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Anterior One- and Two-Level Cervical Corpectomy and Fusion for Cervical Spondylotic Myelopathy: A Retrospective Study

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Research Article

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ABSTRACT

Introduction: Anterior cervical corpectomy is a frequently employed surgical procedure used to decompress the spinal cord in the surgical treatment of cervical spondylotic myelopathy.This study investigated the clinical and radiologic outcomes and complications of one- and two-level anterior cervical corpectomy.

Methods: A retrospective evaluation was conducted on patients with cervical spondylotic myelopathy who underwent one- and two-level anterior cervical corpectomy between 2006 and 2022. The primary outcomes were clinically assessed using the visual analog scale to measure neck pain and radiologically based on the sagittal C2–C7 and T1 slope angles. Further, the results were evaluated in terms of complications and fusion.

Results: The one-level and two-level corpectomy groups comprised 16 and 9 patients, respectively, resulting in a total of 25 patients who underwent anterior cervical corpectomy. The postoperative visual analog scale scores significantly decreased in both groups compared with that of baseline ($p = 0.001$; $p < 0.01$ and $p = 0.007$; $p < 0.01$). Similarly, the postoperative T1 slope angle showed a significant decrease compared with that of baseline in both groups ($p = 0.001$; $p < 0.01$ and $p = 0.007$; $p < 0.01$), while the postoperative C2–C7 angle significantly increased in both groups compared with that of baseline ($p = 0.001$; $p < 0.01$ and $p = 0.007$; $p < 0.01$). However, no significant differences were observed in terms of preoperative and postoperative visual analog scale scores, T1 slope angle, C2–C7 angles, and changes from baseline between the groups ($p > 0.05$), ($p = 0.637$; $p > 0.05$), ($p = 0.169$; $p > 0.05$), and ($p > 0.05$), ($p = 0.452$; $p > 0.05$). The operation duration for patients in the two-level group was significantly longer than that in the one-level group ($p = 0.007$; $p < 0.01$).

Conclusion: The study findings indicated no significant clinical or radiological differences between cases undergoing one-level and two-level anterior corpectomy, except for the differences observed in operation duration. While anterior cervical corpectomy presents surgical challenges and carries a relatively higher risk of complications, meticulous surgical techniques can yield satisfactory outcomes, particularly in the context of one- and two-level anterior corpectomy.

Keywords: Retrospective studies, Cervical vertebrae, Myelopathy, Kyphosis, Surgical decompression.

Servikal Spondilotik Miyelopatide Ön Bir ve İki Seviyeli Servikal Korpektomi ve Füzyon: Retrospektif Bir Çalışma

Araştırma Makalesi

Süreç

Geliş: 25/12/2024
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ÖZET

Amaç: Anterior servikal korpektomi, servikal myelopatik spondilopatinin cerrahi tedavisinde spinal kordun dekompresyonunu sağlamak için kullanılan yaygın bir omurga cerrahisi prosedürüdür. Bu çalışmanın amacı bir ve iki seviye anterior servikal korpektominin klinik,radyolojik sonuçlarını ve komplikasyonlarını araştırmaktır.

Yöntem: 2006 -2022 yılları arasında bir ve iki seviyeli anterior servikal korpektomi cerrahisi uygulanan servikal spondilotik myelopati hastaları rekrospektif olarak değerlendirmeye alınmıştır. Birincil olarak vakaların sonuçları klinik olarak vizüel analog skala (VAS) ile ölçülen boyun ağrısı ile, radyolojik olarak sagittal c2-c7 ve T1 slope açısı üzerinden değerlendirilmiştir. İkincil olarak sonuçlar komplikasyonlar ve füzyon açısından değerlendirilmiştir.

