

# Circumferential Total Resection of Cervical Tumors: Report of Two Consecutive Cases and Technical Note

## Çevresel Total Servikal Vertebra Tümör Rezeksiyonu: İki Olgu Sunumu ve Teknik Not

### ABSTRACT

To date, few studies have addressed the subaxial vertebrectomy technique and related anatomical landmarks in this method. Total spondylectomy is performed via piecemeal resection or en bloc removal in a one-stage procedure associated with stabilizing the spine and preserving neurological status. In this presentation, a circumferential total cervical tumor resection for subaxial cervical spine lesions was described. Two cases of subaxial cervical malignancy, one with primary C3 chondrosarcoma and the other with C4 lung adenocarcinoma metastasis, were both treated by the anterior-posterior approach. The lesions could be removed macroscopically totally in both cases. The patients did well after surgery with preserved neurological status and they survived a considerable period without tumor recurrence. Subaxial total tumor resection can be performed safely while preserving vertebral arteries with adequate anatomical knowledge and careful surgical planning, and circumferential vertebrectomy (even intralaminar) can provide a long recurrence-free survival period for patients suffering from subaxial spine tumors.

**KEYWORDS:** Cervical vertebrae, Spine tumor, Total spondylectomy, Vertebrectomy

### ÖZ

Günlük cerrahi pratiğimizde servikal tümörlerin tedavisinde anterior ve posterior girişimle birlikte tam tümör çıkarılması tekniği çok fazla kullanılmamaktadır. Servikal bölgede vertebral arterin lokalizasyonu nedeniyle servikal blok şeklinde spondilektomi zorluklar arz etmektedir. Bu çalışmada, subaksiyel servikal bölge tümörü olan 2 olgunun tedavisinde kullanılan birlikte anterior ve posterior vertebrektomi ile makroskopik tümör çıkarılması (lezyon içi) tekniği tanımlanmaktadır. Olgulardan ilki servikal 3 vertebraından köken alan bir kondrosarkoma olgusu, diğeri ise servikal 4 vertebraında destrüksiyon oluşturması nedeniyle ileri derece kifotik deformite ve spinal kord basısına yol açan bir akciğer adenokarsinoma metastazı olgusuydu. Her iki olguda da makroskopik olarak tümör dokusu çıkarıldı. Servikal çevresel vertebra çıkarılması, yeterli anatomi bilgisi ve uygun cerrahi teknik kullanılarak servikal bölgede uygulanabilir. Blok şeklinde spondilektomi tercih sebebi olmakla birlikte, uyguladığımız teknik, tümörün tamamen çıkarılmasını sağladığı için, hastaların uzun dönem sağkalımının artıran bir cerrahi tedavi seçeneğidir.

**ANAHTAR SÖZCÜKLER:** Servikal vertebra, Spinal tümör, Vertebrektomi, Spondilektomi

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## INTRODUCTION

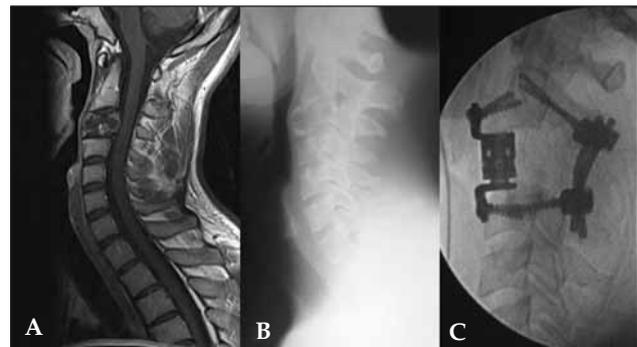
Patients who present with either primary or secondary spinal tumors often require total lesion removal for decompression of the neural tissue, provide a symptom-free or pain-alleviated survival period, and also to achieve a cure (3,4,12-14). Radical excision (total spondylectomy) is widely accepted as a method of choice in the management to achieve this goal (1,2,6,8,11,17,18). Total spondylectomy is performed via piecemeal resection or en bloc removal in a one-stage procedure associated with stabilizing the spine and preserving neurological status (10,15). Complete spondylectomy has usually been reported in cases harboring thoracic and lumbar spine tumors (1,6,7,11,17). However, an ideal, universally applicable technique for cervical lesions has not been well defined. The vertebral arteries and cervical nerve roots seem to be precluding vital elements in this procedure. On the other hand, by considering essential anatomical landmarks and with careful preoperative planning, cervical total spondylectomy can be carried out with no or minimal difficulty. In this study we presented two consecutive cases of subaxial cervical tumor in which total circumferential vertebrectomy and tumor resection were done successfully. The anatomical landmarks and surgical steps were described in detail.

