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Clinical Article

A retrospective review of cervical corpectomy: indications, complications and outcome

S. Özgen[1,2], **S. Naderi**[3], **M. M. Özek**[1,2], and **M. N. Pamir**[1,2]

[1] Department of Neurosurgery, Marmara University Faculty of Medicine, Istanbul, Turkey
[2] Marmara University Institute of Neurological Sciences, Istanbul, Turkey
[3] Dokuz Eylül University School of Medicine, Department of Neurosurgery, İzmir, Turkey

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Summary

Background. Cervical corpectomy is a common spinal surgery procedure used to decompress the spinal cord in numerous degenerative, traumatic and neoplastic conditions. The aim of this study was to investigate the indications, complications and outcomes in past cervical corpectomy cases at one centre.

Method. 72 patients who underwent cervical corpectomy between February 1992 and June 2001 were retrospectively investigated.

Findings. The indications for this operation were degenerative spondylitic disease (26 cases; 36.1%), trauma (18 cases; 25%), tumour (11 cases; 15.3%), infection (10 cases; 13.9%), and ossification of the posterior longitudinal ligament (7 cases; 9.7%). Thirty-seven patients (51.4%) underwent one-level corpectomy, and 35 (48.6%) underwent two-level corpectomy. Autografts were used in 13 cases (18.1%) and allografts were used in 59 cases (81.9%). Anterior plate-screw fixation was performed in all cases. There were 31 postoperative complications in 15 (20.8%) patients. Twelve of the complications were surgical, 5 were graft-related, 7 were plating-related, and 7 were medical. Solid bony fusion was achieved in 65 (92.9%) of the 70 surviving patients. The mean follow-up time was 23.4 months. An overall favourable outcome was achieved in 88% of cases.

Conclusion. The outcomes in this series indicate that cervical corpectomy is an effective method for treating traumatic lesions, degenerative disease, tumours and infectious processes involving the anterior and middle portions of the cervical spine.

Keywords: Cervical spine; corpectomy; spinal instrumentation.

Introduction

The first effective surgical technique developed to decompress the anterior cervical spine was the anterior approach for discectomy and interbody fusion, which was introduced in the 1960s [10, 38]. Wide acceptance of this method led surgeons to consider more challenging techniques, such as corpectomy [23] and various types of fusion with [21, 24, 36] or without [25, 34, 35] plating. Anterior cervical corpectomy is used to treat a range of injuries [4, 7], spinal degenerative disorders [17, 27, 28, 31, 37], tumours [3, 11], ossification of the posterior longitudinal ligament (PLL) [1, 15], infectious disease [13], and other processes that involve the cervical spine [19, 20]. This study investigated our experience with cervical corpectomy over the past 10 years, with special focus on indications, complications and outcome.

Material and methods

The study involved a retrospective review of the medical records and radiological findings for 72 patients (46 males and 26 females) who underwent cervical corpectomy at our centre between February 1992 and June 2001. Patient age at presentation ranged from 19 to 76 years (mean, 48.1 years). The neurosurgeon in charge of each case was responsible for detailing the clinical presentation, pre- and postoperative neurological deficits, pre- and postoperative radiographic findings, operative details, complications and outcome in the patient's medical record. All data used in the study were extracted from the records and were analysed by the first author (SO). Since there was a range of different diagnoses (i.e., tumour, trauma, infection and degenerative disorders) in the series, we used a grading system developed by Mühlbauer *et al.* [26] to score the severity of symptoms pre- and postoperatively (Table 1). Each surviving subject was re-examined by the attending neurosurgeon 6 weeks after discharge and then returned for regular re-checks at 3-month intervals. Follow-up time in the series ranged from 6 to 42 months (mean, 23.4 months). Outcome was regarded as "favourable" if signs and symptoms improved after corpectomy, or if the patient's postoperative scores for pain, motor deficit and myelopathy changed to grade 4 or grade 5.