Bulgular: Bir seviyeli korpektomi grubunda 16, iki seviyeli korpektomi grubunda 9 hasta yer aldı ve toplam 25 hastaya anterior servikal korpektomi uygulanmıştır. Her iki grubun postoperatif vas değerleri preoperatife göre anlamlı derecede azalmıştır. (p=0,001; p<0,01) ve (p=0,007; p<0,01) Her iki grubun preoperatife göre t1 slop açısı postoperatif anlamlı derecede azalmıştır. (p=0,001; p<0,01), (p=0,007; p<0,01) Yine her iki grubun preoperatife göre postoperatif c2-c7 açısı anlamlı derecede artmıştır. (p=0,001; p<0,01), (p=0,007; p<0,01) Ancak gruplar arasında preoperatif ve postoperatif vas, t1 slop açı ,c2-c7 açı değerleri ve değişimleri arasında fark bulunmadı. (p>0,05), (p=0,637; p>0,05) ve (p>0,05), (p=0,169; p>0,05) ve (p>0,05),(p=0,452; p>0,05) İki seviye grubundaki olguların ameliyat süresi, bir seviye grubundan istatistiksel olarak anlamlı düzeyde uzun saptanmıştır (p=0,007; p<0,01).

Sonuç: Elde edilen bulgulara göre bir seviye ve iki seviyeli anterior korpektomi vakalarının arasında klinik ve radyolojik olarak ameliyat süresi dışında fark tesbit edilmedi. Anterior servikal korpektomi zorlu bir ameliyat tekniği olması ve nisbeten fazla komplikasyonları olmasına rağmen özenli bir cerrahi uygulama ile özellikle bir ve iki seviye anterior korpektomide tatminkar sonuçlar alınabilir.

Anahtar Kelimeler: Retrospektif çalışmalar, Servikal vertebralar, Miyelopati, Kifoz, Cerrahi dekompresyon..

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Introduction

Cervical spondylotic myelopathy is characterized by a gradual and insidious onset of symptoms and is more prevalent among the elderly. Early diagnosis and treatment are crucial; advanced cases often necessitate surgical intervention. If left untreated, the condition can result in progressive neurological deficits and lead to permanent sequelae.[1] Because of the degenerative nature of the underlying condition, it often affects multiple segments of the cervical spine, leading to frequent involvement across multiple levels.

In cervical spondylotic myelopathy, the compression typically occurs anteriorly, for which anterior cervical corpectomy and fusion have been the long-established surgical procedures.[2] Anterior cervical corpectomy offers a safe and effective surgical approach for addressing traumatic, neoplastic, and infective diseases affecting the cervical region, particularly in cases of cervical spondylotic myelopathy.[3] Further, there are alternative surgical methods such as posterior decompression and fusion or combined interventions. The superiority between methods or their preferred application in specific cases is debated.

Anterior cervical corpectomy offers several advantages, including more effective decompression, particularly in cases of anterior compression. It also facilitates the restoration of cervical lordosis and has a high fusion success rate.[4] However, it is a more invasive technique compared with posterior approaches, primarily because of the presence of the trachea, esophagus, and vascular structures within the operative field. In contrast, posterior decompression, despite being a less invasive surgery, is associated with drawbacks such as the potential for C5 root palsy or the development of progressive cervical kyphosis.[5,6] The results of low-level anterior cervical corpectomies are encouraging; multilevel anterior cervical corpectomies become more invasive and challenging, and the likelihood of complications increases.[7]

We conducted a retrospective analysis of patients with cervical spondylotic myelopathy who underwent one or two-level anterior cervical corpectomy surgeries in this study. The assessment focused on evaluating clinical and radiological results, early and long-term outcomes, as well as complications.

