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Resection of an Occipital–Cervical Junction Schwannoma through a modified minimally invasive approach: Technical Note

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Abstract

Background: Minimally invasive spine (MIS) techniques have been available for many years, but their application has been largely limited to degenerative spine diseases. There are few reports in the literature of using MIS techniques for removal of neoplasms. We report our experience using a modified MIS technique for removal of an occipital–cervical junction (OCJ) schwannoma with attention to technical aspects of this approach.

Case Description: A 64-year-old male presented with several months of neck pain radiating to the shoulder with bilateral hand numbness. The patient had evidence of early myelopathy on examination. Magnetic resonance imaging (MRI) demonstrated enhancing intradural lesion with significant mass effect on the spinal cord. The mass extended extradurally through the right C1 neural foramen. Imaging characteristics were suggestive of a schwannoma. The patient underwent a minimally invasive far lateral approach to the OCJ for resection of the lesion. A Depuy Pipeline™ expandable retractor was used for visualization. Surgical resection was performed with microscopic visualization. Somatosensory evolved potentials (SSEP) monitoring was used. The patient tolerated the procedure well. Postoperative imaging demonstrated gross total resection. No intra- or postoperative complications were noted. The patient was discharged home on postoperative day 2. At 1-month follow-up, his preoperative symptoms were resolved and his wound healed excellently.

Conclusion: In properly selected patients, minimally invasive approaches to the OCJ for resection of mass lesions are feasible, provide adequate visualization of tumor and surrounding structures, and may even be preferable given the lower morbidity of a smaller incision and minimal soft tissue dissection.

Key Words: Minimally invasive spine, occipital–cervical junction, schwannoma, technique

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INTRODUCTION

Schwannomas are among the most common spinal tumors, with an annual incidence of 3–4 per million.[12] Though these tumors are biologically benign, they may cause significant morbidity through compression of surrounding neural structures. Thus they have been traditionally managed with surgical resection. Historically the most common approach to spinal schwannomas is with an open posterior laminectomy. However, this

approach may cause significant postoperative pain and potential spinal instability.[14]

Over the past decade, minimally invasive spine (MIS) techniques have emerged and may serve to reduce the postoperative pain and musculoligamentous and bony destruction after spinal surgery.[7,10] MIS techniques, used initially for microdiscectomies and decompressive procedures, have of late developed wide indications at all spinal levels with well-described successful outcomes.[6,13] The use of MIS techniques for spinal neoplasms, however, seems to be progressing more slowly, despite the potential benefits to patients. MIS techniques for intramedullary tumors have, in some studies, resulted in decreased operative time relative to traditional posterior laminectomies, as well as decreased blood loss and decreased postoperative stay.

The use of minimal exposure for the resection of cervical neoplasms is an area of recently increasing study and tremendous potential. One small study examined the benefit of a midline posterior approach for upper cervical schwannomas with minimized but traditional exposures and found this successful in tumor resection.[11] Other surgeons have explored the potential efficacy of minimizing exposure for tumors with intra/extradural extension. Specifically, Cavalcanti *et al*. were able to demonstrate the effective removal of small upper cervical schwannomas with a hemilaminectomy and larger neoplasms with a far lateral approach and C2 laminectomy.[4] Many of these preliminary studies suggest good clinical outcomes with modified techniques to decrease bony and musculoskeletal destruction.[3] Despite the apparent benefits and increasing frequency with which such procedures are performed, some authors express concern over the limitations of tumor visibility with MIS approaches, and caution that a major procedural limitation may be adequate tumor visualization or sufficient surgical work space.[2] Furthermore, in the region of the occipital–cervical junction (OCJ) there is the concern of inadequate visualization or iatrogenic injury of vital structures such as the lower cranial nerves and the vertebral artery with its complex course in the upper cervical region.

Given the growing body of evidence on the efficacy of MIS, we believe that MIS techniques are safe for resection large upper cervical benign neoplasms and present our own experience with a modified MIS technique for resection of an OCJ schwannoma.

