

Anterior versus posterior approach to treat cervical spondylotic myelopathy, clinical and radiological results with long period of follow-up

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Ziad A Audat¹ , Mohammad D Fawareh², Ahmad M Radydeh³, Moutasem M Obeidat³, Mohannad A Odat⁴, Khaldoon M Bashairah³, Mohammad M Barbarawi⁵, Murad T Nusairat³, Amna B Ibraheem³ and Mohammad Z Audat³

Abstract

Background: Cervical spondylotic myelopathy increases with age, but not all cases are symptomatic. It is usually diagnosed clinically and radiologically (X-ray and magnetic resonance imaging). Surgical treatment is indicated in severe symptomatic cases, while treatment controversy exists in the presence of less severe cases. Anterior and posterior approaches are generally used for decompression with no significant differences in the results of both.

Methods: A total of 287 patients of cervical spondylotic myelopathy were treated at our hospital between January 2004 and December 2015. Only 140 patients were eligible for our study. They had at least 5 years of follow-up using full clinical scores and radiological evaluation. They were divided into two groups: group I with 73 patients (aged 23–79 years) underwent posterior decompression, lateral mass instrumentation, and fusion, while group II with 67 patients (aged 33–70 years) underwent anterior decompression, instrumentation, and fusion. Neck Disability Index, local score, and X-ray were used in the evaluation of the patients.

Results: Preoperative mean \pm standard deviation of Neck Disability Index of both the groups was 32.06 ± 6.33 and 29.88 ± 5.48 , which improved in the last visit (>5 years) to 5.81 ± 7.39 and 2.94 ± 5.48 for groups I and II, respectively (p value <0.05). The local score of groups I and II was ($P=1$, $F=21$, $G=31$, $E=19$) and ($P=1$, $F=12$, $G=36$, $E=18$), which on discharge day improved to ($P=1$, $F=4$, $G=12$, $E=55$) and ($P=0$, $F=3$, $G=6$, $E=58$) at last follow-up, respectively. Fusion rate was nearly equal for both the groups during all the follow-up intervals and it was 91.1% and 91.7% in the last follow-up.

Conclusion: There were no significant differences in the clinical and radiological results between the anterior and posterior approaches used in the surgical treatment of spondylotic cervical myelopathy. However, statistically significant results of Neck Disability Index of anterior approach were not clinically important and may be due to changes in the size and shape of the neck in group II.

Keywords

Cervical spondylotic myelopathy, anterior approach, posterior approach, lateral mass fusion, anterior decompression, radiological fusion

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¹KAUH Special Surgery Department and Department of Orthopedics, Faculty of Medicine, JUST, Irbid, Jordan

²Ibn Al Haytham Hospital, Amman, Jordan

³Jordan University of Science and Technology, Irbid, Jordan

⁴King Hussein Medical Center, Amman, Jordan

⁵King Abdullah University Hospital, Ramtha, Jordan

Corresponding author:

Ziad A Audat, KAUH Special Surgery Department and Department of Orthopedics, Faculty of Medicine, JUST, Irbid 22110, Jordan.
Email: ziadaudat@hotmail.com



Introduction

Cervical spondylosis is an age-related condition that affects the anterior (intervertebral disk, uncovertebral joints, and longitudinal ligaments) and posterior structures (facet joints and ligamentum flavum) of the spinal column and leads to spinal canal stenosis.^{1,2} Most degenerative changes (about 85%) are diagnosed radiologically.¹ Some occupations and postures that increase the load of the head on the neck may increase the risk of spondylosis of the cervical spine. These degenerative changes are the most common causes of clinical manifestation of spinal cord compression, which is called spondylotic myelopathy.¹⁻⁷ These symptoms include weakness in the extremities, imbalance of gait, abnormal reflexes, and clumsiness. Normal radiographs, magnetic resonance imaging (MRI), and in some cases electrodiagnostic study are the most commonly used methods for diagnosis.^{2,8}

Treatment of cervical spondylosis is a matter for controversy. What is the best way of treatment? Many studies have shown improvement in the neurological status of severe myelopathy after surgical treatment, while others did not have the same opinion about dissimilar cases of severity of symptoms that may improve with conservative management.⁹⁻¹⁵ No agreement exists regarding the best approach for decompression. Anterior approach, whether corpectomy or discectomy, is commonly used on younger patients, whereas posterior approach, whether laminectomy and instrumentation or laminoplasty without instrumentation, is used on older patients.⁹ Except for recurrent laryngeal nerve dysfunction as a complication of the anterior approach, other complications, such as infection, neurological dysfunction, and quality of life, are relatively comparable.^{4,9}

This is a retrospective comparative study of cervical myelopathy patients who were treated at our institution by anterior and posterior approaches between January 2004 and December 2015.

