total no. = 30
Calcified disc	3 (10.0%)
OPLL	9 (30.0%)

Table 5: Comparison among group A and group B with regard to amount of blood loss

Blood loss	Group A	Group B			
	No. = fifteen	No. = fifteen	Test value	P-value	Sig.
Mean ± SD	252.3 ± 80.8	550.15 ± 35.4	13.077•	<0.001	HS
Range	100 – 350	400 – 600			

P-value more than 0.05: non-significant; P-value less than 0.05: significant; P-value less than 0.01: highly significant. Independent T-test

Table 6: Comparison between pre-operative and follow-up MJOA among group A

MJOA	Group A		Difference			
	Pre-operative	Follow-up	Mean ± SD	Test value	P-value	Sig.
Mean ± SD	13.03 ± 2.92	15.40 ± 2.63	1.60 ± 1.99	-3.110•	0.008	HS
Range	6 – 17	8 – 18				

Table 7: Comparison between pre-operative and follow-up MJOA among group B

MJOA	Group B		Difference			
	Pre-operative	Follow-up	Mean ± SD			
Mean ± SD	11.80 ± 2.91	14.33 ± 2.92	2.53 ± 1.60	-6.141•	<0.001	HS
Range	6 – 15	8 – 17				

Table 8: Comparison among group A and group B regard as complications following surgery

Postoperative complications	Group A	Group B	Test value	P-value	Sig.
	Number = fifteen	Number = fifteen			
Hoarseness	1 (6.7%)	0 (0.0%)	1.034*	0.309	NS
Dysphagia	1 (6.7%)	0 (0.0%)	1.034*	0.309	NS
Infection	0 (0.0%)	2 (13.3%)	2.143*	0.143	NS
Vascular injury	0 (0.0%)	0 (0.0%)	–	–	–
Hematoma	0 (0.0%)	0 (0.0%)	–	–	–
Transient weaness	1 (6.7%)	0 (0.0%)	1.034*	0.309	NS
C5 Palsy	0 (0.0%)	1 (6.7%)	1.034*	0.309	NS
Dural tear	1 (6.7%)	0 (0.0%)	1.034*	0.309	NS
System failure	0 (0.0%)	2 (13.3%)	2.143*	0.143	NS

*: Chi-square test

4. Case presentation

Case 1:

53-year-old female patient, hypertensive & diabetic, presented with difficulty in walking, holding objects & urine precipitancy. On examination, she was spastic quadriparetic (G3-4 in both upper & lower limbs) with hyperreflexia +BB; Hoffman and ankle clonus were observed, and MJOAS was 12. CT cervical spine showed narrow disc space, posterior osteophytes, and calcified discs at C4,5 & 5,6. MRI showed (CDP C4,5 & 5,6), with cord signal at the same levels. Pt was operated on by (ACDF 4,5 & 5,6). On follow-up 6 months later: weakness and spasticity improved; MJOAS 15.