Materials and methods

Patients

The study was approved by the local ethics committee (reference number: E-22686390-050.99-36167). We analyzed patients who underwent one- and two-level anterior cervical corpectomy with the diagnosis of cervical spondylotic myelopathy in our center between 2006 and 2022 retrospectively. Preoperative and postoperative clinical assessments of the patients were conducted using the visual analog scale (VAS). All patients underwent preoperative radiological assessments, including anteroposterior and lateral neutral cervical radiography, dynamic cervical radiography, cervical computed tomography, and cervical magnetic resonance imaging (MRI) (Figure 1). The inclusion criteria comprised persistent neck and radicular pain, neurological deficits, and radiological evidence indicating stenosis caused by anterior compression. All patients underwent anterior cervical corpectomy, followed by stabilization achieved through the use of an anterior plate and expandable cage. Patients undergoing posterior or combined interventions were excluded from the study. Patients with malignancy, trauma, or infection were also excluded from the study. The surgical procedures were conducted at a single center by a single surgeon (H.D.). Age, gender, and neurologic status of the patients were recorded. All patients underwent cervical radiography at 1 month, 6 months, and 1 year. The T1 slope and C2–C7 lordosis angle values were used in the evaluation. The cervical lordosis angle is the angle between the inferior end plate of the C2 vertebra and the inferior end plate of the C7 vertebra. The T1 slope was defined as the angle between the superior end plate of the T1 vertebra and the horizontal line.[8]

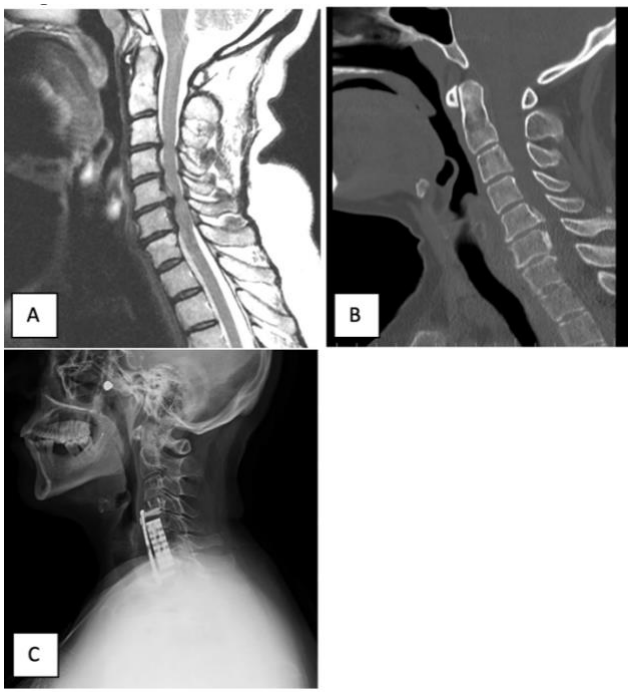

Figure-1. Imaging findings in a patient with two-level cervical spondylotic myelopathy. A. Preoperative sagittal T2-weighted images show severe stenosis at the C5–C6 level. B. Computed tomography scan of the cervical vertebra in the sagittal plane without contrast enhancement in the preoperative phase shows a calcified herniated disc in the bone window. C. Postoperative lateral neutral cervical radiograph showing C5 and C6 corpectomy cage, anterior cervical plate, and peek cage at the C3–C4 space.

Surgical technique

Standard cervical anterior approach was used, and a vertical incision was made. The trachea and esophagus were medially retracted, and the neurovascular bundle was laterally retracted. The retractor was intermittently loosened during the operation to protect the laryngeal nerve. Anterior discectomy was conducted both above and below the corpectomy level. The bone fragments retrieved during corpectomy were preserved for use during the fusion procedure. Corpectomy was conducted using a high-speed

drill. The height of the expandable cages was customized to match the corpectomy site. Autograft was employed for the fusion procedure, and it was fixed with an anterior plate. Fluoroscopy was used to check the instrumentation, and a drain was inserted. No blood transfusions were administered to any patient.

Postoperative anteroposterior and lateral cervical radiographs were taken on day 1 for all patients. After the surgery, patients were advised to use cervical collars for 6 weeks. Follow-up clinical examinations were conducted on postoperative days 7 and 20, as well as at 3 months, 6 months, and 1 year. Dynamic cervical radiography was performed for fusion control. Mobility exceeding 2° on flexion-extension radiographs, the existence of a radiolucent area between the end plate and the graft, or the absence of bone trabeculae were considered to indicate pseudoarthrosis.

