

# Surgical Approaches for Radical Resection of Cervical Spine Lesions: Analytical Review and Surgical Experience with Correlation to the Vertebral Artery. A Retrospective Study

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## Abstract

**Objective:** The management cervical spine lesions, with spinal cord compression and vertebral artery involvement, are problematic both in terms of obtaining adequate resection and stabilisation and ensuring neurovascular compromise.

**Methods:** Cervical spine approaches for total resection of the underlying pathology and reconstruction even in a staged operation are still a matter of challenge. Twelve patients with Non traumatic, non spondylotic cervical spine disorders were managed in this study. The cardinal presentation was neck and arm pain with progressive cervical myelopathy. All patients had plain x-rays of cervical spine, cervical spine CT scan MRI. The angiogram was performed to both vertebral arteries when the pathology is in proximity to the vertebral artery. When tumour blush with feeders was evident; endovascular embolisation to minimize intraoperative bleeding was also considered. A single approach or combined anterior and posterior cervical approaches for corpectomy and cage with plate fixation and then posterior fixation for gross total resection of the lesion was considered as indicated.

**Results:** All cases made a good neurological recovery and had no neural or vascular complication. Two patients had superficial wound infection that recovered well. Three patients died; two of them died of their primary malignancy and one died from pulmonary embolism. On the long term follow up, there was no recurrence of the disease or surgical failure of the instrumentation.

**Conclusion:** This report documents a safe and reliable way to deal with non spondylotic, non traumatic cervical spine lesions with preservation of the vertebral arteries in a retrospective manner.

**Keywords:** Cervical Spine, Non Spondylotic, Spine Fixation, Vertebral Artery, Radical Resection.

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## Introduction

Variable lesions are usually encountered in the cervical spine that includes neoplastic,

spondylotic, infectious or inflammatory lesions and congenital anomalies. These lesions may present at any age group and can affect both males and females equally.<sup>1,2</sup>

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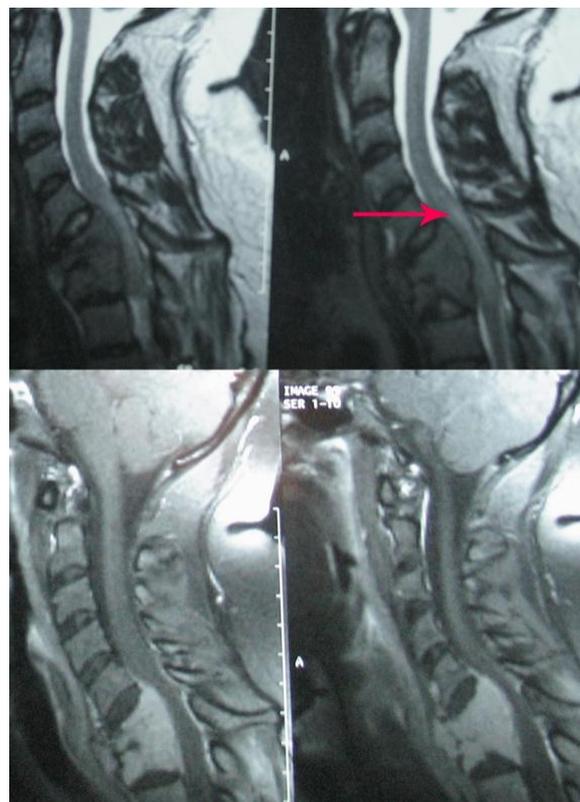
Symptoms and signs are variable and may extend from a localized or radicular pain to paraplegia. However, progressive and gradual cervical radiculo-myelopathy is usually common but swift symptoms may also occur.<sup>3</sup> In this review, we analyze cases suffering from spinal cord and nerve roots compression from cervical spine pathological changes very close to the vertebral arteries. Variable surgical options utilized for the decompression and spinal instrumental fixation with preservation of the neuro-vascular components is discussed, in particular the authors' surgical experience used to obtain the best results.

### **Methods and Analytical Review**

The study was approved by the ethical committee for human research (IRB) at Jordan University of Science and Technology. Our study group consisted of twelve adult patients treated for non traumatic non spondylotic cervical spine lesions in King Abdullah University Hospital between January 2004 and January 2009. The diagnosis was based on the clinical presentation; CT and MRI scan findings, and the final histopathology report. Exclusion criteria included patients with spondylotic cervical myelopathy, acute cervical spine trauma and intramedullary spinal cord lesion.