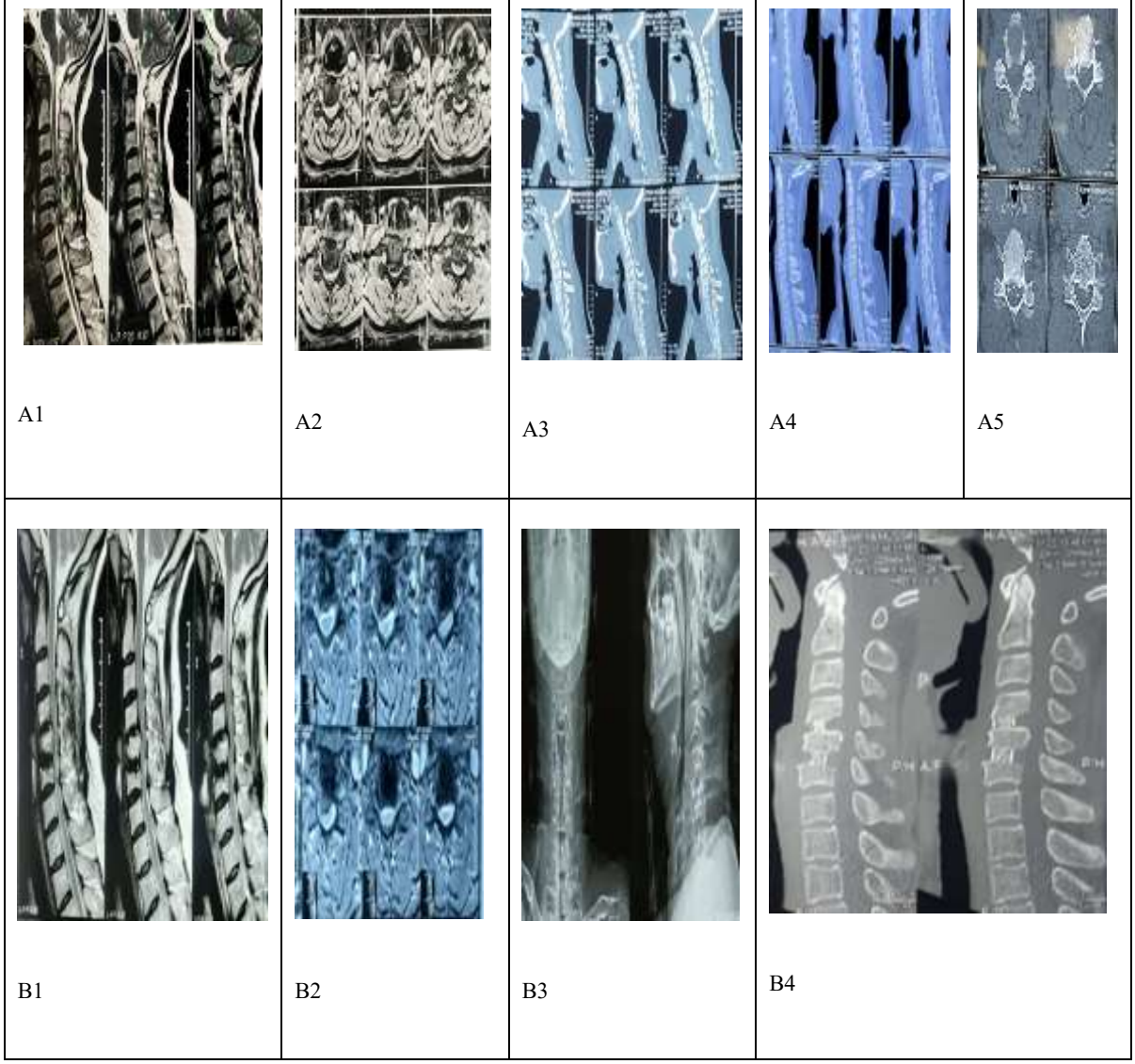

Fig. 1: Shows case 1, A) Preoperative, B) Postoperative.

Case (2):

A 65-year-old male patient presented with symptoms of neck pain, weakness of both ULs, and numbness, then started to walk with support and developed urinary precipitancy. On examination he was spastic quadriparatic G3-4, Hyperreflexia, + BB, Hoffman ankle clonus, MJOAS 13. Pt investigated by CT & x-ray that revealed narrow disc space osteophytic lipping. MRI cervical canal stenosis at multiple levels and cord malacia at C3,4. Pt operated by cervical laminectomy & lateral mass fix C3-C7. In follow-up 6 months later, there was improvement in numbness and spasticity, with motor power showing partial improvement. Post-op MJOAS 16.

