CRANIOCERVICAL JUNCTION DISEASES TREATMENT WITH A MINIMALLY INVASIVE APPROACH

ABORDAGEM MINIMAMENTE INVASIVA PARA TRATAMENTO DE LESÕES DA UNIÃO CRANIOCERVICAL

ABORDAJE MINIMAMENTE INVASIVO PARA TRATAMIENTO DE LESIONES DE LA UNIÓN CRANIOCERVICAL

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ABSTRACT

Objective: To introduce a new minimally invasive surgical approach to anterior and lateral craniocervical junction diseases, preserving the midline posterior cervical spine stabilizing elements and reducing the inherent morbidity risk associated with traditional approaches. Methods: We describe a novel surgical technique in four cases of extra-medullary anterolateral compressive lesions located in the occipito-cervical junction, including infections and intra- and/or extradural tumor lesions. We used a paramedian transmuscular approach through an anatomical muscle corridor using a micro MaXcess® surgical expandable retractor, with the purpose of reducing morbidity and preserving the posterior muscle and ligamentous tension band. Results: This type of surgical approach allows adequate visualization and microsurgical resection of lesions and reduces muscle manipulation and devascularisation, preserving the tension of the ligament complex. There was minimal blood loss and a decrease in postoperative pain, with rapid start of rehabilitation and shorter hospitalization times. There were no intraoperative complications, and all patients recovered from their pre-operative symptoms. Conclusions: This novel surgical technique is feasible and adequate for the occipito-atlanto-axial complex, with better results than traditional procedures.

Keywords: Spine; Cervical vertebrae; Laminectomy; Microsurgery; Surgical procedures, minimally invasive; Spinal neoplasms.

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INTRODUCTION

The craniocervical junction is considered to be a biomechanical and functional unit comprising bony, ligamentary, and soft tissue structures on which craniospinal structural stability and the integrity of vitally important neurovascular structures depend. 1 The study of the anatomy of these structures in clinical pathology and surgery justifies the implementation of new techniques for approaches at...
this level. Over the last ten years, these concepts have influenced surgical procedure plans for the resection of tumors, traumatic pathology, and degenerative diseases.²⁻⁷

Technological advances in neuroimaging, microsurgical instruments, and minimally invasive surgery have enabled the development of new approaches that maintain the favorable neurological outcomes achieved using conventional spinal neoplasia resection techniques. Additionally, these approaches preserve the midline and posterior spinal structures, reducing the risk of post-operative instability, with less damage to the soft tissues, less blood loss, minimal post-operative pain, and a short hospital stay.²⁻⁵⁻⁷⁻¹³

Success in the approach to injuries of the craniocervical junction is based on knowledge of the dynamics of this unit. Anatomical studies of this area stress the importance of preserving both the paraspinal muscular structures and the anterior and posterior ligaments, to insure adequate post-operative stability.¹ Our study describes a new surgical technique for the resection of anterolateral, compressive, intra- and extradural, extramedullary lesions of the craniocervical junction, through an anatomical transmuscular paramedian corridor, using the Maxcess® (Nuvasive Inc., San Diego, CA, USA) micro-retractor with the aim of reducing morbidity and preserving the posterior muscular ligamentous tension band.

MATERIALS AND METHOD

We present a case report of a patient with intra and extradural, intra-rachidian, extramedullary lesions located in the anterolateral region of the craniocervical junction, with the objective of evaluating the surgical anatomy and the feasibility of the approach for injuries at this level. Clinical follow-up was conducted, and patients treated between January 2009 and December 2011 were included. Surgical time, blood loss, intra-operative and post-operative complications, hospitalization time, and pre- and post-operative neurological status were recorded.¹⁴

