CERVICAL CORPECTOMY VERSUS TWO-LEVEL ANTERIOR DISCECTOMY FOR DOUBLE-LEVEL CERVICAL SPONDYLOTIC MYELOPATHY

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ABSTRACT:

Background*: The recognized surgical procedures for cervical spondylotic myelopathy (CSM) include anterior cervical discectomy and fusion (ACDF) and anterior cervical corpectomy and fusion (ACCF). The best surgical technique for double-level CSM is still up for debate, though.*

Aim of the study: *This study aimed to evaluate the postoperative clinical and radiological outcomes of the CSM patients who underwent two adjacent cervical discectomies versus a single-level corpectomy.*

Patients and Methods: *In this retrospective cohort study, we reviewed the medical records of patients with double-level CSM at our university hospital. We included the data of the patients who underwent two adjacent ACDFs (group A) and the patients who underwent a single-level ACCF (group B) from January 2015 to December 2020. Thirty-five patients met our selection criteria. The functional impairment was assessed using the Nurick grades.*

Results: *The study groups were similar in age, gender, and comorbidities. The mean operative time and the intraoperative blood loss were significantly lower in the ACDF group. There were no statistically significant differences in the clinical outcome of both groups. Also, there were no statistically significant differences between the two groups regarding the one-year incidence of bony fusion, the improvement in the degree of canal stenosis, or Cobb's angle. In addition, the postoperative complications were similar between groups.*

Conclusions: *From our results, we cannot recommend one procedure over the other for treating double-level CSM. However, ACDF carries a significantly shorter operative time with less blood loss than the ACCF procedure.*

Key words: *Cervical spondylotic myelopathy; corpectomy; cervical cage; discectomy*

INTRODUCTION:

Cervical spondylotic myelopathy (CSM) is a degenerative disorder of the cervical vertebrae and the intervertebral discs. It results in spinal cord dysfunction and neurological deficits[1].

Surgically-treated CSM patients improved better than conservatively-treated patients regarding their functional ability[2].

The surgical procedure for CSM depends on several factors, like the extent and location of the disease, the presence of preoperative neck pain, and previous operations[3].

Anterior cervical corpectomy and fusion (ACCF) and ACDF are optional procedures for spinal cord decompression and alignment reconstruction [4].

Cervical corpectomy is preferred when the compression is mainly behind the vertebral bodies[4]. The most effective surgical procedure for double-level CSM is still debatable.

AIM OF THE WORK

To evaluate the postoperative clinical and radiological outcomes of the CSM patients who underwent two adjacent cervical discectomies versus a single-level corpectomy.

MATERIALS AND METHODS

We performed this retrospective cohort study respecting the Code of Ethics of the World Medical Association (Declaration of Helsinki) for human studies. We anonymized the collected data.

We reported our study following the guidelines of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).

Ethical consideration:

The study protocol was reviewed and approved by the Research Ethics Committee of the Faculty of Medicine at Ain Shams University **(**FWA 000017585-FMASU R59/2023).

We reviewed the medical records of the patients who underwent surgery for double-level CSM from January 2015 to December 2020 at our university hospital.

We classified the included patients into two groups: group A (patients who underwent two adjacent ACDFs) and group B (patients who underwent a single-level ACCF). Patients with an associated ossified cervical posterior longitudinal ligament were excluded.

Thirty-five patients met our selection criteria. Twenty-one patients underwent double-level ACDF, and 14 cases underwent single-level ACCF. The surgical procedure was chosen according to the preference of the treating surgeon.

We collected the following data for each patient: age, gender, comorbidities, preoperative clinical and radiological findings, operative details, postoperative complications, and outcomes.

The postoperative complications included wound infections, graft-related complications, and the need to redo surgery in the operated cervical segments within one year of the index operation.

Neck pain was assessed using the visual analogue scale (VAS), and functional ability was evaluated using the Nurick grades[5].

Preoperatively, all patients underwent plain X-rays, computed tomography (CT), and magnetic resonance imaging (MRI) on the cervical spine.

The sagittal cervical Cobb angles were measured by drawing two lines: one parallel to the inferior endplate of the C2 body and the other parallel to the superior endplate of the C7 body. After that, we draw two lines perpendicular to the first two lines, and the angle formed by the intersecting perpendicular lines is the angle of cervical curvature. A positive value indicated lordosis.