## CASE REPORTS

### Case 1

This 18-year-old man was admitted to the hospital because of chronic neck pain for the last 4 years. One month earlier, the patient had started experiencing a throbbing left upper extremity pain accompanied by muscle spasms in the neck region and difficulty in neck motion. His medical history was unremarkable especially for trauma or infection. On neurological examination, hypoesthesia was found in the left C4 dermatome. His neck musculature was rigid by palpation and neck movements were painful. Laboratory investigations including alkaline-phosphatase, ESR, and CRP were all within normal limits. X-ray of the cervical spine revealed an expansive radiolucent mass in the C3 vertebra body with no indication of immobility as demonstrated by dynamic scans. Pathological signal increase was found only in C3 vertebra body in whole body bone scintigraphy. Bone marrow investigation revealed no specific pathology. CT and

MRI (Figure 1A) and the lateral plain radiograph (Figure 1B) of the cervical spine showed an expansive mass lesion with no contrast enhancing appearance and involving only the body of the C3 vertebra. Percutaneous biopsy of the lesion revealed pathology characteristic for chondrosarcoma in the chondroma setting. Total spondylectomy was planned for management of the disease. Prior to surgery, bilateral selective vertebral DSA was obtained for the course to rule out any involvement of vertebral arteries.

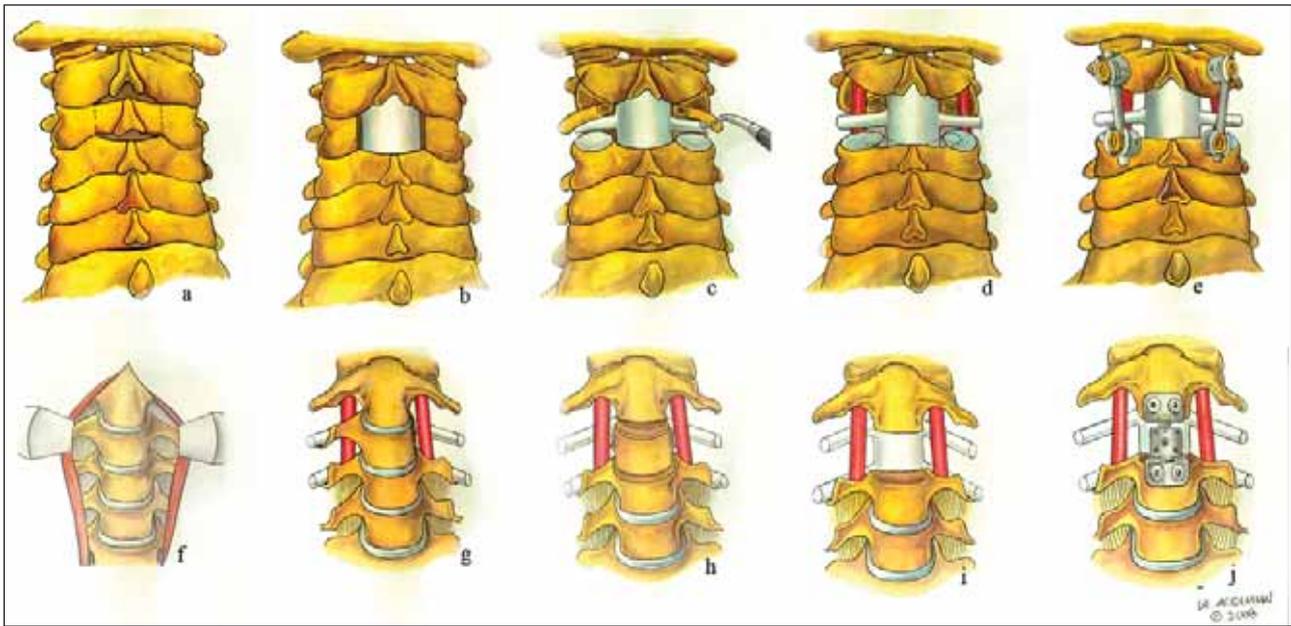


**Figure 1:** Imaging findings in Case 1. Preoperative sagittal MRI (A) and lateral radiograph (B) of the cervical spine confirming a tumor predominantly affecting the C3 vertebral body. (C) Intraoperative fluoroscopy of the final construct. The construct consisted of the anterior distractible interbody cage with plate. Posteriorly the C2-C4 pedicle screw fixation with rods can be seen.

**Surgery:** The patient was first placed in the prone position and the head was fixed with the 3-point pin system; a C2-6 midline vertical skin incision was made with the neck in neutral posture and the paravertebral muscles were bilaterally elevated in a subperiosteal fashion over C2-C4 vertebrae until the lateral masses were exposed (Figure 2A). The C3 lamina was removed as one-piece and dura mater of the spinal cord freed posteriorly from surrounding soft tissues (Figure 2B). The pedicles of C3 were identified and transected by using a medium-sized T-saw (Figure 2C). Facets and lateral