The group consisted of eight males and four female patients (F: M 2:1) with a median age of 30 years (range, 18-65 years). Symptoms duration to treatment was ranging between 6 and 24 months. Long term Follow up period extended from 4 months up to 48 months with an average of 2.8 years.

Two patients had spinal malignancy; one case had metastasis from the kidney and the other one had C2 malignant nerve sheath tumour. There were other two patients with craniocervical junction meningioma; the tumour was distorting the vertebral artery, spinal cord and adjacent nerve roots. One patient had a giant cell tumour that caused osteolytic lesion and engulfed the vertebral artery (figure 1a, b).

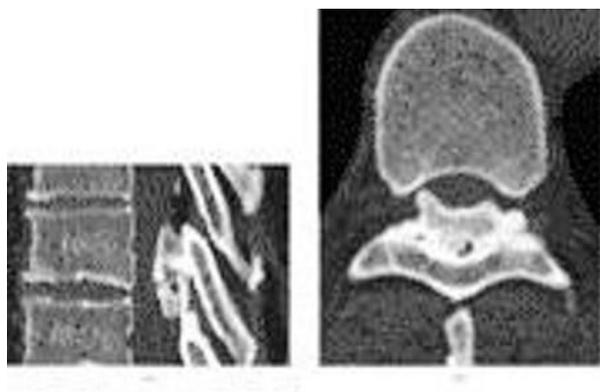


**Figure (1 a & b) : T2WI and T1WI post contrast sagittal MRI reveals a C6, C7 vertebral body destructive lesion with kyphotic angulation of the lower cervical spine and retropulsion of the posterior elements of the vertebral body resulting in a significant spinal cord compression and distortion; the lesion extends into the nerve root exit foramina and to the prevertebral space. A spinal cord high signal is also noted, arrow. The lesion illustrates a vivid enhancement after GAD contrast.**

There was a 38 week pregnant woman with a vertebral body haemangioma and exophytic extension causing spinal cord compression and acute paralysis. Rheumatoid arthritis with C5/6 subluxation and pannus formation resulted in spinal cord compression was seen in one case. Three patients had odontoid pathology with spinal instability and spinal cord compression; two had os odontoidum and one had odontoid cyst. Metabolic pathology was seen on two patients; one of them displayed heavy calcification of the posterior longitudinal ligament and the other one had ligamentum flavum calcification; both had severe spinal canal

stenosis (figure2). Although vertebral arteries were not directly affected in this pathology, we included it in this review as a wide and extensive resection with stabilization of the cervical spine which was needed and this may cause vertebral artery injury.

Neck and arm pain with progressive weakness, spastic gait and subsequent sphincteric problems were the cardinal presenting symptoms in common. Pre operative work up included; complete blood count, inflammatory markers that included erythrocyte sedimentation rate, C-reactive protein and PPD to rule out infectious process in certain cases. Plain x-ray, CT scan and Magnetic resonance imaging of the cervical spine with contrast were done routinely. Malignancy work up including chest, abdomen-pelvic CT scan, bone scan, mammogram in females were also considered in suspicious cases.

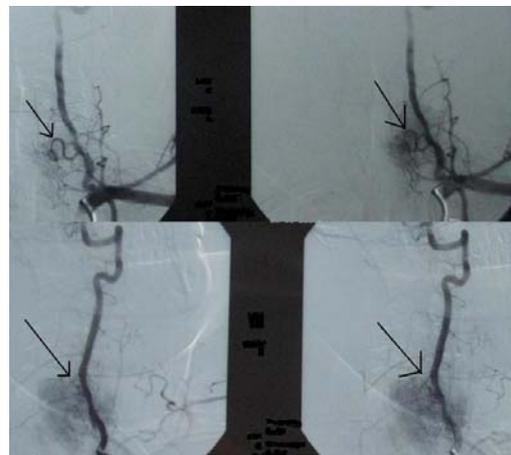


**Figure (2):** Axial and sagittal slices of the CT scan of the thoracic spine reveals a heavy calcification of the posterior longitudinal ligament resulting in a significant narrowing of the spinal canal.

A vertebral angiogram as a road map was done to cases with extensive and enhancing lesions on the MRI. With endovascular embolisation of the tumour feeders was carried out to the highly vascular lesions just a day before the planned surgery to minimize intra-operative profuse bleeding (figure 3a, b).