Table 1. *The grading system used to score each patient's clinical and neurological symptoms pre- and postoperatively*

Grade	Pain	Motor deficit in root related muscles	Myelopathy
5	no pain	no motor deficit	no myelopathy
4	mild pain, no analgesic	can move against resistance	reflexes increased
3	pain, casual demand for analgesics	can move against gravity	gait disturbance, but can move legs against gravity
2	severe pain, regular demand for analgesics	can move without graity	can move legs without gravity only, bladder dysfunction
1	severe pain, opiate analgesics	cannot move	tetraplegia

Radiography, computerized tomography, and magnetic resonance imaging of the cervical spine were carried out pre- and postoperatively in all cases. For the purpose of this study, all 72 patients underwent another set of neurological and radiological investigations for assessment of spinal fusion. On the plain films, we defined fusion as lack of spinal movement on lateral x-rays taken with the neck flexed and extended, and the presence of bony trabeculae between the segments operated upon.

Surgical technique

For each operation, the patient was placed in the supine position on the operating table with his or her head and neck in neutral position. General anaesthesia was maintained without paralytic agents if possible, and prophylactic antibiotics were used. A bolster pad was placed between the patient's scapulae in order to achieve slight neck extension and optimise radiographic visualisation of the lower cervical spine. In 24 of the cases, the patient's head was positioned in a Gardner cranial tong skeletal-traction device to facilitate placement of the graft with traction.

A right-sided approach to the spine was made, with a vertical skin incision along the anterior border of the sternocleidomastoid muscle. After the operative levels were carefully identified, the longus colli musculature was dissected and elevated to expose 1.5–2 cm of vertebral body width. The anterior longitudinal ligament was incised and all necessary discectomy procedures were carried out. Next, corpectomy was performed using a pneumatic high-speed drill to create a 15- to 25-mm hole in the cervical vertebra. The uncinate processes were identified and used as reference points for establishing the width of corpectomy required. Posterior cortical bone and osteophytes were removed microsurgically with the aid of an operating microscope. Decompression was considered to be successful when the surgeon could directly visualise a protruding pulsating dural sac. Once this was achieved, cranial tong skeletal traction was initiated and a full-thickness bone graft was inserted in the defect. In cases in which the Gardner device was not used, the graft was placed with the head in manual traction. Correct positioning of the graft was confirmed by intra-operative fluoroscopy. A plate-and-screw system was used to achieve anterior cervical fixation, and proper positioning of the fixation materials was confirmed by intra-operative radiography. No screws were placed in the graft itself.

All patients were mobilized the first day after the operation. Follow-up investigations with plain films, computed tomography and magnetic resonance imaging were done the same day to ensure adequate decompression and proper positioning of the bone graft and plate-screw system. A Philadelphia cervical collar was worn for 6–16 weeks postoperatively. Follow-up checks were done as outlined above. Plain films were evaluated every 3 months, and magnetic resonance imaging was done yearly.

Results

The indications for cervical corpectomy in the 72 cases were degenerative cervical spondylotic myelopathy (CSM) (n = 26, 36.1%), trauma (n = 18, 25%), tumour-related (n = 11, 15.3%), infection-related (n = 10, 13.9%), and ossification of the PLL (n = 7, 9.7%). Table 2 shows the cause of spinal pathology, the level(s) operated upon, and the outcome for each case. Thirty-seven patients (51.4%) underwent one-level corpectomy and 35 (48.6%) underwent two-level corpectomy. Autografts were used in 13 (18.1%) of the cases, and allografts in 59 (81.9%) of the cases.

As described above, anterior plate-screw fixation was performed in all patients. The specific types of plates used were as follows: Synthes plate (Synthes, Oberdort, Switzerland) in 32 cases (44.4%); Codman plate (Johnson and Johnson Professional Inc., Raynham, MA, USA) in 24 cases (33.3%); Casper plate (Aesculap, San Francisco, CA, USA) in 11 cases (15.3%); and Orion plate (Sofamor Danek, Memphis, TN, USA) in 5 cases (6.9%).