masses were excised in one piece. The dissection was extended bilaterally to the posterior tubercles. The posterior tubercles were excised to prevent entrapment of the vertebral arteries during removal of the vertebral body during the second step of procedure (Figure 2D). The corpus of the vertebra was exposed on pedicular points. Bilateral C4 roots and also the vertebral arteries were exposed carefully. The vertebral arteries were covered with a Goretex® sheet

anteriorly as a preventive measure for the ensuing anterior approach. C2-C4 pedicle-screw-fixation with rods (Tipsan, Turkey) was performed (Figure 2E). The wound was closed in anatomical layers. In the second step, performed under a hard collar using the neutral neck posture, the patient was rotated to the supine position and the anterior anatomical neck layers were retracted in a standard fashion through a right oblique skin incision as performed in the anterior cervical discectomy procedure. After dissection of longus colli muscles bilaterally over the C3 body, the anterior tubercles were exposed (Figure 2F). C2-3 and C3-4 discectomies were carried out and the posterior longitudinal ligament was removed (Figure 2G). The lesion was very soft in nature and appeared to be very fragile for removing the vertebra in en bloc fashion. The C3 vertebra body including anterior tubercles was removed totally in piecemeal fashion using rongeurs. The resection was completed with careful resection of the medial and

lateral aspects of the vertebral arteries to remove any remnants of tumor or vertebra (Figure 2H). The Goretex® sheets which were placed during the first step of the surgery were identified and left in place after confirming the patency of both vertebral arteries (Figure 2I). A cervical corpectomy distractible cage with plate/screw (ADD Plus, Ulrich®) including bone fusion materials was placed between the C2 and C4 space using a bone fusion material inside (Figure 2J). Because of the unique anatomy of the C2 vertebra, it was hard to place the corpectomy cage and to perform anterior C2 corpus screw fixation. C4 anterior bilateral corpus screw fixations were also performed (Figure 1C). The layers were closed in the anatomical plane. The postoperative period was uneventful with no neurological deficit. His preoperative neck pain resolved completely almost immediately. The duration of surgery was 5 hours and two units of blood were transfused during the procedure. The histological examination of the