We classified cervical canal stenosis according to the T2-weighted sagittal images into three grades: grade 1, subarachnoid space obliteration exceeding 50%; grade 2, subarachnoid space obliteration exceeding 50% and spinal cord deformity; and grade 3, subarachnoid space obliteration exceeding 50%, spinal cord deformity, and spinal cord signal change [6].

We considered a bony fusion based on the trabecular bridging on CT scans and the absence of motion on dynamic X-rays.

The conventional anterior cervical approach was used for ACDF and ACCF under C-arm fluoroscopy guidance and using the operating microscope.

In Group A (ACDF), each patient underwent two-level cervical discectomies followed by the insertion of

polyetheretherketone (PEEK) cages filled with cancellous allograft.

In Group B (ACCF), each patient underwent a single-level cervical corpectomy with the implant of a pyramesh filled with autograft bone and an anterior cervical plate.

The endplates of the operative segments were both preserved to guard against implant subsidence.

The patients underwent a plain X-ray of the cervical spine on the second postoperative day, then a CT scan on the cervical spine at 6-month intervals for one year. Patients were followed-up for at least one year in the outpatient clinic.

A follow-up MRI and flexion-extension radiographs of the cervical spine were performed one year after the index operation.

Statistical Analysis

We described the quantitative data by the mean and range and the qualitative data by frequencies. The comparison between groups with qualitative data was assessed using the chi-square test. We compared the quantitative data using the t-test. We used the Statistical Package for the Social Sciences (SPSS) software version 24 (IBM Corp., Armonk, New York, USA) for the statistical analyses. We called the results statistically significant if the p-values were less than 0.05.

RESULTS

Thirty-five patients met our selection criteria. We divided the patients into two groups.

Group A (*double-level ACDF*): 21 cases.

Group B (*single-level ACCF*): 14 cases.

The demographics and comorbidities of the patients are shown in Table 1.

We found no significant differences between both groups regarding age, gender, and comorbidities.

The preoperative clinical and radiological findings are illustrated in Table 2.

There were no statistically significant differences between both groups regarding preoperative neck pain, functional disability, levels of cord compression, degree of cervical canal stenosis, cord signal, Cobb's angle, or cervical kyphosis.

We demonstrated an illustrative case from each group in Figures 1 and 2.

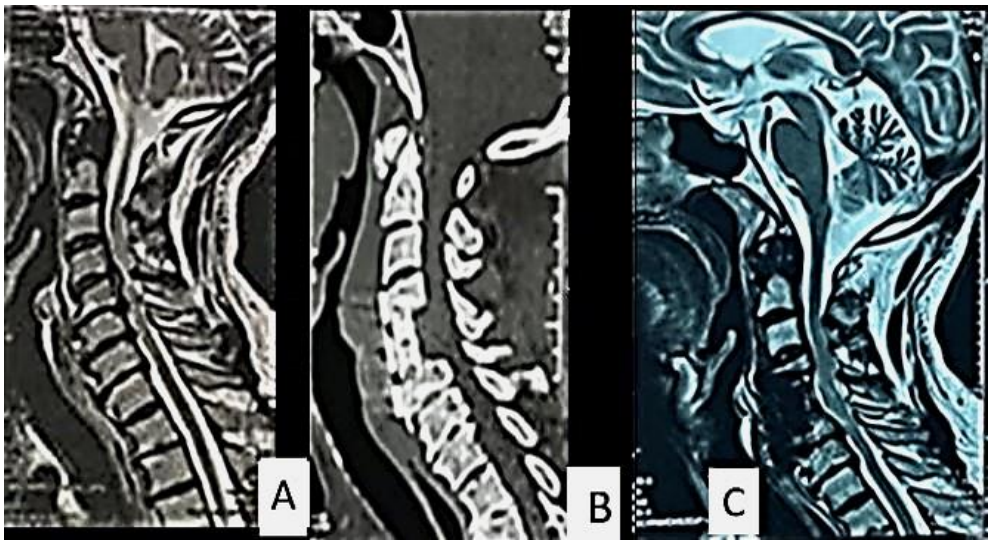

Figure 1: A case of C5 corpectomy. A; preoperative MRI T2WI sagittal views on the cervical spine show disc prolapse at C4-5 and C5-6 with canal stenosis and cord compression. B; postoperative CT scan sagittal views on the cervical spine showing a good alignment of the pyramesh cage. C; postoperative MRI T2WI sagittal views on the cervical spine showing adequate cord decompression.