Anterior or posterior surgical technique was considered to achieve gross total resection of the lesion. However, in certain conditions staged

approaches were planned to deal with destructive and extensive lesions; these lesions were initially treated with anterior approach for corpectomy and fixation using cage and plates. Posterior approach for completion of the tumour resection, as feasible, with spinal fixation was accomplished on the same day (figure 4).

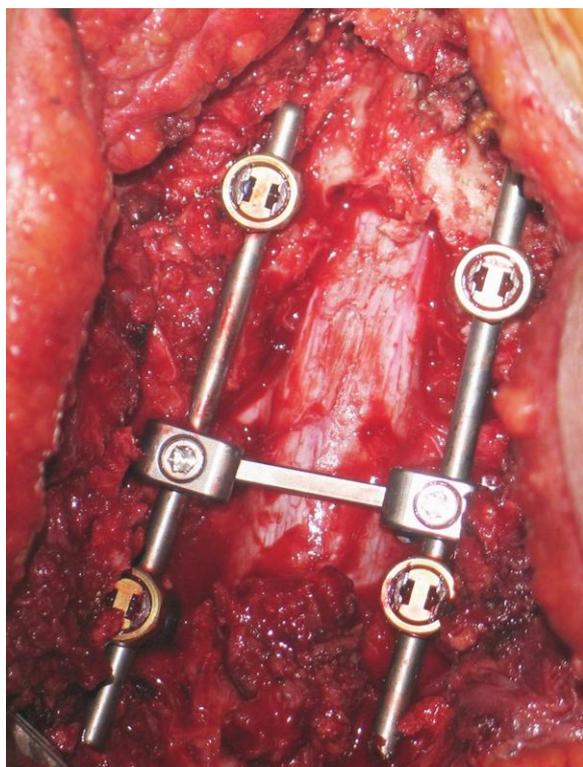


**Figure 3 (a & b):** left vertebral artery angiogram. Reveals a large feeder arising from left vertebral artery with tumour blush, arrows (a). Post endovascular embolisation angiogram revealed obliteration of the tumour feeder, arrow (b).



**Figure 4:** anterior and posterior spinal fixation after corpectomy and total resection of the spinal tumor from front and back in a staged operation.

Intraoperatively, the microscope was used for a piecemeal removal of the lesion from the neural and vascular components. Identification of the vertebral arteries was crucial as the lesion becomes very close to the arteries; this allows adequate resection with total preservation of these structures. In certain cases, the vertebral artery was encased and displaced posterio-laterally by the tumour; some kink in the entry of the artery to foramen was also noted. With gentle micro dissection and piecemeal nibbling, the tumour was taken away from the arteries and they were preserved entirely. No intraoperative vascular complication was encountered during the procedure. (Figure 5)



**Figure (5):** *Intra operative view of the thecal sac and nerve roots with spinal instrumental fixation.*

All patients had uneventful post operative course. Post operative plain x-rays of the cervical spine was done to all patients, the site of surgical resection and fixation appeared satisfactory and they started ambulation with a neck collar on the second or third post operative day. Neuro-rehabilitation was organized to all cases.

Some co morbidities were encountered in some patients; the first case had back wound superficial infection, another patient recovered well from chest infection (table 1).

## **Results**

Based on the intraoperative findings and early post operative clinical and radiological assessment, there was no evidence of neurovascular injury in all patients in this review. No one exhibited any neurological deterioration postoperatively.

On the regular long term follow up as an outpatient up to 4 years. Three patients, two females and one male died; one of them was obese and had craniocervical meningioma. She passed away from massive pulmonary embolism after 2 months of surgery, while the second case deceased of recurrence and local cervical invasion within 6 months. The third case died after three years from recurrence of the primary malignancy. Nine patients displayed a variable neurological recovery in regards to the motor and sphincteric functions, two patients of them continued to have both leg weakness and needed a mobile aid, another two patients continued to have trivial sensory changes along the medial aspect of their arms that required medications. While the rest of the patients displayed a significant neurological recovery. However, all patients continued to have hyperreflexia. As a result, no patient developed vascular or neural complication on the short and long term follow up (table 2).

Table (1): Analysis of the cases with cervical spine lesion.