Methods

Of the 287 patients treated at our hospital between January 2004 and December 2015 for myelopathy of the cervical spine using two different approaches (anterior or posterior), 140 were eligible in our criteria. These criteria include more than 5 years of follow-up, full score forms filled out by the patients during all intervals of follow-up, and symptomatic spondylotic cervical canal stenosis or multilevel cervical disk prolapsed with spinal cord compression and myelopathy. Patients with complete tetraplegia, infection (diskitis, osteomyelitis or epidural abscess, tuberculosis), tumors, artificial disk, or previously operated were excluded. Institutional Research Board agreement was taken.

All patients of both the groups had severe symptoms of spinal cord compression: neck pain, weakness in both upper limbs (shoulders and elbows), decreased sensation in upper and lower limbs, spasticity in abdominal and lower limbs muscles, spastic gait, constipation, and urinary urgency.



Figure 1. Lateral view of cervical spine showed lateral mass screws of C3-5 and pedicle screws of C7 with decompressive laminectomy.

Physical examination and radiological investigations (anteroposterior and lateral X-rays and MRI) were done before surgical intervention. Patients were operated by a single surgeon and the approach selection was done according to the surgeon's judgment; in the case of anterior cord compression anterior approach was used, while on the other hand, posterior or circumferential compression of the cord was treated posteriorly.

Group I: 73 patients, aged between 33 and 79 years (mean=56.52 years), underwent posterior approach, laminectomies, and lateral mass instrumentation and fusion, as in Figure 1.

Group II: 67 patients, aged between 23 and 70 years (mean=47.43 years), underwent anterior decompression (discectomy or corpectomy), instrumentation (with disk spacer or body cage), and fusion using autograft, as in Figure 2.

All patients were followed up at the outpatient department clinically and radiologically. The Neck Disability Index (NDI) was used before surgery and after surgery at regular intervals of follow-up. We also used our protocol of clinical outcome, which is prescribed as (local score):^{16,17}

Poor (P): patients experience the same preoperative symptoms or the symptoms had worsened after surgery and there was a significant restriction of their daily life activities.

Fair (F): pain had improved by up to 50% compared with the preoperative status, but still required strong analgesics; mild improvement in sensory and motor symptoms was evident but the patients still had some difficulty with



Figure 2. Lateral view of cervical spine showed C4 corpectomy with vertebral body (mesh), C5/6 discectomy with interbody cage, and anterior plates with screws from C3 to C6.

their daily life activities. Patient satisfaction was around 50%–60%.

Good (G): when the patients had a significant improvement in their neck and upper limb radiating pain and sciatica, occasional analgesics were required and they experienced less numbness and paresthesia with a noticeable improvement in muscle force. No constraint in daily activities anymore. Patient satisfaction was 60%–80%.

Excellent (E): this group included cases with no more pain or neurological deficits. Normal daily life activities and patient satisfaction was more than 80%.

Radiological solid fusion was considered when a continuous bone bridge is seen between the vertebral bodies in the anterior approach or along the posterior aspect of the lateral masses in the posterior approach on normal X-rays and sometimes computed tomography (CT) scans. All clinical information, scores, and radiological investigations were extracted from the patients' files during all follow-up intervals, except the last results which were taken from the patients directly.

The sample size was calculated at a power of 80% and alpha level of 0.05 to detect a difference of three points in the postoperative NDI between the two groups, assuming a common standard deviation (SD) of 6.0. The common SD was calculated from a sample of 10 patients in group 1 and 10 patients in group 2. The calculated needed sample was 62 subjects per group. Sample size was calculated using EpiCalc 2000, Version 1.2.

Statistical analysis was done utilizing SPSS Version 21 to evaluate the results. Levine's test for equality of variances

was used to evaluate the patients at each follow-up interval. The results were considered to be significant if p value <0.05 .