Statistical analysis

During the evaluation of the study's findings, statistical analysis was conducted using the IBM SPSS version 27. During the study data analysis, quantitative variables were represented using measures such as mean, standard deviation, median, minimum, and maximum values. Qualitative variables were presented as descriptive statistics, including frequency and percentage. Shapiro–Wilk test and box plots were used to evaluate the normality of the data.

Mann–Whitney U test was used to compare non-normally distributed quantitative variables between the two groups. Wilcoxon signed-rank test was used to compare non-normally distributed variables between the two follow-up measurements. Fisher's exact test was used to compare qualitative data.

The results were assessed within a 95% confidence interval, and the significance was determined at $p < 0.05$.

Results

The study was conducted at Hospital with a total of 25 patients, comprising 19 (76%) women and 6 (24%) men. The mean age of the participating patients was 62.28 ± 7.11 years (range: 50–73 years) (Table 1). Sixteen patients underwent one-level anterior cervical corpectomy, with the most frequently involved level being C6. Nine patients underwent two-level anterior cervical corpectomy, with the most frequently involved level being C5–C6.

There was no difference between the groups in terms of age and gender ($p > 0.05$), but the operative time in the two-level group was significantly longer than that in the one-level group ($p = 0.007$).

All patients had cervical spondylotic myelopathy, with 16 individuals (64%) exhibiting myelomalacia findings on cervical MRI. The most common complaint was neck and radicular pain (96%), followed by sensory changes (76%) and muscle weakness (64%). None of the patients experienced neurologic deterioration, and no mortality occurred. Two patients (after 3 and 5 years) died of other causes. The mean length of hospital stay was 2.28 (2–7) days.

The mean duration of follow-up after surgery was 2.5 years (1–9 years). At the 1-year follow-up radiography, fusion findings were observed in 96% of the patients. Two patients underwent anterior discectomy and cage application in a different segment, alongside the corpectomy procedure.

Based on preoperative and postoperative VAS scores, both groups benefited from surgery. The decrease of 2.94 ± 1.53 points in the postoperative VAS score of the patients in the one-level group compared with baseline and the decrease of 3.11 ± 1.45 points in the postoperative VAS scores of the patients in the two-level group compared with baseline were statistically significant ($p = 0.001$ and $p = 0.007$, respectively). Preoperative and postoperative VAS scores ($p > 0.05$) and the change from baseline ($p = 0.637$) did not show significant differences between the groups ($p > 0.05$) (Table 2).

Preoperative and postoperative T1 slope angles did not show significant differences between the groups ($p > 0.05$). The decrease in postoperative T1 slope angles from baseline was 1.44° ± 1.09° in the one-level group and 2.56° ± 2.07° in the two-level group, and the differences were statistically significant ($p = 0.001$ and $p = 0.007$, respectively). In the comparison between the groups, the difference in the postoperative T1 slope angles and the change from baseline was not statistically significant ($p = 0.169$).

Both groups experienced postoperative gain in lordosis angle. The increase in postoperative C2–C7 values from baseline was 3.31° ± 2.36° in the one-level group and 2.68° ± 2.41° in the two-level group, and the differences were statistically significant ($p = 0.001$ and $p = 0.007$, respectively). Preoperative and postoperative C2–C7 angle values and the change from baseline did not show significant differences between the groups ($p = 0.452$).

In the one-level group, transient dysphagia (1 patient), transient dysphonia (1 patient), and a simple superficial infection (1 patient) were detected. The superficial infection (subcutaneous abscess) was treated with a 10-day course of antibiotic therapy. In the two-level group, one patient experienced intraoperative dural rupture due to adhesion. The dural rupture was repaired using primary sutures through the corpectomy site. The postoperative follow-up did not show any problems related to cerebrospinal fluid. In another patient within the two-level group, pseudoarthrosis was noted; however, reoperation was not deemed necessary because of the absence of clinical complaints. Additionally, neither cage slippage nor plate dislocation was observed in any patient from both groups during both early and late periods.