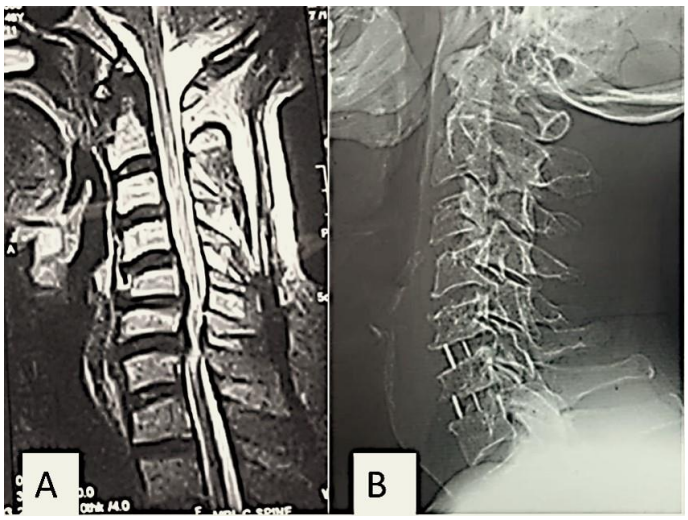

Figure 2: A case of double-level anterior cervical discectomy and fusion. A; preoperative MRI T2WI sagittal views on the cervical spine show disc prolapse at C5-6 and C6-7, with canal stenosis and cord compression. B; postoperative lateral cervical spine X-ray demonstrating proper positioning of the two cervical cages.

The mean operative time and the intraoperative blood loss were significantly lower in the ACDF group than in the ACCF group (p-values = 0.004 and 0.003, respectively).

The operative findings and the clinical and radiological outcomes are illustrated in Table 3.

Table 1: Demographics and comorbidities of the patients

	Cage group (n = 21)	Corpectomy group (n = 14)	P-value
Average age ± SD range	51.86 ± 9.92 32 to 65	56.36 ± 7.92 43 to 68	0.40
Gender male female	 9 (42.8%) 12 (57.2%)	 10 (71.42%) 4 (28.58%)	 0.09
Co-morbidities Hypertension Diabetes Myocardial ischemia	 4 2 1	 2 1 1	 0.71 0.8 0.76

SD: standard deviation

Table 2: The preoperative clinical and radiological findings

Preoperative clinical and radiological findings		Group A (n = 21)	Group B (n = 14)	P-value
Neck pain (VAS) mean ± SD (range)		6.19 ± 0.67 (5-7)	5.28 ± 0.78 (4-7)	0.23*
Functional disability n (%) ‡ 0 1 2 3 4 5		 0 (0%) 10 (47.6%) 7 (33.3%) 4 (19%) 0 (0%) 0 (0%)	 0 (0%) 5 (35.7%) 4 (28.5%) 3 (21.4%) 2 (14.2%) 0 (0%)	 0.33**
Levels of cord compression	C3-4, C4-5 C4-5, C5-6	9 (42.8%) 6 (28.5%)	4 (28.57%) 6 (42.8%)	 0.61**

mean ± SD (range)	C5-6, C6-7	6 (28.5%)	4 (28.57%)	
Degree of canal stenosis mean ± SD (range)		2.4 ± 0.7 (2-4)	2.8 ± 0.63 (2-4)	0.23*
Cobb's angle mean ± SD (range)		3.9° ± 6.78° (-8° to 20°)	3.1° ± 6.9° (-7° to 18°)	0.4*
Cord signal n (%)		5 (23.8%)	4 (28.6%)	0.75**
Cervical kyphosis n (%)		7 (33.3%)	6 (42.85%)	0.56**

* Paired sample T-test **Chi-Square Test of independence VAS: visual analogue scale ‡ Nurick grades