**Figure 2:** Artist's drawings illustrating the procedure for Case 1. The posterior view of the cervical spine (A). The C3 lamina was removed as one-piece and dura-mater of the spinal cord freed posteriorly from surrounding soft tissues (B). The pedicles of C3 were identified and transected by using a medium-sized T-saw. Facets and lateral masses were excised in one piece. The dissection was extended bilaterally to the posterior tubercles. The posterior tubercles were excised to prevent entrapment of the vertebral arteries during removal of the vertebral body in the second step of procedure (C). The corpus of the vertebra was exposed on pedicular points. Bilateral C4 roots and also vertebral arteries were exposed carefully (D). The vertebral arteries were covered with a Goretex® sheet anteriorly as a preventive measure for the ensuing anterior approach. C2-C4 pedicle-screw-fixation with rods was performed (E). Anteriorly, the anterior tubercles were exposed after dissection of longus colli muscles bilaterally over the C3 body (F,G). C2-3 and C3-4 discectomies were carried out (H). The C3 vertebra body including anterior tubercles was removed totally (I). The Goretex® sheets which were put during the first step of the surgery were identified and left in place after confirming the patency of both vertebral arteries. A distractible interbody cage with plate/screws including bone fusion materials was placed between C2 and C4 space (J).

lesion confirmed the diagnosis of chondrosarcoma. The patient did not receive radiotherapy or chemotherapy. Follow-up for more than a year revealed neither recurrence nor any symptom.

### Case 2

This 45-year old man was admitted to the neurosurgery service because of severe neck and left shoulder pain. He had suffered a car accident approximately 2 months ago. His symptoms had started afterwards and within a month he was unable to move his neck in any direction. On neurological examination, his left shoulder abduction was 4/5 and neck movements were restricted due to painful musculature. MRI and X-ray of the cervical spine showed a hyperdense lesion in the C4 body with kyphotic deformity and spinal cord compression (Figure 3A,B). Whole body bone scintigraphy revealed pathological signal intensity at the same level of the spine. X-ray of the lung and PET scintigraphy revealed pulmonary lesions in the left lobe. The bronchoscopic biopsy disclosed primary adenocarcinoma of the lung. A spondylectomy was performed for local cure and the procedure was performed in the same way as described in the previous case for C4 vertebra. C2 pedicle/C3-5-6 lateral mass screw-fixation with rods was performed posteriorly (Tipsan, Turkey). Anteriorly distractible cage with plate/screw (ADD Plus, Ulrich®) including bone fusion materials was placed between C3 and C5 space and the bilateral C3 and C5 corpus screws were placed bilaterally (Figure 3 C,D). Duration of surgery was three and a half hours and no blood transfusion was used. The



**Figure 3: Imaging findings in Case 2.** Preoperative sagittal MRI (A) and the lateral radiograph (B) of the cervical spine confirming a tumor predominantly affecting the C3 vertebral body with kyphotic deformity and spinal cord compression. Postoperative lateral and antero-posterior plain radiograph of the final construct (C,D). The construct consisted of the anterior distractible interbody cage with plate/screw and, posteriorly the C2 pedicle-C3-5-6 lateral mass screw fixation with rods.

postoperative period was uneventful and no neurological deficit was found. His preoperative neck pain persisted for a month after surgery and gradually resolved to a more tolerable state thereafter. The patient received conventional radiotherapy to the C4 level. Chemotherapy was given afterwards. No recurrence was noted during his follow-up for nearly one year. He reported minimal neck pain with no restriction of neck motion at the 10th month follow-up.

### DISCUSSION

Primary or metastatic tumors of the spine are well associated with patients' survival period and quality of life. As the spine is one of the most common sites of osseous metastasis, management of these lesions is of particular importance. In the past two decades, the practice for vertebral tumors consisted commonly of curettage or piecemeal excision of the lesion. However, high recurrence rates and inadequate local cure have been reported for certain pathologies with these approaches (3,4,8,12-14). Total removal of vertebral malignancies while stabilizing the spine biomechanically in a proper way may provide local cure and long symptom-free survival time (3-5,9,12,16). Thus, the contemporary concept of surgery for these tumors involves radical excision with the primary goal of local cure and secondary goals of alleviating pain, preserving neurological status and stabilizing the spine (9,11,16, 17).