Clinical presentation

A 64-year-old male presented with a complaint of several months of neck pain radiating into his right arm, as well as bilateral hand anesthesia. He denied any weakness or difficulty walking. His past medical history was notable only for hypertension and hyperlipidemia. He had a distant history of hand surgery and a pilonidal cystectomy, and denied any past head or back operations. Neurologic examination was notable for a subtle drift of the right upper extremity as well as one to two beats of clonus in both feet. Hoffman's sign was absent bilaterally. The remainder of his neurologic and physical examination was normal.

Magnetic resonance imaging (MRI) of the cervical spine demonstrated a right-sided extramedullary lesion at the C1-C2 level with an intradural component causing significant compression of the spinal cord. The mass also had a large extradural component extending through the right neural foramen and tracking along the nerve root. The mass avidly enhanced and showed some evidence of cystic degeneration [Figure 1]. Computed tomography (CT) of the neck with angiogram confirmed the course of the right vertebral artery in close proximity to the mass [Figure 2]. The right C2 foramen was widened, but there was no evidence of significant bony destruction by the mass. Imaging characteristics were highly suggestive of a schwannoma. Surgical resection was recommended due to the size of the lesion, evidence of spinal cord compression, and early signs of myelopathy on examination.

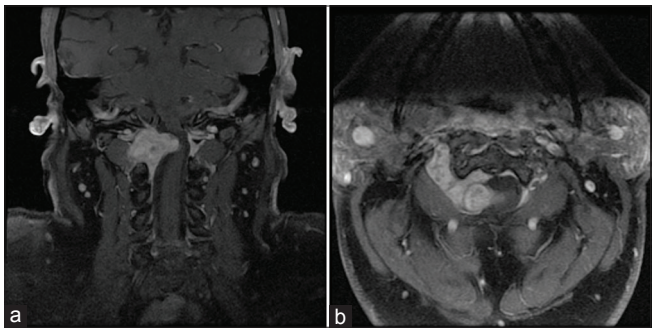

Figure 1: Coronal (a) and axial (b) fat-suppressed T1-weighted images postGadolinium administration demonstrating a large avidly enhancing extramedullary mass at the C1-2 level with both intra- and extradural components consistent with a schwannoma

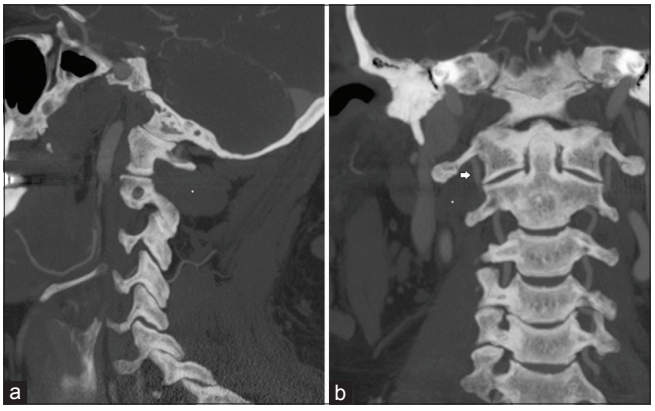

Figure 2: Sagittal (a) and coronal (b) slices from preoperative CT Angiogram demonstrating widening of the right C2 foramen but without bony destruction. The tumor is indicated by (*) and the vertebral artery is highlighted by the closed arrow

Operative technique: Modified minimally invasive far lateral approach

Position and preliminary incision / dissection

The patient was brought to the operating room and underwent general anesthesia. SSEP monitoring was used. The patient was placed in the lateral position with the right side up and head in three-point fixation with the neck flexed and the contralateral ear tipped toward the contralateral shoulder. An incision was marked from the mastoid tip inferiorly 4 cm paralleling the posterior border of the sternocleidomastoid muscle. Preliminary dissection was performed under direct visualization with a surgical knife and electrocautery. Metzenbaum scissors were used to continue the dissection down to the suboccipital triangle. The lamina and transverse process of C2 were visualized. Multiple dilators were placed in series on the C2 lamina. Correct placement of the dilators on C2 was confirmed by fluoroscopy. Next the dilators were moved cranially to allow visualization of the oblique muscle bridging the C2 and C1 laminae and transverse processes. The muscle was divided with electrocautery and reflected to allow excellent visualization of the underlying bony anatomy, and subsequently the Depuy Pipeline™ retractor was inserted and expanded [Figure 3].