Surgical Technique

Under general anesthesia, the patient is positioned in prone decubitus, with the head fixed in the neutral position using a Mayfield-type three-pin support. The alignment of the C1 – C2 complex is confirmed using a fluoroscopic guide. A 3 cm linear paramedian incision is made, two centimeters from the midline, ipsilaterally to the location of the lesion, to expose the outer surface of the muscle. (Figure 1) A transmuscular digital dissection was performed through the trapezius and semispinalis capitis; deeper, following a line parallel to the spinous process of C2, an anatomical corridor was found, formed by the angle between the rectus capitis posterior minor and the obliquus capitis inferior muscles. (Figure 2) There are no important vascular or neural structures at this level. Guided by fluoroscopy, the first tubular dilator is positioned in this corridor and then the other dilators are gradually inserted. Finally, the Micro Maxcess® retractor, which has its own light source, is positioned and secured. (Figure 3) The C2 – C3 articulation, the lamina, and the pedicle are observed under high magnification. Sometimes residual vascular tissue is found at this level and can be submitted to monopolar or bipolar resection. Once the bone surface is exposed at a 30° angle, a hemilaminectomy of C2 is performed, with 1 and 2 mm Kerrison punches, identifying and resecting the ligamentum flavum, and observing the lateral outer surface of the dural sac. Depending on the case, the lesion is microsurgically resected or drained. (Figure 4) Hemostasis with Gelfoam and irrigation with saline solution are performed. In the event of dural opening, closure is performed using fibrin sealant and an autologous fat graft.

Case History

Patient, 39 years of age, who began to experience numbness of the right hand one year prior to the consultation, and which had spread bilaterally to the arms, abdomen, and legs over the last few months. The patient also presented clumsiness of the hands and changes in gait. The neurological exam revealed hypoaesthesia with sensory level C4, spastic paraparesis at C4-C5, changes in proprioception, osteotendinous hyperreflexia of the four extremities, and Hoffman, Trommer, and Babinski signs.

Simple and contrast magnetic resonance of the craniospinal junction was performed, revealing an intradural, extramedullary lesion in the anterolateral region of the spinal canal at the C1 – C2 level, causing severe compression of the spinal cord and the nerve roots. Resection of the lesion was performed using the surgical technique described, with no complications, a surgical time of 4 hours and 10 minutes, blood loss of 500 cc, and the complete improvement of the numbness and recovery of the sensory level in the immediate post-operative period. Hospital discharge after 36 hours with appropriate evolution. In the follow-up visit one week after the procedure, the symptoms were completely resolved and there was minimal post-operative pain. Cervical resonance was performed a month later as a control and there was no evidence of any residual tumor causing compression.
Between January 2009 and December 2011 four patients (two men and two women) underwent surgical procedures using this technique. All the lesions were located in the anterolateral region of the craniocervical junction. Two patients had extradural tumors, one patient had an intradural tumor, and one patient had an extradural abscess. There were no intra- or post-operative complications. All the patients (100%) recovered adequately from their pre-operative symptoms. Average intra-operative bleeding was 203.5 cc. The patients experienced minimal post-operative pain and were discharged after an average of 46.8 hours following surgery. There were no associated cases of infection. (Figure 5)

**DISCUSSION**

The current trend in spinal neurosurgery is for minimally invasive surgery. Multiple previous studies have established a valid justification for this type of approach with similar results in terms of resected volume, neurological outcomes, and conservation of structures essential to the biomechanics of the spine. 9-11,15-18

Minimally invasive approaches have been developed for degenerative pathology4,5,18-21 and for some predominantly thoracolumbar neoplasias.1,7,11,13,16,17,22-24 This development has been associated with technological advances in minimally invasive techniques. Our review of the literature on approaches to resection of spinal tumors found few studies of the craniocervical junction or upper cervical spine levels, and those that were reviewed involved anterior or anterolateral approaches requiring total or partial corpectomy.14,25,26 However, other authors believe that posterior approaches are safer and avoid the complications of the anterior approach, such as visceral or vascular damage or recurrent paralysis of the laryngeal nerve.19,25,27,28 Reports of minimally invasive posterior approach techniques for tumors suggest the need to perform hemilaminectomy, subtotal hemilaminectomy, of interlaminar fenestration in all cases with midline incisions and dissections.2,9,10,13,29 These approaches involve disinsertion of the paraspinal musculature and ligamentary structures, though to a lesser extent than traditional techniques. Unlike both the traditional and minimally invasive approaches reported in the literature, our approach is performed via the paramedian route, through an anatomical muscle corridor, reducing further damage to the paravertebral soft tissue and preserving the craniocervical band. Besides this being a paramedian approach, it allows a 30° entry angle for anterolateral lesions, which is difficult to achieve with traditional approaches.
This approach offers an alternative to traditional treatment of the anterolateral spinal occlito-atlas-axis complex level because it demonstrates good results in terms of the volume of the lesion resected, the post-operative neurological evolution, less blood loss, less post-operative pain, and shorter hospitalization times.