Spondylectomy or total vertebrectomy has been described for reducing local recurrence of a vertebral tumor with excellent clinical results (1,2,5,6,8,11,15, 17). In their comprehensive work, Tomita et al. (17) concluded that one vertebra could be regarded a single oncological compartment and its surrounding tissues such as ligaments and periosteum as barriers in the spine. With regard to this determination, total removal of a vertebra in anatomical fashion could be performed for certain spine tumors depending on their degree of invasion. However, the spine surgeon must have an expert understanding of the paraspinous vascular and visceral anatomy to perform this procedure safely and comfortably.

Indications for total spondylectomy in spine tumors include aggressive primary benign tumors, primary malignant tumors, and isolated spinal metastases in the setting of controlled systemic disease (1,4,11-14,17,18). Primary spine tumors that have been subjected to this procedure include

chordoma, chondrosarcoma, osteosarcoma, giant cell tumor, solitary plasmacytoma, malignant fibrous histiocytoma, Ewing sarcoma, osteoblastoma and hemangioendothelioma. (6). Contraindications may include distant metastases, uncontrolled systemic disease, and encasement of adjacent visceral or vascular structures that cannot be excised (4,6,11,13,14,18).

Total en bloc spondylectomy has been described to achieve complete tumor resection and oncological cure of primary malignant vertebral tumors of the cervical spine (2,3,8,10,14). The procedure is performed in 2 steps, consisting of en bloc laminectomy after bilateral pediculotomy using a thread-wire saw (T-saw) and posterior spinal instrumentation (step 1), and en bloc corpectomy followed by anterior fusion with instrumentation (step 2). Wide en bloc excision of malignant tumors is complicated in the cervical spine due to the complex anatomy of this region. The major risks of total en bloc cervical spondylectomy are injury to adjacent neural structures, the possibility of tumor contamination during pediculotomy, injury of vertebral arteries, excessive bleeding from the epidural venous plexus, infection, pseudoarthrosis, and cerebrospinal fluid leakage (8). Piecemeal removal is therefore recommended for certain lesions when it seems to be necessary (3,4,7,10,15). We were only able to remove both tumors in piecemeal fashion in our cases due to the tumors' fragile nature and the technical difficulties of en bloc spondylectomy.

Although total spondylectomy for thoracic and lumbar lesions is well described there is paucity in the literature for this procedure regarding the subaxial cervical spine. One reason seems to be the vital tissues such as vertebral arteries and cervical nerve roots believed to prevent total spondylectomy in this region. Recently sporadic case reports of cervical spondylectomy have been emerging but few of them focus on total removal of the cervical vertebra (2,8,14). As we showed in our report, a circumferential total cervical tumor excision in the subaxial cervical region can be performed successfully in selected patients without harming any vital structure with careful planning and by following the essential steps.

Total en bloc spondylectomy for cervical spine tumors with soft tissue extension and involvement

of the pedicles may require ligation of the vertebral artery. Ligation of a vertebral artery should be performed only when preoperative angiographic study demonstrates that the artery is nondominant, and temporary occlusion does not cause neurological symptoms (2,8). The tubercles have particular importance for accomplishing total spondylectomy. Partial removal of tubercles may compromise vertebral arteries and may cause a cerebro-vascular incident. Extending the dissection more laterally both in posterior and also anterior steps may provide a sufficient surgical window for excising the tubercles. A wide exposure at the affected level is essential because it also facilitates subsequent anterior release of the vertebra.

In conclusion, total spondylectomy in the subaxial cervical region can be performed successfully with adequate anatomical knowledge and detailed surgical planning. A long survival period and symptom-free life can be provided by total circumferential vertebrectomy (even intralesional) for patients who suffer from cervical spine tumors. However, careful preoperative evaluation is essential and patient selection should be done on an individual basis.

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