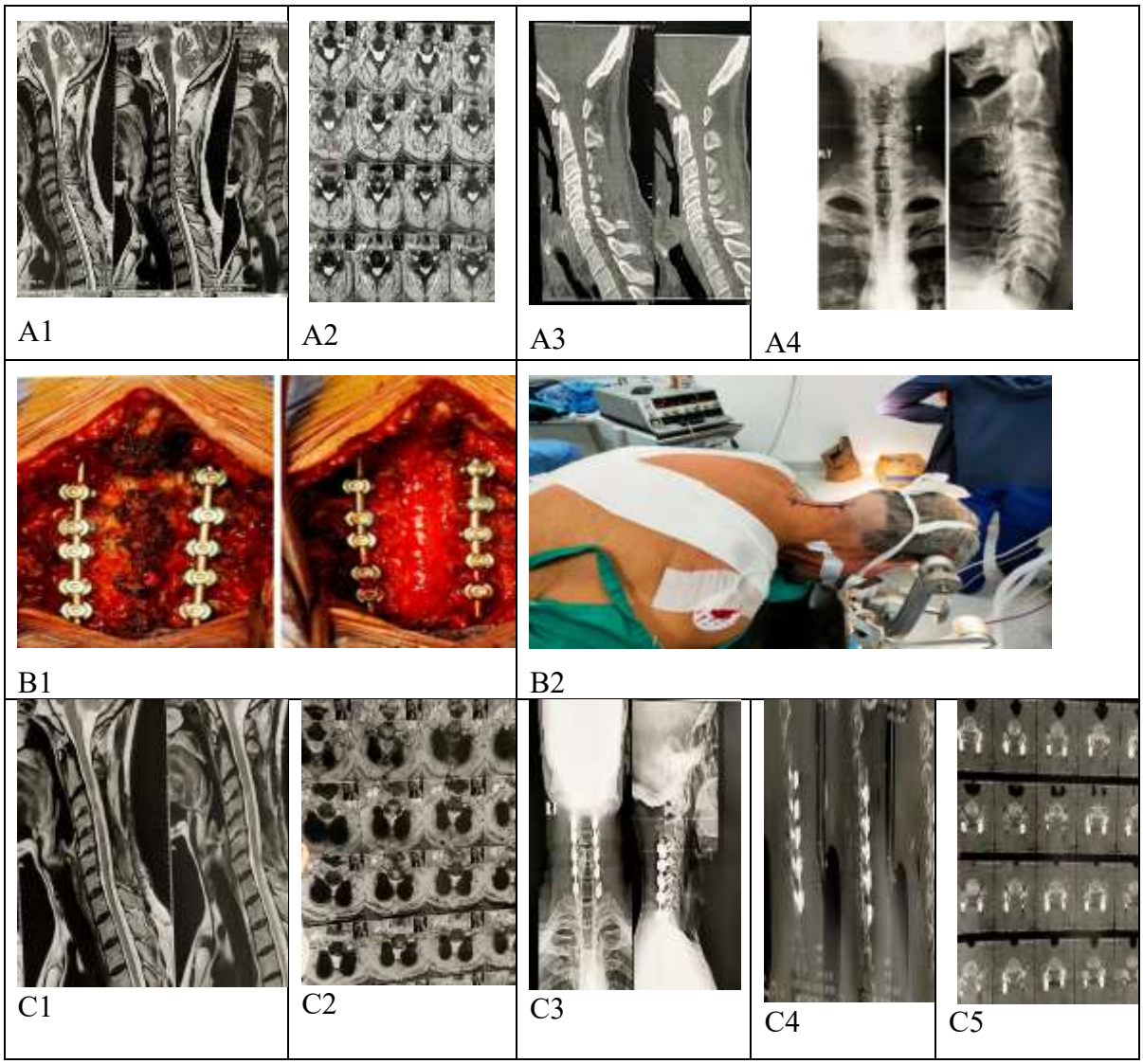

Figure 2: Shows Case Two A) preoperative, B) Intraoperative, C) Post-operative

5. Discussion

Cervical spondylotic myelopathy is the most prevalent cause of myelopathy in adults over the age of 50, resulting in a decline in quality of life and progressive disability. The optimum operative procedure for CSM is still a topic of controversy, regardless of the availability of a variety of management options.

In our study, we had 20 males (66.7%) and 10 females (33.3%) with a mean age of 59.03± 7.76, ranging from 50 to 76 years. In the investigation conducted by Sharafuddin and El-Shokhaiby [8], the mean age was fifty-one (range, twenty-five to seventy), with a male predominance of eighty percent. Group (A) consisted of seven (seventy percent) males and three (thirty percent) women, while group (B) only had one (ten percent) female and nine (ninety percent) males.

Regarding the presenting symptoms in our study (neck pain, numbness, brachialgia, heaviness, numbness, and urine priceptency), we found that the most frequent presenting symptom was neck pain symptoms occurring in 23 cases, followed by heaviness occurring in 22 patients, numbness in 20 patients, brachialgia in 17 patients, and sphincteric disturbance in 14 cases.