Table-1. Comparison of descriptive characteristics by groups

	Cervical corpectomy group		p
	One-level (n = 16)	Two-level (n = 9)	
Gender			
Women	13 (81.3)	6 (66.7)	†0.630
Men	3 (18.8)	3 (33.3)	
Age (years)			
Mean ± SD	63.19 ± 7.00	60.67 ± 7.43	‡0.329
Median (minimum-maximum)	63.5 (49.9–73.4)	56.9 (51.7–71.9)	
Duration of surgery (min)			
Mean ± SD	186.25 ± 24.12	238.89 ± 56.22	‡0.007**
Median (minimum-maximum)	185 (155–220)	220 (180–350)	

Fisher's exact test; ‡ Mann–Whitney U test; ** p < 0.01. SD, standard deviation.

Table-2. Comparison of visual analog scale scores, T1 slope, and C2–C7 angle measurements between the groups.

		Cervical corpectomy group		†p
		One-level (n = 16)	Two-level (n = 9)	
VAS Score				
Preoperative phase	Mean ± SD	5.69 ± 1.14	6.00 ± 1.22	0.522
	Median (minimum-maximum)	5.5 (4–8)	6 (4–8)	
Postoperative phase	Mean ± SD	2.75 ± 0.77	2.89 ± 0.78	0.677
	Median (minimum-maximum)	3 (2–4)	3 (2–4)	
	‡p	0.001**	0.007**	
Change Δ	Mean ± SD	−2.94 ± 1.53	−3.11 ± 1.45	0.637
T1 Slope Angle				
Preoperative phase	Mean ± SD	21.06 ± 2.46	21.11 ± 2.67	0.978
	Median (minimum-maximum)	21 (17–25)	21 (17–25)	
Postoperative phase	Mean ± SD	19.63 ± 2.22	18.56 ± 2.19	0.301
	Median (minimum-maximum)	20 (16–24)	19 (16–22)	
	‡p	0.001**	0.007**	
Change Δ	Mean ± SD	−1.44 ± 1.09	−2.56 ± 2.07	0.169
C2–C7 Angle				
Preoperative phase	Mean ± SD	5.75 ± 3.42	5.9 ± 2.46	0.718
	Median (minimum-maximum)	5 (1–12)	5 (3.1–11)	
Postoperative phase	Mean ± SD	9.06 ± 3.43	8.58 ± 2.65	1.000
	Median (minimum-maximum)	8 (5–17)	8 (5–13)	
	‡p	0.001**	0.007**	
Change Δ	Mean ± SD	3.31 ± 2.36	2.68 ± 2.41	0.452

VAS, visual analog scale; †Mann–Whitney U test; ‡Wilcoxon signed-rank test; **, p < 0.01.

Discussion

In this study, we investigated the early and late outcomes in cases of cervical spondylotic myelopathy treated surgically with one- or two-level anterior cervical corpectomy. Our study findings indicate that conducting anterior cervical corpectomy along with cage plate application proved to be an effective and safe method for treating cervical spondylotic myelopathy surgically.

An effective anterior cervical corpectomy should achieve fusion, restore cervical alignment as close to neutral as possible, and significantly enhance the patient's quality of life. Simultaneously, it should have the lowest incidence of early or late complications. Previous studies have reported a high rate of fusion with anterior cervical corpectomy. Kotil and Tari[1] reported a series of 21 patients undergoing two-level corpectomy. They achieved fusion in all cases (100%) using a graft harvested from the iliac wing. Similarly, Tome-Bermejo et al.[9] reported a series of 56 cases undergoing one- or two-level corpectomy and a 98% fusion rate. However, Bayerl et al.[10] compared anterior intervention with combined anterior–posterior intervention in a study involving 21

patients who underwent corpectomy. They reported a 33% rate of instrument failure with anterior intervention.