Two patients who were rendered quadriplegic by trauma died within 30 days of the initial injury due to pneumonia and respiratory distress. The 70 survivors were followed for a mean of 23.4 months (range, 6–42 months). The mean follow-up times for the survivors with different types of spinal pathology were as follows: 25.6 months in the CSM group (n = 26), 23.2 months in the trauma group (n = 16), 13.9 months in the tumour-related group (n = 11), 31.8 months in the infection-related group (n = 10), and 20.1 months in the group with ossification of the PLL (n = 7). Review of the neurological and clinical symptoms at presentation in the 70 survivors revealed myelopathy in 46 patients (65.7%), radiculopathy in 49 patients (70%), and neck pain in 69 patients (98.6%). The frequencies of the different grades of pre- and postoperative symptoms (pain, radiculopathy and myelopathy) in these individuals are summarized in Table 3. The best results were observed in pain relief, with favourable outcomes in 65 of 70 cases (93%). Sixty-two (89%) of the 70 patients showed favourable outcomes for root-related motor deficits, and 58 (83%) showed favourable outcomes for myelopathy. Overall, 62 (88%) of the 70 survivors showed favourable outcomes.

Table 2. *Patient sex and age, cause of spinal pathology, level(s) of spinal compression operated on, follow-up and preoperative–postoperative grading score (Mühlbauer et al. [26]) in each case*

Name	Sex	Age (yrs)	Cause	Levels operated	Follow-up (months)	Pain		Motor deficit in root related		Myelopathy	
						Preop	Postop	Preop	Postop	Preop	Postop
1.	M	32	Trauma	C4	9	3	5	4	5	5	5
2.	M	45	Trauma	C5	36	4	5	4	5	5	5
3.	M	65	Tumour	C3	15	3	4	4	4	3	4
4.	M	42	Trauma	C5	27	3	4	2	4	4	5
5.	M	38	Trauma	C5	12	4	4	3	5	5	5
6.	M	43	Infection	C6, C7	33	3	5	4	5	4	5
7.	M	56	Degenerative	C6	42	4	4	5	5	4	5
8.	F	57	Tumour	C7	12	3	4	3	4	3	4
9.	F	28	Trauma	C7	36	3	4	3	3	4	5
10.	F	45	Degenerative	C7	6	4	5	4	4	4	4
11.	M	66	Tumour	C3, C4	9	3	4	4	5	3	4
12.	M	45	Tumour	C6	18	2	3	3	4	5	4
13.	M	24	Trauma	C5	12	2	3	1	1	1	1
14.	M	58	Tumour	C3, C4	24	2	4	4	5	3	3
15.	M	63	Degenerative	C5, C6	27	3	4	3	4	4	4
16.	F	53	Degenerative	C4	12	4	5	4	5	5	5
17.	M	29	Trauma	C6	42	3	5	4	5	4	5
18.	M	37	Trauma	C7	21	2	3	3	4	3	3
19.	F	57	Degenerative	C5	36	3	5	4	5	4	5
20.	M	48	Trauma	C7	12	3	4	2	2	2	3
21.	M	57	Degenerative	C5, C6	36	3	5	4	5	4	5
22.	M	72	Degenerative	C5, C6	18	3	4	5	4	3	3
23.	M	52	Trauma	C5	–	–	–	–	–	–	–
24.	M	46	Degenerative	C4, C5	18	3	4	3	5	4	5
25.	M	42	Infection	C5, C6	21	2	5	3	5	3	5
26.	F	21	Trauma	C7	24	3	5	3	4	2	3
27.	M	31	Trauma	C5	12	2	4	1	2	1	1
28.	F	45	Tumour	C6	6	3	4	3	4	4	5
29.	F	57	Degenerative	C6, C7	36	3	5	5	5	4	5
30.	F	41	Tumour	C5	18	2	3	4	5	4	4
31.	F	63	Degenerative	C6, C7	12	4	5	3	4	3	4
32.	F	38	Infection	C5, C6	36	3	5	2	4	4	5
33.	F	45	Opll	C5, C6	27	4	5	4	5	4	5
34.	M	38	Tumour	C4	9	3	3	3	3	3	3
35.	M	51	Degenerative	C6	39	4	5	4	5	4	5
36.	M	19	Trauma	C7	42	3	5	4	5	5	5
37.	M	62	Degenerative	C4, C5	12	4	5	5	5	4	4
38.	M	37	Infection	C4, C5	39	3	5	5	5	5	5
39.	M	56	Opll	C7	33	3	4	3	4	3	4
40.	M	76	Tumour	C6	27	3	2	4	3	3	2
41.	F	42	Degenerative	C4, C5	6	4	5	4	5	4	5
42.	F	19	Infection	C6, C7	36	2	4	3	4	3	4
43.	M	60	Opll	C3, C4	12	3	5	4	5	4	3
44.	M	37	Infection	C4, C5	42	3	5	4	5	5	5
45.	M	32	Trauma	C6	21	3	5	5	5	5	5
46.	M	54	Opll	C3, C4	15	4	4	3	4	3	3
47.	F	53	Degenerative	C5, C6	18	4	5	3	4	4	5
48.	M	24	Trauma	C5	33	4	5	3	4	4	5
49.	M	62	Degenerative	C6	24	3	4	4	4	4	4
50.	M	27	Infection	C5	36	4	5	3	4	3	4
51.	F	61	Degenerative	C5, C6	39	3	5	4	5	4	5
52.	M	51	Degenerative	C6	12	4	4	3	4	5	5
53.	M	34	Trauma	C6	18	2	3	3	5	4	4
54.	M	63	Degenerative	C4, C5	36	4	5	4	4	3	4
55.	M	39	Infection	C5, C6	24	4	5	4	5	5	5
56.	F	55	Degenerative	C5, C6	36	3	4	3	4	4	5