Our results were consistent with the investigation carried out by Sharafuddin and El-Shokhaiby [8]. They discovered that

in the anterior group, neck pain was the most prevalent presenting symptom, affecting eight cases (eighty percent), followed by paralysis in seven cases (seventy percent). The most prevalent presenting symptom in the posterior group was heaviness in both the lower and upper limbs, which was reported by eight cases (eighty percent). Neck pain has also been reported by eight cases (eighty percent).

Machino et al. [9] in Japan detected that the occurrence of sensory function impairment following surgery in the upper and lower extremities was 88.6 percent and 56.5 percent, correspondingly, while that of motor function impairment in the upper and lower extremities was 77.7 percent and 80.4 percent, correspondingly. The preoperative occurrence of urinary bladder function impairment was 41.2 percent.

Regarding clinical examinations, motor deficits, including the upper limbs, have been observed in 28 patients (93.3%) of examined patients. Motor deficits, including upper and lower limbs, have been observed in 19 patients (63.3%) of cases, spasticity in 18 patients (60%), hypereflexia in 20 patients (66.7%), a positive Babinski sign in 21 (70%), Hoffman in 18 patients (60%), and ankle clonus in 14 patients (46.7%). Our results were in agreement with the study done by Acharya and his colleagues [10], as they found that Babinski extensor response was 95% of the patients enrolled in their study, followed by Hoffman sign at 86%, while clonus was 48%.

Our results showed that 53%, 40%, and 7% of the cases had 2, 3, and 4 levels in the anterior group, correspondingly, whereas 0%, 87%, and 13% of the cases had 2, 3, and 4 levels in the posterior group, correspondingly.

For the functional outcome of the two cervical approaches among the two groups assessed by the modified Japanese orthopedic (mJAO) score, the mean of the preoperative functional (mJAO) score in groups A & B was 13.03±2.92 and 11.8±2.91, correspondingly. Then postoperative scores were 15.4±2.63 and 14.33±2.92, respectively, while changes (after-before) were 1.60±1.99 and 2.53±1.6, correspondingly.

Postoperative functional mJAO score was improved in 73% of patients, 7% of patients showed deterioration, while 20% of patients remained unchanged in group A, and 87% of patients improved, while 13% of patients remained unchanged and no patients showed deterioration in group B, respectively. So, there was a significant enhancement in (mJAO) score following surgery in both groups, 1.60±1.99 and 2.53±1.6, respectively.

Shen et al. [11] found the mean JOA score before surgery was (8.3±2.7) in the anterior approach group and (8.9±2.1) in the posterior approach group (P-value more than 0.05). Mean JOA scores following surgery were (13.6±2.5) in the anterior approach group and (14.0±1.7) in the posterior approach group at final monitoring (P-value more than 0.05). Mean enhancement rate was (55.7%±16.3%) in the anterior approach group and (58.3%±15.7%) in the posterior approach group (P-value more than 0.05).

Operative complications encountered in our study (dural tear, dysphagia, hoarseness, weakness) in group A were 1 (3.3%), 1 (3.3%), and 1 (3.3%), and 1 (3.3%), respectively, while in group B we had only one case with postoperative C5 palsy (3.3%), and 2 cases had wound infection (13%) and system failure in 2 (13%) cases.

Sharafuddin and El-Shokhaiby [8] had in group A 2 (20%) cases with dysphagia, 1 (10%) case with transient weakness, 1 (10%) case with hoarseness of voice, and 1 (10%) case with dural tear. While, in group B, they had 1 (10%) case with C5 palsy, 1 (10%) case with superficial infection, and 1 case with transient weakness.

This was in accordance with the study done by Liu et al. [12] outcomes that illustrated there were no cases developed C5 palsy in the anterior group, whereas there was 7.4%

of the posterior group that developed C5 palsy, which were not in agreement with the study done by Shibuya et al. [13] outcomes illustrated that there was 9% of the anterior group that developed C5 palsy, whereas there was 10% of the posterior group that developed C5 palsy.

6. Conclusion

Both posterior and anterior surgical approaches are effective for managing cervical spondylotic myelopathy, with no significant difference in functional outcomes. The choice of approach should be tailored to the condition of the case, considering factors like the number of levels included, cervical alignment, and surgeon expertise. The anterior approach offers shorter operative time and reduced loss of blood, while the posterior approach is better for multilevel disease. Both techniques significantly improve clinical outcomes and enhance patients' quality of life.

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