Results

Group 1

In total, 72 out of 73 patients (1 patient died 2 days after surgery due to pulmonary embolism) were followed up. Age ranged between 33 and 79 years (mean \pm SD = 56.52 ± 10.435 , 95% confidence interval (CI) = 53.98 – 58.91) and male:female = 57:16. All patients (95.9%) except 3 had neck pain, 68 (93.2%) patients had radiating pain (49 bilateral and 19 unilateral), 55 (75.3%) patients had motor weakness of the upper limbs, and 65 (89%) patients had sensory disturbance. Spastic bladder and constipation were seen in 13 (17.8%) patients, dizziness was seen in 44 (60.3%) patients, and gait abnormalities in 42 (57.5%) patients (2 bed ridden, 1 wheelchair dependent, and 39 with spastic gait). In all, 25 (34%) patients had a history of medical illnesses (mostly diabetes mellitus and hypertension) and 20 (27.4%) patients were long-term smokers. Duration of symptoms ranged between 0.02 and 20 years (mean \pm SD = 2.899 ± 4.46 , 95% CI = 1.88 – 3.99).

All patients underwent lateral mass (C3–6) or pedicle (C7–D2) screwing and laminectomy decompression, in whom laminae were used as autograft for bony fusion. The number of fused levels was 1–7 (mean \pm SD = 3.4 ± 1.213 , 95% CI = 3.11 – 3.69), the number of inserted screws was 4–12 (mean \pm SD = 7.89 ± 1.72 , 95% CI = 7.48 – 8.3), blood loss volume was 100–1000 (mean \pm SD = 364 ± 176.46 , 95% CI = 321.5 – 405) mL, and operative time was 120–300 (mean \pm SD = 200.68 ± 37.42 , 95% CI = 191.95 – 209.42) min. Intraoperative complications were small dural tears and excessive bleeding (about 1 L) from epidural vessels in one patient.

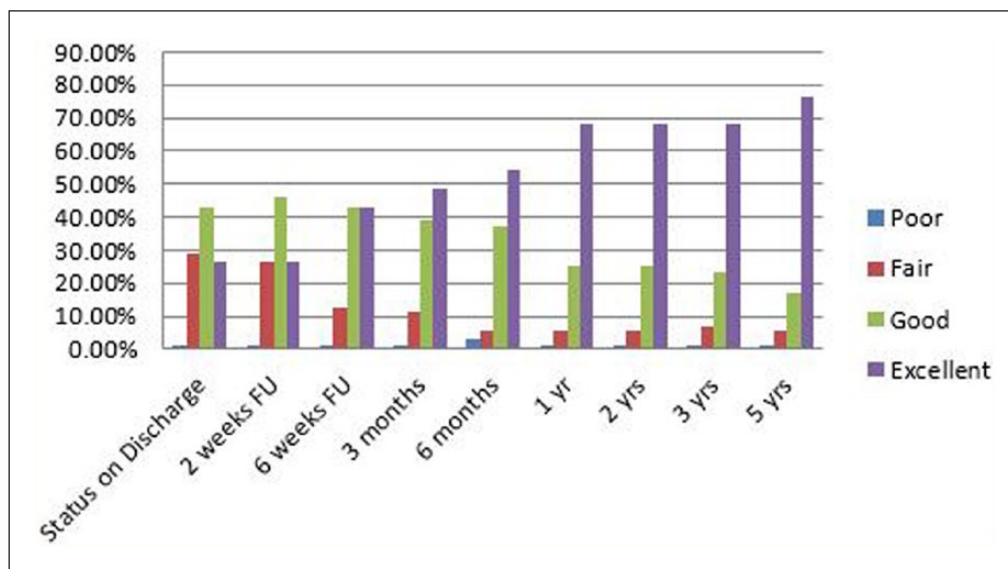
Postoperative complications were seen in eight (11%) patients. Cerebrospinal fluid (CSF) leakage was seen in two patients postoperatively, which stopped following lumbar aspiration to decrease CSF pressure. Wound infection was seen in two patients (wound healing achieved following debridement and intravenous antibiotics). Nerve root compression due to long screw was seen in two patients, which improved after revision. Another patient developed adjacent segment disease: huge disk prolapse that required corpectomy and insertion of the vertebral body cage with residual chronic neck pain and loss of lordosis. A few patients complained of fifth cervical nerve root pain. Fatal pulmonary embolism was seen in one patient (mortality rate was 1.37%).

NDI presurgery mean \pm SD was 32.06 ± 6.33 (95% CI = 30.59 – 33.52) improved at all intervals of follow-up and reach at last visit (fifth-year post-operation) to 5.81 ± 7.39 (95% CI = 4.01 – 7.44), as seen in Table 1. The local score was (P=1 (1.39%), F=21 (29.2%), G=31 (43.06%), and E=19 (26.4%)), which on discharge day improved to (P=1 (1.39%), F=4 (5.6%), G=12 (16.7%), and E=55 (76.4%)) at last

Table 1. Neck Disability Index values and p value of two groups at all intervals of follow-up.