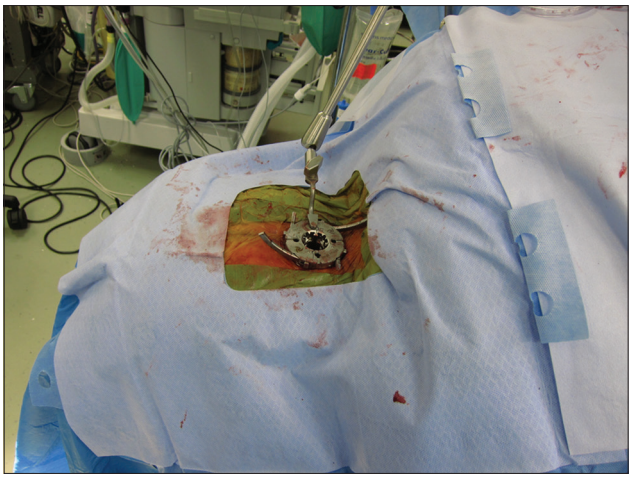

Figure 3: Intraoperative photograph demonstrating the Pipeline retractor in place on the posterolateral aspect of the patient's neck

Hemilaminectomy and tumor debulking

The tumor was readily visible underneath the arch of C1 extending both caudally and cephalad, as well as laterally. Hemilaminectomy of C1 and partial hemilaminectomy of the superior aspect of C2 were performed to allow visualization of the tumor in its entirety as well as the surrounding critical structures. Under microscopic visualization, the tumor was debulked piecemeal. The vertebral artery and its venous plexus were well visualized [Figure 4]. The extradural component of the mass was resected until its entrance into the dura could be visualized. Bleeding from the vertebral venous plexus was controlled with irrigation and surgifoam. The dura was opened and the tumor was traced along the C2 nerve root. The C2 nerve root was divided and the remainder of the tumor was removed.

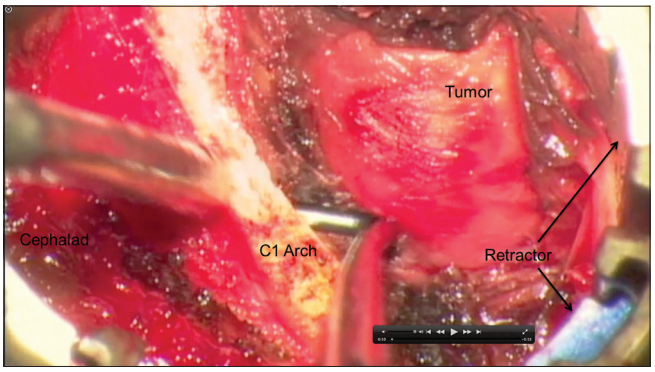

Figure 4: Intraoperative photograph of microscopic view of the tumor in relation to the arch of C1

Closure

The dura was closed using an on-lay patch of Duragen and Duraseal. The fascial and subcutaneous layers were closed in routine interrupted watertight fashion [Figure 5]. There were no changes to the somatosensory potentials at any point during the case. Total operation time was 6 h. The estimated blood loss was 550 cc. The patient was taken to recovery where he awoke in a normal fashion.