Table 3: Operative findings and one-year clinical and radiological outcomes

Findings	Group A (n = 21)	Group B (n = 14)	P-value
Mean operative time (min) ± SD (range)	122.38 ± 18.6 (90-180)	137.85 ± 11.47 (120-160)	0.004*
Average blood loss (ml) ± SD (range)	150.6 ± 40.5 (100-250)	223.5 ± 40.5 (150-350)	0.003*
Neck pain (VAS) mean ± SD (range)	2.42 ± 0.54 (2-4)	2.35 ± 0.6 (1-4)	0.46*
Functional disability n (%)‡			
0	15 (71.4%)	8 (57.1%)	
1	2 (9.5%)	4 (28.6%)	
2	0 (0%)	1 (7.1%)	0.22 **
3	4 (19%)	1 (7.1%)	
4	0 (0%)	0 (0%)	
5	0 (0%)	0 (0%)	
Bony Fusion n (%)	20 (95.23%)	13 (92.85%)	0.76**
Degree of canal stenosis mean ± SD (range)	0.6 ± 0.27 (0-1)	0.4 ± 0.32 (0-1)	0.7*
Kyphosis n (%)	1 (4.76%)	0 (0%)	
Cobb's angle mean ± SD (range)	18.31° ± 4.41° (-2° to 26°)	19.2° ± 6.9° (3° to 22°)	0.41*
Postoperative complications n (%)			
Superficial wound infection	2 (9.5%)	1 (7.14%)	0.8**
Graft complications	0	0	
Redo surgery	1 (4.7%)	0	0.40**

* Paired sample T-test **Chi-Square Test of independence VAS: visual analogue scale ‡ Nurick grades

There were no statistically significant differences in the clinical outcome of both groups regarding neck pain and functional disability.

Also, there were no statistically significant differences between both groups regarding the one-year incidence of bony fusion, the improvement in the degree of canal stenosis, the kyphosis, or Cobb's angle.

In addition, the postoperative complications were similar between both groups, with no significant difference.

Highlights

- Anterior cervical corpectomy and fusion (ACCF) and anterior cervical discectomy and fusion (ACDF) are effective procedures for cervical spondylotic myelopathy (CSM).
- From our results, we cannot recommend one procedure over the other for treating double-level CSM.
- ACDF carries a significantly shorter operative time with less blood loss than the ACCF procedure.

DISCUSSION:

Both ACDF and ACCF are acceptable procedures for treating CSM [4]. ACCF has the advantage of decompressing a larger area of stenosis and providing a source of autologous bone graft, which increases the likelihood of bony fusion [7 8].

In our study, although ACDF offered better improvement in Cobb's angle and better restoration of cervical lordosis than ACCF, these differences were not statistically significant.

Compared with the ACDF group, the ACCF group experienced much more blood loss. These results are comparable with the **Guan** et al. study (2015), where the ACDF group showed significantly less blood loss than those in the ACCF group [9].

The average operative time was significantly shorter in the ACDF group (122.38 ± 18.6 min) than in the ACCF group (137.85 ± 11.47 min). These results are slightly better than the **Hwee** et al. study (2015), where the mean operative times in the ACDF and ACCF groups were 148.5 ± 35.97 and 165 ± 30.49, respectively [10].

We did not find a significant difference in the bony fusion between both groups. We noticed bony fusion in 95.23% and 92.85% of the ACDF and ACCF groups, respectively. This bony fusion was comparable with the Lin et al. (2012) study, which demonstrated 95% bony fusion at 12 months [11].

In addition, we found no significant difference between both groups concerning postoperative complications.

Two-level discectomy and fusion offer more fixation points to hold the construct rigidly in place, but corpectomy and pyramesh fusion provide only two points of fixation. So, graft-related complications are relatively higher in the ACCF group [12].

Guan et al. recommended ACDF as the procedure of choice for anterior decompression of double-level CSM because of a better fusion rate, restoration of lordosis, and fewer graft-related complications [9].

In our study, there were no statistically significant differences between both groups regarding the clinical and radiological outcomes one year after surgery. As a result, there is no advantage to two-level ACDF over one-level ACCF for decompression and fusion of double-level CSM.

A randomized controlled trial is necessary to determine which is better for the surgical treatment of multilevel CSM.

The single-center experience, the limited number of patients, and the short follow-up period are among the limitations of this retrospective study.

Conclusions:

We found no statistically significant differences between the ACDF and ACCF groups regarding the clinical and radiological outcomes one year after surgery. As a result, we cannot recommend one procedure over the other for treating double-level CSM. However, ACDF carries a significantly shorter operative time with less blood loss than the ACCF procedure. We suggest a randomized controlled trial to compare the two surgical procedures for treating double-level CSM.