NDI	Group I (LMF) Mean \pm SD	Group II (ACF) Mean \pm SD	Sig. (two-tailed; p value)
Pre-op	32.06 \pm 6.33 (95% CI = 30.57–33.54)	29.88 \pm 5.48 (95% CI = 28.54–31.22)	0.033
3-month post-op	19.81 \pm 6.76 (95% CI = 18.22–21.39)	15.48 \pm 7.43 (95% CI = 13.67–17.29)	<0.0001
1-year post-op	13.43 \pm 8.24 (95% CI = 11.49–15.37)	8.60 \pm 7.07 (95% CI = 6.87–10.32)	<0.0001
2-year post-op	9.54 \pm 8.44 (95% CI = 7.56–11.53)	4.55 \pm 6.27 (95% CI = 3.02–6.08)	<0.0001
3-year post-op	6.93 \pm 8.16 (95% CI = 5.01–8.85)	3.31 \pm 5.24 (95% CI = 2.03–4.59)	0.002
5-year post-op	5.81 \pm 7.39 (95% CI = 4.07–7.54)	2.94 \pm 5.48 (95% CI = 1.72–4.16)	0.009

NDI: Neck Disability Index; LMF: lateral mass fixation; ACF: anterior cervical fusion; SD: standard deviation; CI: confidence interval.

**Figure 3.** Local score follow-up of group I (LMF).

follow-up (fifth-year post-operation), as seen in Figure 3. Bony fusion began to be seen at the 1-year follow-up interval in 42 (58.3%) patients and increased gradually to be seen in 66 (91.7%) patients after 5 years of surgery, as seen in Figure 4.

Group II

In total, 67 patients were followed up; age ranged between 23 and 76 years (mean \pm SD = 49.16 \pm 12.06, 95% CI = 46.22–52.11), male:female = 37:30, all patients had neck pain, all patients (97%) except 2 had radiating pain, 31 (46.3%) patients complained of dizziness, 58 (86.6%) patients had sensory disturbance, 48 (71.6%) patients had different degrees of motor weakness, 10 (14.9%) patients had spastic bladder and constipation, 13 (19.4%) patients had spastic gait, 26 (38.8%) patients had a history of medical illnesses (mostly diabetes mellitus and hypertension), 11 (15.9%) patients were long-term smokers and only 1 was an alcohol drinker. Duration of symptoms ranged between 0.17 and 15 years (mean \pm SD = 2.98 \pm 3.14, 95% CI = 2.21–3.74).

All patients underwent anterior approach; corpectomy = 22 patients (32.8%; 1 vertebra = 12 + 2 vertebrae = 10), discectomy and osteophyte excision = 45 patients (67.2%; 1 level = 31, 2 levels = 10, >3 levels = 4), in whom autografts were used for bony fusion. The number of fused levels was 1–5 (mean \pm SD = 2.04 \pm 1.152, 95% CI = 1.76–2.33), blood loss volume was 50–500 (mean \pm SD = 279.85 \pm 132.30, 95% CI = 247.6–312)mL, and operative time was 120–300 (mean \pm SD = 175.52 \pm 63.26, 95% CI = 160–191) min. No intraoperative complications were seen. Postoperative complications were temporary voice hoarseness in one patient (which improved 3 months post-surgery), one plate malpositioning that needed revision, and one epidural hematoma with tetraparesis, which improved after revision and evacuation.

Preoperative NDI mean \pm SD was 29.88 \pm 5.48 (95% CI = 28.54–31.22), which improved at all intervals of follow-up and reached at last visit (fifth-year post-operation) to 2.94 \pm 5.48 (95% CI = 1.72–4.16), as seen in Table 1. The local score, as seen in Figure 5, was (P = 1 (1.49%), F = 12 (17.91%), G = 36 (53.73%), and E = 18 (26.87%)) on the day of discharge and improved to (P = 0 (0.0%), F = 3 (4.48%),