	<b>Neoplasm</b>	<b>Inflammatory</b>	<b>Developmental</b>	<b>Idiopathic Metabolic Disorder</b>
<b>Sex ratio: F: M</b>	4:1	1:0	1:2	0:2
<b>Pre operative Neurological Status</b>	Mixed upper & lower motor neuron findings, spastic gait	Mixed upper & lower motor neuron findings, spastic gait	Tender and limited neck movement, hyperreflexia	Nuchal spasm Upper motor neuron findings Spastic gait
<b>Site of lesion</b>	Craniocervical C3-C5 C6-C7	C4-C6	C2	C3-C7
<b>Fine needle aspirate</b>	Done on three cases; one was suggestive of GCT other Suggestive of malignancy	Not done	Not done	Not done
<b>Neck angiogram</b>	Tumour blush and a large feeder from the left vertebral artery	Not done	Not done	Not done
<b>Intra-operative findings</b>	1-Well defined, highly vascular lesion very close to the vertebral artery and nerve roots suggestive meningioma vs haemangioma 2-Destructive, highly vascular grey and fragile lesion encasing the nerve roots and the left vertebral artery. Findings suggestive of a highly malignant tumour	Granulation tissue. Engulfing the nerve roots and the vertebral arteries	1-Destructive bony lesion involving the dens and C2 vertebral body 2- C1/C2 subluxation	1- Calcified of the ligamentum flavum, severe narrowing of the spinal canal 2- calcification of the posterior longitudinal ligament
<b>Surgical technique utilised</b>	1-GCT: endovascular embolisation, C6,C7 corpectomy with C5-T1 titanium cage & plate fusion, C6, C7 laminectomy & C5 lateral mass & T1 transpedicular screws fixation 2- other lesions: total resection with preservation of the vertebral arteries and posterior spinal fixation	Posterior decompressive laminectomy and spinal fixation	Odontoid cyst: Transoral odontoidectomy and lesionectomy with anterior plate fixation Os odontoid : C1/C2 Lateral mass fixation	Wide decompressive laminectomy and lateral mass fusion C3-C7
<b>Recurrence</b>	One patient developed local recurrence with invasion of the upper cervical structure within 3 months of surgery	Nil	Nil	Nil

Table (2): Long term patients' outcome.

	<b>Neoplastic</b>	<b>Inflammatory</b>	<b>Developmental</b>	<b>Metabolic</b>
<b>Motor</b>	One patient continued to have leg weakness	Normal	Normal	One patient continued to have leg weakness. But he is ambulatory with aid
<b>Sensory</b>	Residual numbness along the medial aspect of both arms	Normal	Normal	One patient had minimal sensory disturbances
<b>Sphincters</b>	Normal	Normal	Normal	Normal
<b>Gait</b>	Abnormal in one case	Mildly spastic	Normal	Abnormal in one case
<b>Vascular complication</b>	Nil	Nil	Nil	Nil

## **Discussion**

The cervical spine is a usual spot for trauma and spondylosis; while non traumatic and non spondylotic lesions are relatively uncommon and usually seen in adolescence. Unlike other locations of the spine, total resection of cervical spine lesion may not be feasible in all cases because of its proximity to the vital structures particularly the vertebral arteries. Like any other pathology patients with C-spine lesion often present with non specific symptoms; a long standing local and or radicular pain is very common, vertebral collapse may compromise the spinal canal and cause radiculo-myelopathy with gait unsteadiness and both sphincter disturbances. Acute symptoms may occur due to pathological fracture.<sup>4-7</sup>

The imaging appearance of the cervical spine lesions is almost remarkable. In general, malignant lesions appear on plain films and CT scan, destructive and radiolucent lesions without sclerotic margins and with soft tissue extension. While benign lesions may appear as well defined and enhance slightly. However, MRI findings for neoplastic lesions are more reliable than CT scan.<sup>8</sup> On T1-weighted images, aggressive lesions may illustrate heterogeneous or homogeneous signals of low intensity. On T2-weighted images, heterogeneous low-to-intermediate signal intensity is seen in solid areas of the tumor. Spinal cord signal changes or edema may be noticed. Areas of low signal intensity may be exaggerated on T2-weighted because of haemosiderin deposits. Its presence is probably as a result of blood leak. Peritumoral edema is common in the presence of a fracture. The tumor is usually enhancing and spinal deformity in kyphotic angulation may occur due to vertebral body collapse. Vertebral arteries may also be encased or distorted with these lesions. These radiological findings were seen in our cases with neoplastic pathology.<sup>9-11</sup> Metabolic disorders resulting in deposit of calcium salts in the soft tissues, posterior longitudinal ligament and ligamentum flavum, may cause thickening of these structures and result in a significant narrowing of the spinal canal and neural compromise. This can be illustrated better on the