A robust instrumentation is necessary to ensure an effective fusion. Instrument failure was not observed in any case in our study. Fusion was achieved in 96% of cases; revision surgery was not required.

In addition to fusion, cervical alignment is another crucial factor influencing outcomes following anterior cervical corpectomy. Disturbance in cervical alignment negatively affects the comfort experienced in daily life. Kotil and Tari[1] reported a mean kyphosis improvement of 25.2° in all patients. Darry Lau et al.[11] reported a postoperative lordosis angle gain of 7.7° in a series of 35 cases undergoing cervical anterior corpectomy. In our series, the lordosis angle gain was 3.31° ± 2.36° in the one-level corpectomy group and 2.68° ± 2.41° in the two-level corpectomy group.

The necessity of posterior fusion due to the inability to achieve fusion after anterior corpectomy has been reported in many studies [3,10]. Tatter et al.[3] reported 119 cases undergoing anterior cervical corpectomies due to different pathologies. At a single level, a high fusion success rate was reported, while cases involving multiple levels required subsequent posterior fusion. However, in our study, which involved both one- and two-level anterior cervical corpectomies, no cases required posterior intervention or fusion.

Some authors have examined or compared cases undergoing one- and two-level anterior cervical corpectomies. Ozgen et al.[12] performed one-level anterior cervical corpectomy in 37 (51.4%) patients and two-level anterior cervical corpectomy in 35 (48.6%) patients. In their series of 72 cases, fusion was achieved at a rate of 92.9%, and the outcomes were satisfactory in 88% of the patients. Five patients experienced graft-related complications, and seven patients experienced plate-related complications. Similarly, Hartmann et al.[13] compared one- and two-level anterior cervical corpectomy cases in their series involving 45 cases. They identified a 22.9% (10 cases) rate of complications, which included six instrument-related complications and two cases of hematoma. Four patients had neurological deterioration. All complicated cases underwent revision surgery. However, their report indicated no correlation between the number of corpectomy levels and instrument failure.

Tome-Bermejo et al.[10] presented a series of 56 cases undergoing one- or two-level anterior cervical corpectomy. They achieved fusion in 98% of their patients and reported good outcomes. One patient experienced esophageal bleeding, while another patient experienced instrument dislocation requiring reoperation. Yu et al.[7] evaluated the results of two-, three-, and four-level anterior cervical corpectomy in a study of 248 cases. They reported that as the number of levels increased, blood loss, operation time, complications, Neck Disability Index score, and cervical range of motion were negatively affected. In our study, the operation time was significantly longer in the two-level corpectomy group than in the one-level group, but there was no difference between them in terms of VAS score and radiological outcomes.

Complications following cervical anterior corpectomy have been reported to range between 11% and 27% [11,12]. Some of these include vocal cord paralysis, dysphagia, tracheal and/or esophageal injury, cerebrospinal fluid fistula, and surgical site infections [4]. In our study, one patient experienced transient dysphagia, while another patient experienced dysphonia, both of which resolved within a few days. In addition, one patient experienced a dural rupture, which was repaired with primary suture and did not cause a cerebrospinal fluid fistula.

Limitations

Both groups in our study had a limited number of cases. There is a need for studies involving a larger number of patients. This study exclusively compared one- and two-level corpectomies. Future evaluations could expand to include comparisons with multilevel corpectomies. Moreover, our study was retrospective, conducted at a single center, and conducted by a single surgeon. In the future, multicenter prospective studies will allow us to obtain larger and more diverse data sets.

Conclusion

This study evaluated the long-term outcomes of patients undergoing one- or two-level corpectomy. Our findings indicated no significant clinical or radiological differences between one- and two-level anterior cervical corpectomy cases, except for the duration of surgery. Anterior cervical corpectomy presents a challenging surgical technique with a relatively high risk of complications. However, employing a meticulous surgical approach yields satisfactory outcomes, particularly in patients undergoing one- or two-level anterior cervical corpectomy.

Declaration of Conflicting Interests

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