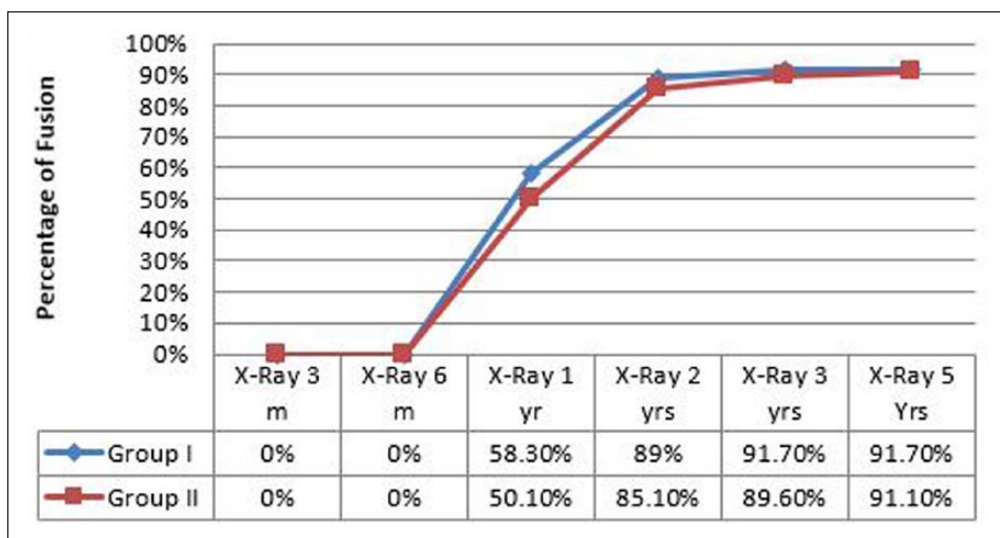


Figure 4. Fusion rate of posterior (LMF) and anterior cervical fusion (ACF) approaches.

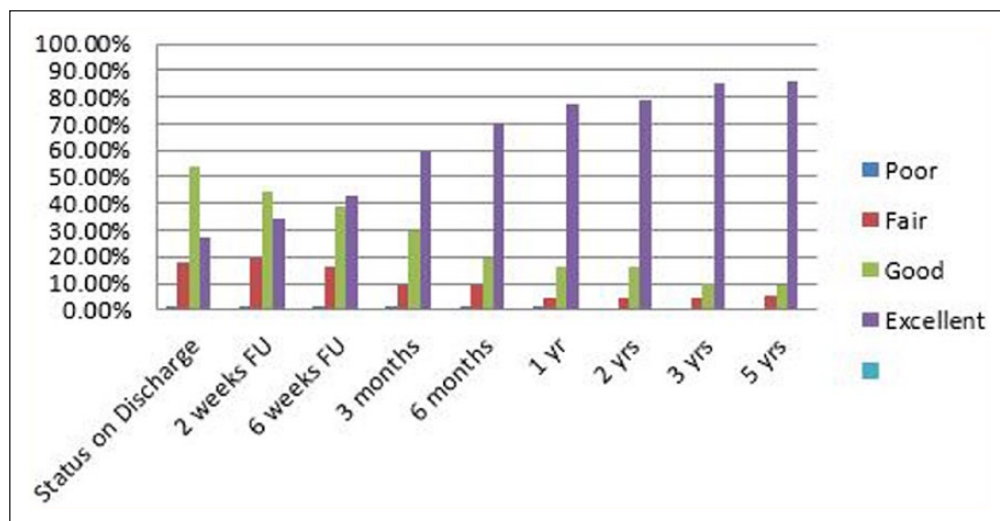


Figure 5. Local score follow-up of group II (ACF).

G=6 (8.96%), and E=58 (86.57%) at the last follow-up (fifth-year post-operation). Bony fusion started to be seen at 1-year follow-up interval (34 patients (50.7%)) and increased to be seen in 61 patients (91.1%) after 5 years of surgery. Figure 4 shows the fusion rate at all intervals of follow-up.

Discussion

Anterior approach includes discectomy (>1 disk) or corpectomy with instrumentation and bony fusion. Posterior approach can be used in all types of cervical spinal canal stenosis and includes laminectomy or laminoplasty with instrumentation and fusion or laminoplasty without fusion.^{9,18} Fehlings et al.⁹ reported in a multicenter prospective study that there were no differences between anterior and posterior approaches in clinical results, complications, and international

scores. Luo et al.¹⁹ in their meta-analysis found that there is no definite indication for each approach and no difference in late clinical results instead of postoperative better neurological results with anterior approach. Many studies found no difference in recovery between anterior and posterior surgery.^{19,20} Lawrence et al. found no superiority of the anterior or posterior approach, while others recommended the anterior approach when <3 segments were involved.