CONCLUSION

Our surgical technique involves a minimally invasive posterior paramedian approach, based on the description of a new anatomical transmuscular paraspinal posterolateral corridor that promotes less surgical injury and simplifies access to the craniocervical junction. This new approach is useful not only in tumor pathology, but also in the management of degenerative or traumatic diseases at this level. This surgical technique has not been previously recorded in the literature for the resection of compressive intraspinal lesions at this level, and may be extremely useful for the development of new treatment alternatives. We believe, as in the literature reviewed, that minimally invasive surgery requires special training in these techniques and should be performed by groups with sufficient experience to achieve reproducible results.\textsuperscript{5,7,15} The continuation of this study and future contributions will establish this technique as a key alternative within the area of spinal surgery.

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REFERENCES

1. Tubbs RS, Hallock JD, Radcliff V, Naftel RP, Mortazavi M, Shoa MM, et al. Ligaments of the craniovertebral junction. J Neurosurg Spine. 2011;14(6):697-709.
2. Dethco R, Marci S, Ricci A, D’Cola F, Galizio RJ. Less invasive approaches for the treatment of cervical schwannomas: our experience. Eur Spine J. 2011;21(8):887-96.
3. Fessler RG, O’Toole JE, Eichholz KM, Perez-Cruet MJ. The development of minimally invasive spine surgery. Neurosurg Clin N Am. 2006;17(4):403-9.
4. Franke J, Greiner-Perth R, Boehm H, Mahfeld K, Grasshoff H, Allam Y, et al. Comparison of a minimally invasive procedure versus standard microscopic discotomy: a prospective randomised controlled clinical trial. Eur Spine J. 2009;18(7):992-1000.
5. Fessler RG, O’Toole JE, Ferroli P, Broggi G. Minimally invasive disc preserving surgery in cervical radiculopathies: the posterior microscopic and endoscopic approach. Acta Neurochir Suppl. 2011;108:197-201.
6. Maiuri F, Iaconetta G, de Divitiis O. The role of intraoperative sonography in reducing invasiveness during surgery for spinal tumors. Minim Invasive Neurosurg. 1997;40(1):8-12.
7. O’Toole JE, Eichholz KM, Fessler RG. Minimally invasive approaches to vertebral column and spinal-cord tumors. Neurosurg Clin N Am. 2006;17(4):491-506.
8. Haji FA, Cenic A, Cirex L, Mutty N, Reddy K. Minimally invasive resection for the resection of neoplastic spine. Spine (Phila Pa 1976). 2011;36(19):E1019-26.
9. Naganawa T, Miyamoto K, Hosoe H, Suzuki N, Shimizu K. Hemilaminectomy for removal of extramedullary or extradural spinal cord tumors: medium to long-term clinical outcomes. J Spinal Disord Tech. 2011;24(6):429-33.
10. Sun CX, Meng XL, Xie SN, Yu Y, Yang HJ, Wu B. Unilateral hemilaminectomy for patients with intradural extramedullary tumors. J Zhejiang Univ Sci B. 2011;12(7):576-81.
11. Pompili A, Caroli F, Telera S, Occhipinti E. Minimally invasive resection of intradural-extradural spinal neoplasms. Neurosurgery. 2006;59(5):E1152.