Conflict of Interest:

The authors report no conflicts of interest.

Financial Disclosures:

No funding was received for this research.

Authors' contributions:

The conception and the design of the study were made by SH and AG. SH, AG and AI collected the date of the patients. MA, and SH analyzed and interpreted the patients' data. MA and SH wrote the manuscript. All

authors read and approved the final manuscript.

This paper has not been published in its current form or substantially similar form elsewhere including on a web site and also, it has not been accepted for publication elsewhere.

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Not applicable.

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استئصال جسم الفقرة مقابل استئصال الغضروف العنقى من الامام بمستويين من أجل رفع الضغط على الحبل الشوكى مزدوج المستوى

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البيانات الخلفية: يعتبر العلاج الجراحى لرفع الضغط على الحبل الشوكى افضل من العلاج التحفظى فى تحسين الحالة الوظيفية للمرضى. يعتبر استئصال جسم الفقرة العنقية واستئصال الغضروف العنقي من الامام من العمليات الفعالة فى علاج الضغط على الحبل الشوكى, و لكن لا يزال الإجراء الجراحي الأكثر فعالية فى علاج الضغط على الحبل الشوكى مزدوج المستوى محل نقاش.

الغرض: تهدف هذه الدراسة إلى تقييم ومقارنة النتائج السريرية ونتائج الاشعة بعد الجراحة للمرضى الذين خضعوا لاستئصال جسم الفقرة العنقية مقابل استئصال الغضروف من الامام بمستويين لرفع الضغط على الحبل الشوكى مزدوج المستوى.

المرضى والطرق: شملت هذه الدراسة بيانات ٣٥ مريضًا بأثر رجعي. قمنا بمراجعة السجلات الطبية في مستشفانا الجامعي من يناير ٢٠١٥ إلى ديسمبر ٢٠٢٠. قمنا بتضمين بيانات المرضى الذين خضعوا لاستئصال جسم الفقرة العنقية مقابل استئصال الغضروف من الامام بمستويين. تم استبعاد المرضى الذين يعانون من كسور بالفقرات العنقية وأولئك الذين يعانون من الرباط الطولي الخلفي المتحجر. تم تقسيم المرضى الى مجوعتين, مجموعة (أ) و هم المرضى الذين أجرى لهم استئصال الغضروف من الامام بمستويين و مجموعة (ب) و تشمل المرضى الذين خضعوا لاستئصال جسم الفقرة العنقية. تم استخدام المقياس التناظري البصري لتقييم الام الرقبة. تم استخدام درجات نوريك لتقييم مدى الإعاقة الوظيفية. تمت متابعة المرضى لمدة عام على الأقل بعد العملية.

النتائج: كانت مجموعات الدراسة متشابهة في العمر والجنس والأمراض المصاحبة. لم تكن هناك فروق ذات دلالة إحصائية بين المجموعتين فيما يتعلق بآلام الرقبة قبل الجراحة أوالإعاقة الوظيفية أومستويات ضغط الحبل الشوكى أو درجة ضيق القناة الشوكية أو إصابة الحبل الشوكى أو زاوية كوب. كان متوسط وقت العملية وفقدان الدم أثناء العملية أقل بكثير في مجموعة المرضى الذين أجرى لهم استئصال الغضروف. لم تكن هناك فروق ذات دلالة إحصائية في النتائج السريرية لكلا المجموعتين. أيضًا، لم تكن هناك فروق ذات دلالة إحصائية بين المجموعتين فيما يتعلق بالالتحام العظمى بعد عام أو التحسن في درجة ضيق القناة العصبية أو زاوية كوب. بالإضافة إلى ذلك ، كانت مضاعفات ما بعد الجراحة متشابهة بين المجموعات.

الخلاصة: لم نجد فروق ذات دلالة إحصائية بين المجموعتين فيما يتعلق بالنتائج السريرية او نتائج الاشعة بعد عام من الجراحة. نتيجة لذلك لا يمكننا التوصية بإجراء جراحى دون الآخر لعلاج الضغط على الحبل الشوكى مزدوج المستوى. ومع ذلك، فإن استئصال الغضروف من الامام بمستويين تستغرق وقتًا جراحيًا أقصر بكثير مع فقدان دم أقل من استئصال جسم الفقرة العنقية.