In our retrospective study, we based our approach selection on the compression site of the spinal cord (anterior or posterior), sometimes on the number of involved segments or if there was a contraindication to do the requested approach. We considered the site of compression to be more than the number of involved segments. The NDI of each group showed significant improvement at all intervals of follow-up with small difference between the values of the

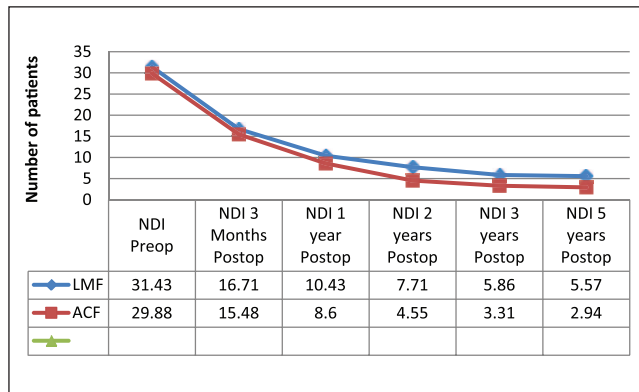


Figure 6. Neck Disability Index of both groups (group I: LMF and group II: ACF).

two groups, as seen in Figure 6. However, Table 1 shows the mean \pm SD of the NDI values of both the groups with better statistical results in group II and p value <0.05 at all follow-up periods. Local clinical score improved at all stages of follow-up. We can observe the gradual transfer of patients from fair to good and from good to excellent, noticing that the excellent results are seen more in group II (group I = 76.4% and group II = 86.6%). The sum of good and excellent results was 93.1% in group I and 95.5% in group II after 5 years of follow-up without significant difference.

Compared with previous studies, our study showed better results in the anterior group than in the posterior one, which is comparable to some studies.²¹ Mortality and morbidity were seen more in group I than in group II. Except for the case of tetraparesis, which was caused by epidural hematoma in group II, all complications were not life-threatening or clinically significant. No cases of wound infection or dural tear were seen in patients with the anterior approach. In addition, there were a few cases of C5 nerve root pain in group I. Fifth cervical nerve root pain was seen in the posterior group, which may be due to wide foramen decompression or traction by posterior drift of the spinal cord.^{22,23} Fifth cervical nerve root and other complications may influence the values of scores (local and NDI).

Radiological bony fusion was evaluated using X-ray at all intervals of follow-up. CT-scan was used in the last two follow-up periods. The fusion rate of posterior surgery was 87%–100% in most of the previous studies.^{18,24–26} The fusion rate of anterior surgery ranged from 86.4% to 97.6% for anterior cervical discectomy and fusion (ACDF) and 87.5% to 92.1% for anterior cervical corpectomy and fusion (ACCF).^{27,28} Chibbaro et al.²⁹ reported a fusion rate of 100% on X-ray with solid fusion in most patients after 12 weeks. In our study, we could not see fusion before 6 months of surgery in both the groups. The fusion rate increased gradually after that in nearly equal rhythm in both the groups and reached the maximum rate at the third-year post-surgery. At final follow-up (5 years post-surgery), the fusion rate was 91.7% and 91.1% for groups I and II, respectively.

The limitations of this study are as follows: (1) the number of patients was not large; (2) heterogeneity of the levels, number of levels, surgical procedures, and instrumentations (discectomy and spacer, corpectomy and vertebral body cage, or both) of anterior group, which would bring bias to the results; (3) not all patients had CT-scan at follow-up intervals; (4) only one international score system was used; (5) the local system is not well known internationally; and (6) it was a retrospective study. We need more prospective comparative studies that observe a larger number of patients while using different methods of clinical and radiological evaluation.

Conclusion

Cervical spondylotic myelopathy is a common problem in old aged people and is rare in the youth. X-ray and MRI are widely used modalities of diagnosis. Surgical treatment is the ideal choice and whether to use the anterior or posterior surgical approach is still a matter of controversy. Most of the previous studies showed no significant difference between the two approaches clinically and radiologically. Our study showed statistically significant better results in NDI with the anterior approach, while the local score showed no significant differences. However, the statistically significant results of NDI, which were found with the anterior approach, were not clinically important and may be due to the changing size and shape of the neck in group II. The radiological fusion rate was nearly equal in both the groups.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval for this study was obtained from University Research Committee of Jordan University of Science & Technology (Number of approval: 634-2016).

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Informed consent

Obtaining written informed consent was waived by the Institutional Review Board, as the study is retrospective on already operated patients.

ORCID iD

Ziad A Audat  <https://orcid.org/0000-0003-0133-7716>

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