12. Uribe JS, Dakwar E, Le TV, Christian G, Serrano S, Smith WD. Minimally invasive surgery for thoracic intraspinal tumors. J Spinal Disord Tech. 2011;24(6):429-33.
13. Yu Y, Zhang X, Hu F, Xie T, Gu Y. Minimally invasive microsurgical treatment of cervical intraspinal extramedullary tumors. J Clin Neurosci. 2011;18(9):1688-73.
14. Yasuda M, Bresson D, Cornelius JF, George B. Anterolateral approach without fixation for resection of an intradural schwannoma of the cervical spinal canal: technical note. Neurosurgery. 2009;65(6):1788-91.
15. Gersztten PC, Welch WC. Spine: minimally invasive techniques. Prog Neurol Surg. 2006;19:135-51.
16. Mannion RJ, Nowitzke AM, Efterdy J, Wood MJ. Safety and efficacy of extradural intramedullary spinal tumor removal using a minimally invasive approach. Neurosurgery. 2011;68(1 Suppl Operative):208-16.
17. Sario-glu AC, Hanci M, Bozkus H, Kaynar MY, Kafadar A. Unilateral hemilaminectomy for the removal of the spinal space-occupying lesions. Minim Invasive Neurosurg. 1997;40(2):34-7.
18. Winder MJ, Thomas KC. Minimally invasive versus open approach for cervical laminoforaminotomy. Can J Neurol Sci. 2011;38(2):262-7.
19. Galà VC, O’Toole JE, Volydizis JM, Fessler RG. Posterior minimally invasive approaches for the cervical spine. J Neurosurg. 2009;111(3):539-49.
20. Shchedrenok VV, Ivanenko AV, Sebelev KI, Moguchaya OV. [Minimally invasive surgery of degenerative diseases of the spine.] Vestn Khr Im I I Grek. 2010;169(2):102-4.
21. Wang MY, Levi AD. Minimally invasive lateral mass screw fixation in the cervical spine: initial clinical experience with long-term follow-up. Neurosurgery. 2006;58(5):307-12.
22. Gottfried ON, Dalley AT, Schmidt MH. Adjunct and minimally invasive techniques for the diagnosis and treatment of vertebral tumors. Neurosurg Clin N Am. 2008;19(1):125-38.
23. Pompili A, Caroli F, Cattani F, Crecco M, Giovannetti M, Raus L, et al. Unilateral limited laminectomy as the approach of choice for the removal of thoracolumbar neurofibromas. Spine (Phila Pa 1976). 2004;29(15):1698-702.
24. Sridhar K, Ramamurthi R, Vasudevan MC, Ramamurthi B. Limited unilateral approach for extramedullary spine tumors. Br J Neurosurg. 1998;12(5):430-3.
25. Acosta FL Jr, Aryan HE, Chu, J, Parsa AT, Ames CP. Modified paramedian transpedicular approach and spinal reconstruction for intradural tumors of the cervical and cervicothoracic spine: clinical experience. Spine (Phila Pa 1976). 2007;32(8):E203-10.
26. Barret C, Saint-Pierre G, Frappaz D, Herrier M, Mottola C. Complete removal of an intraspinal and extraspinal cervical chordoma in one stage using the lateral approach. Technical note. J Neurosurg Spine. 2006;5(5):471-5.
27. Atn DK, Park HS, Choi DJ, Kim KS, Kim TW, Park SY. The surgical treatment for spinal intradural extramedullary tumors. Clin Oncol Surg. 2009;1(3):165-72.
28. Angeline PD, Kallner C, Haque RM, McCormick PC. Surgical management of ventral intradural spinal lesions. J Neurosurg Spine. 2011;15(1):28-37.
29. Wang J, Ou SW, Wang YJ, Wu AH, Wu PF, Wang YB. Microsurgical management of dumbbell C1 and C2 schwannomas via the far lateral approach. J Clin Neurosci. 2011;18(2):241-6.