(*continued*)

Table 2 (*continued*)

Name	Sex	Age (yrs)	Cause	Levels operated	Follow-up (months)	Pain		Motor deficit in root related		Myelopathy	
						Preop	Postop	Preop	Postop	Preop	Postop
57.	M	29	Trauma	C5	15	4	4	2	3	2	3
58.	M	58	Degenerative	C6	39	5	5	3	5	4	5
59.	M	47	Trauma	C5, C6	–	–	–	–	–	–	–
60.	F	61	Degenerative	C5, C6	39	3	4	3	4	3	4
61.	F	66	Opll	C4, C5	12	3	5	3	3	4	4
62.	M	59	Degenerative	C5, C6	33	4	5	4	5	3	4
63.	M	63	Tumour	C7	9	3	4	2	3	3	4
64.	F	71	Degenerative	C3, C4	24	4	4	3	3	3	3
65.	M	69	Opll	C3, C4	18	4	5	5	5	4	5
66.	F	49	Degenerative	C5, C6	15	3	4	3	5	3	4
67.	M	33	Infection	C4, C5	33	1	4	4	5	4	5
68.	F	60	Degenerative	C4, C5	27	3	3	3	4	3	3
69.	F	64	Degenerative	C5	12	4	5	4	5	3	4
70.	F	42	Opll	C5, C6	24	3	5	5	5	3	4
71.	F	44	Infection	C5, C6	18	4	5	4	5	4	4
72.	F	61	Tumour	C4	6	4	3	3	2	4	2

M Male, *F* female, *OPLL* ossification of the posterior longitudinal ligament.
* Patients "23" and "59" died postoperatively.