Figure 5: Postoperative photograph of the patient's skin incision at the end of the procedure

Postoperative outcome

The patient had a very good postoperative course. His mean postoperative pain score was 2. MRI of the cervical spine on postoperative day 2 demonstrated gross total resection [Figure 6]. He was discharged home on postoperative day 2. At 1-month follow-up, the patient was doing well. Final pathology confirmed the tumor to be a World Health Organization (WHO) Grade I schwannoma. His symptoms were significantly improved, his wound was healing quite well, and he experienced no significant movement restriction. The patient did

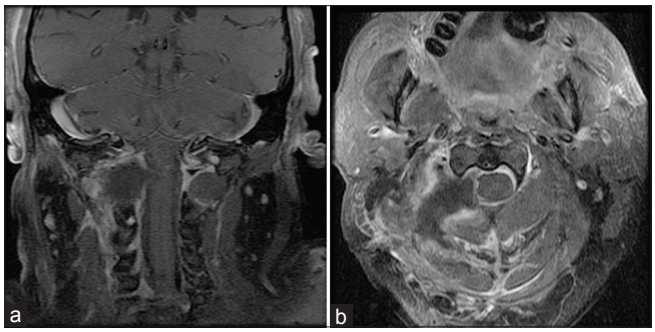

Figure 6: Coronal (a) and axial (b) fat-suppressed T1-weighted images postGadolinium administration showing excellent resection of the tumor

have a recurrence of the extra-dural component of the tumor without neurologic sequelae. The recurrence was treated with stereotactic radiosurgery with good effect. At 3 years follow-up, he is doing well with his only neurologic symptoms being numbness of the posterior scalp secondary to his incision and sacrifice of the C2 nerve root.

DISCUSSION

In this case report, we describe the first noted resection of an OCJ schwannoma with a modified minimally invasive far lateral approach. This patient had an excellent operative and functional outcome.

MIS approaches to cervical tumor debulking are becoming increasingly common, but there still exists a dearth of descriptive literature attesting to their safe and beneficial use. This may be in part due to many of the reasons discussed previously, namely a restricted surgical field and concerns about adequate tumor access, exposure, and visualization of surrounding anatomic structures. Preliminary studies have actually demonstrated the opposite, with one notable study showing that MIS approaches were able to effectively remove cervical intradural, extramedullary neoplasms with less blood loss and shorter operative times.[15] Further, MIS procedures minimize risk to the patient for potential kyphosis, spondylolisthesis, or other debilitating structural instability due to disruption of the bony and ligamentous architecture or posterior muscle attachments.[1,5]

Some authors have voiced caution over the use of MIS techniques for the OCJ. However, this case demonstrates that this region can be safely approached with MIS techniques. Although there are a paucity of reports, Lu *et al.* have previously described their experience with the use of a MIS approach for treatment of Bowhunter's syndrome in an adolescent caused by a suboccipital bony spur with excellent technical and clinical results.[8] Our case furthers the argument that MIS techniques are technically feasible for cervical tumors and in particular for the OCJ. The demonstrated complete visualization and removal of a complex and large multilevel intra- and extradural schwannoma with minimal tissue disruption using an MIS approach is a significant step forward for widening the indication for MIS procedures.

The key for our operative approach was the use of careful dissection to identify bony landmarks; in our case the lamina and lateral mass of C2, followed by the use of dilators and an expandable retractor to obtain a suitable corridor for visualization of the tumor and surrounding anatomy. Our technique was predicated on several key items: First, an excellent working knowledge of OCJ anatomy. The senior author has performed many procedures in this region. Second, the approach was predicated on a substantive exposure to MIS techniques, as the senior author has performed hundreds of previous MIS procedures. With this solid foundation, this novel modified MIS approach could be attempted with reasonable safety to the patient.

Because of their novelty, especially for neoplastic indications, MIS procedures are operator dependent and there is an expected learning curve for MIS procedures. With the proliferation of MIS techniques accelerating, Mannion *et al.* proposed criteria for the use of MIS, suggesting that these approaches should be taken only if they do not have increased risk, offer some tangible benefit to the patient, and can achieve the same surgical goals.[9] We would offer that MIS techniques, in the setting of tumor resections or approaches to anatomically complex regions, should be reserved for surgeons who have accumulated significant experience with the use of MIS.

We posit that our experience with this case shows that MIS techniques can be used for approaches to the OCJ, even for tumors more complex and expansive than may be suggested by the current literature. Furthermore, we suggest that the described far lateral approach achieves good surgical field access while minimizing the postoperative pain and risks of instability associated with more extensive procedures.

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