plain films and the CT scan.<sup>12,13</sup>

Patients harboring non spondylotic C-spine lesion are usually young and active with normal life expectancies. So the treatment goal is to remove the underlying pathology completely and to preserve the spinal integrity. The anatomy of the cervical spine and difficulty of surgical resection require special consideration. However, multimodal treatment strategy has been adopted for lesions in this location, including surgery, radiotherapy, endovascular embolisation and adjuvant therapy as indicated. If applicable, radical surgery remains the optimal treatment basically with more aggressive lesions. Although it carries a good outcome, complete surgical excision of spinal lesions is not always achievable and it is not without a significant morbidity and mortality. Co morbidities are frequently encountered with radical resection while high failure rate is seen with inadequate treatment.<sup>14,15</sup>

In the essence, the site and extent of the lesion dictate which surgical approach is employed. In a lesion that affects the posterior elements, a Laminectomy for decompression of the neural structures and resection of the lesion along side posterior fusion is performed as indicated. While lesions involving the anterior parts require an anterior decompression with stabilization. However, in common situations combined anterior and posterior decompression and instrumental stabilization may be required. To attain adequate treatment, lesions involving this part of the spine requires staged operation for both removal and stabilization from front and back with special cautions to be focused to the vertebral arteries and other adjacent structures.<sup>2, 4,16-20</sup>

Adjuvant radiotherapy and or chemotherapy remain a matter of debate but it is definitely advocated for cases with incomplete excision when the cause is malignancy. However, optimal dose of radiation is yet to be known because the risk of spinal cord myelitis and malignant transformation. The mainstay predictor of good outcome is the adequacy of

the pathology removal and spinal stabilization with neurovascular protection and controlled recurrence on the routine surveillance for malignant lesion.<sup>6, 10, 15, 20</sup>

## Conclusion

Radical surgical treatment of the cervical spine lesions with spinal fixation is the treatment of choice. This requires the utility of wide surgical techniques and may need staged operations. Certain attention to the vertebral arteries is to be considered when treating pathology in this region; this may require a neck angiogram and endovascular embolisation. Adjuvant radiotherapy is preserved by many authors to cases of residuals or recurrence. Close follow up is essential even after gross total resection in cases of malignancy and neuro rehabilitation is required on all patients with cervical myelopathy. With variable surgical approaches long term satisfactory outcome can be obtained.

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## التداخل الجراحي لاستئصال الآفات الرقبية: مراجعة تحليلية مع الخبرة فيما يتعلق بالشريان الرقبي (دراسة راجعة)

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### الملخص

**الهدف:** تعتبر إصابات العمود الفقري الرقبي مع الضغط على النخاع الشوكي خطيرة لقرعها من الشريان الرقبي الذي يغذي جذع الدماغ. وهذه الخطورة ناجمة عن الحاجة للاستئصال الكامل للآفة مع المحافظة على ثبات العمود الفقري وسلامة الشريان الرقبي، وهذا يتطلب إجراء عملية جراحية من الأمام أو الخلف أو كليهما. تشمل هذه الدراسة المرضى المصابين بآفة في الرقبة عدا عن الرضوض أو التآكل الهرمي. أغلب المرضى كانوا يعانون من الآم في الرقبة ومن اعتلال في النخاع الشوكي. وقد اجري هؤلاء المرضى صور رنين مغناطيسي للرقبة، وصور طبقية وصور قسطرة شريانية للرقبة، وأجري للبعض مداخل شاعية لإغلاق الشريان المغذي للورم. المداخل الجراحية الأمامية عبارة عن استئصال الفقرة وتثبيت بواسطة صفائح وبراغي. وكانت المداخل الجراحية الخلفية إزالة الصفيحة العظمية مع تثبيت بواسطة براغي مع المحافظة الكاملة على الشريان الرقبي. تم معالجة اثني عشر مريضاً بواسطة هذه الطرق العلاجية وكانت النتائج مشجعة. وبمتابعة الحالات على المدى الأطول توفيت سيدة من جلطة رئوية. وتوفي اثنان من مرض عودة السرطان الأولي. وبالتالي أثبتت هذه الدراسة أن التقنية الجراحية وطريقة العلاج المستخدمة من قبل الجراحين هي آمنة وفعالة ونتائجها مرضية.

**الكلمات الدالة:** العمود الفقري الرقبي، غير الفقاري، تثبيت العمود الفقري، الشريان الفقاري، إستئصال جذري.