Table 3. *The frequencies of different grades of symptoms pre- and postoperatively in the 70 surviving patients. The results for the two patients who died were excluded*

n = 70	Pain		Motor deficit in root related muscles		Myelopathy	
Grade	Pre	Post	Pre	Post	Pre	Post
5	1	35	8	34	11	32
4	24	26	27	24	31	23
3	35	8	28	7	23	11
2	9	1	5	3	3	2
1	1	0	2	2	2	2

There were 31 postoperative complications in 15 of the 72 cases (overall complication rate 20.8%). Twelve of the complications were surgical, 5 were graft-related, 7 were plating-related, 7 were medical, and there were 2 deaths (Table 4). Two patients had to be re-operated on. One of these individuals developed transient dysphagia due to screw pullout, and underwent revision surgery 6 months after the first operation. The other required further decompression and was re-operated on 1 month after the initial operation.

Solid bony fusion was achieved in 65 (92.9%) of the 70 surviving patients. There was no significant difference between the autograft group and allograft group with respect to fusion.

Table 4. *Complications of cervical corpectomy in the series (n = 72)*

	N (%)
Surgical complications	
Recurrent laryngeal nerve injury	1 (1.4%)
Transient dysphagia	5 (6.9%)
Transient C5 radiculopathy	3 (4.2%)
Partial ptosis	1 (1.4%)
Reflex sympathetic dystrophia	1 (1.4%)
Wound infection	1 (1.4%)
Graft-related complications	
–Donor site	
Graft site pain	1 (1.4%)
Graft site infection	1 (1.4%)
–Implant site	
Telescoping (subsidence > 5 mm)	3 (4.2%)
Plate-related complications	
Screw pullout	6 (8.3%)
Screw-plate migration	1 (1.4%)
Medical complications	
Deep vein thrombosis	4 (5.6%)
Pneumonia	2 (2.8%)
Respiratory distress	1 (1.4%)
Death	2 (2.8%)

Discussion

In addition to cord decompression, cervical corpectomy is used to treat a range of spinal lesions. Outcomes and complications differ relative to indication, and the most important of these are discussed below.

Indications

Trauma

The specific indications in cervical spine trauma cases remain controversial [4, 6, 13]. At our centre, we use cervical corpectomy to treat trauma-induced cervical cord compression, flexion-compression fracture with ventral canal compromise, and hyperextension injuries that cause central cord injury. Our goal in extension injuries is to re-establish the integrity of the anterior part of the spinal column. In most cases of cervical spine trauma, the surgeon must excise the PLL and confirm adequate decompression by direct vision. However, in flexion-compression injury the PLL is often intact, and the decision whether or not to excise is based on radiology.

Degenerative disease

Surgery options for CSM include anterior multiple interbody approaches for decompression, corpectomy, laminectomy, and laminoplasty with or without stabilization. Laminectomy and laminoplasty have three major disadvantages: the ventral compressive lesion is not removed; there is risk of instability and kyphosis; and the C5 nerve root may be stretched [32, 36]. We perform cervical corpectomy in CSM cases with predominantly anterior cord compression, and/or in patients who have circumferential stenosis of the cervical spinal canal with cervical kyphosis. In patients with CSM, the PLL should always be resected to prevent spinal cord compression. We perform one- and two-level cervical corpectomy in cases of CSM. Most authors claim that two vertebrae is the maximum that can be safely treated in these patients [21, 22, 33].

Tumours

A variety of primary and secondary neoplasms affect the cervical spine [3, 11, 12]. At our centre, we perform cervical corpectomy when a tumour involves the entire cervical vertebral body and PLL at the time of diagnosis. It is usually necessary to excise the entire vertebra and ligament. In cases with life expectancy less than 6 months, the optimal surgical management is decompressive corpectomy with methylmethacrylate reconstruction. For patients with estimated life expectancy of at least 6 months, we use bone allografts and anterior instrumentation.

Infection

Cervical corpectomy can be used to decompress the spinal cord in cases of spondylodiscitis and cases of epidural abscess anterior to the cord [13]. Typically, these patients exhibit osteolysis and vertebral body collapse in conjunction with obliteration of the intervertebral disc space. Some infectious material may be concealed beneath the PLL; thus, it is vital to ensure wide exposure during surgery for exploration and drainage. Anterior spinal instrumentation is effective for reconstructing an infected cervical spine.

Ossification of the posterior longitudinal ligament

Ossification of the PLL is the most challenging pathology of the cervical spine to treat surgically because the risks of haemorrhage, dural tear, and aggravation of neurological deficit are all relatively high [1, 15]. As mentioned above, the surgeon must directly visualise the bulging dural sac after ligament resection. According to Abe *et al.*, ossified PLL below C2 can be removed via an anterior approach as long as no more than five vertebral bodies [1]. In our opinion, three-level corpectomy is the maximum for safety in these cases.

Outcome and complications

The reported frequency of overall improvement in clinical status after cervical corpectomy ranges from 53% to 100% [1, 13, 14, 17, 24, 29, 33, 34]. Several outcome scales are used for assessment, including the Nuric Grading, the modified Japanese Orthopaedic Association Score (JOA), and others. Due to the range of diagnoses and complaints in our series, we used an objective grading system developed by Mühlbauer *et al.* to score the severity of symptoms pre- and postoperatively. We observed 100% total cure in patients with cervical infections who completed 3 to 9 months of antibiotics in addition to cervical corpectomy (mean follow-up 31.8 months). The other success rates in our study were 92% for patients with degenerative disease (mean follow-up 25.6 months) and ossification of the PLL (mean follow-up 20.1 months), 70% for tumour cases (mean follow-up 13.9 months), and 87% for trauma cases (mean follow-up 23.2 months). Overall, 88% of the 70 survivors had favourable outcomes.

The reported complication rates for cervical corpectomy range from 11% to 27% [2, 5, 9, 13, 24, 30, 39, 41]. In our series, there were 31 postoperative complications in 15 (20.8%) of the 72 total patients. Flynn reported 100 cases of significant permanent myelopathy or myeloradiculopathy in a series of 36,000 anterior cervical procedures [18]. Four of our patients (three tumours and one ossified PLL) showed progression of myelopathy post-surgery, and the PLL had been excised aggressively in all four cases. The PLL must be removed with extreme care according the indications.

The estimated incidence of graft slippage with cervical interbody fusion is 1% to 2% [8, 16], and the corresponding range for strut grafting is 6% to 29% [8, 42]. Telescoping of a strut graft (subsidence more than 5 mm) occurred in two of our cases. The graft donor site is also an important area for complications. Whitecloud reported a 20% overall rate of donor site morbidity in spinal fusion [40]. In cervical spine surgery, the frequency of postoperative infection of the spine itself is less than 1% due to rich vascularity. Graft donor site infection is considerably more common, with reported incidence of 2% to 5% [41]. The majority of our cases involved allograft implants, so the rate of donor site infection was low (1.4%).

In summary, these results from our centre show that cervical corpectomy is an effective decompression technique for treating disorders which involve the anterior and middle parts of the cervical spinal column. The overall rate of favourable outcome in our series was 88%, which is highly satisfactory. Since fusion rates are similar for allografts and autografts, the choice of graft material should be based on the surgeon's preference. Use of internal fixation increases the probability of successful fusion and reduces the frequency of graft-related complications.

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Comment

Cervical corpectomy is now a relatively common procedure for decompression of the cervical spinal cord from the ventral approach. This procedure is performed, as the authors emphasized, for a variety of pathological entities. With the advent of anterior cervical plating, internal fixation is usually successful without external immobilization such as a halo device. The authors' rate of complication appears at first somewhat high (20.8%); however, it is certainly acceptable considering the number of tumours, infections, and trauma cases. We have found [1] that corpectomy is a valuable surgical technique. However, if it is necessary to perform corpectomies at three or more levels, we advocate additional stabilization and would consider applying a halo brace or performing a posterior stabilization procedure [2].

I congratulate the authors on their good outcomes and diligent follow-up.

Volker KH. Sonntag
Phoenix, Arizona

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Correspondence: Dr. Serdar Özgen, P.K.4 Göztepe 34730, Istanbul, Turkey. e-mail: omurga@tnn.net