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Technical Note & Surgical Technique

Quadrantectomy for resection of spinal ependymomas with a new classification of unilateral approaches regarding bone drilling and the use of a new tool: The Balak ball-tipped water jet dissector

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ABSTRACT

Objective: The "unilateral approach" is widespread in surgery for spinal degenerative pathologies. However, it is seldom used for resection of spinal intradural lesions. We present two cases where the "quadrantectomy approach", a sub-category of the unilateral approach, was used for resection of spinal ependymoma and propose a new classification system of the unilateral approach regarding bone drilling and describe the use of the Balak ball-tipped water jet dissector in this procedure.

Patients and methods: Two patients who underwent surgical treatment of spinal intradural tumor are presented. The tumors were resected using microscopic dissection techniques and neuro-monitoring. An instrument specifically designed for the dissection of the cauda equina nerve roots was used. The surgical technique is presented with stepwise photographs.

Results: Contrast enhanced magnetic resonance imaging scans obtained on the second day after surgery showed that the tumors in both cases had been totally removed and the nerve roots had regained their natural shape. Histopathological diagnosis was a myxopapillary ependymoma in both cases. There were no postoperative neurological deficits and both patients recovered completely. At two-year and one-year follow-up respectively after surgery, the patients were perfectly well.

Conclusion: A quadrantectomy approach, which preserves the facet joints and midline structures, should be regarded as a safe subtype of unilateral approaches to spinal intradural lesions. This new terminology will be helpful in proper comparison of the results of various surgical approaches in terms of postoperative spinal instability. The ball-tipped water jet dissector is a beneficial tool for surgery in the cauda equina region.

1. Introduction

Although unilateral hemilaminectomy is a relatively widespread procedure for decompression of the spinal canal for degenerative diseases, it is seldom used for resection of spinal intradural lesions [1–15]. "The unilateral approach" is a broad term, which can be misleading; its use in the literature to refer to a variety of approaches may result in a failure to distinguish between them. For example, a unilateral approach may or may not include the removal of the unilateral facet joint, the spinous process, the interspinous ligaments, the contralateral muscles or the contralateral hemilamina. It should also be noted that the amount of required bone removal for treatment in the surgery of a spinal intradural tumor differs from that of spinal degenerative stenosis. These variations in the procedure produce very different results in post-operative spinal instability. Hence, in order to eliminate misunderstandings and provide more sound evaluations of scientific articles in the field, the use of specific terms for modifications of the unilateral approach are needed.

The term "*quadrantectomy*" to denote a unilateral *partial* hemilaminectomy, in which the facet joint and spinous process are not removed was first described by Mahmut Gazi Yaşargil in 1991 [3,16]. The word "*quadrant*" refers to a sector equal to one quarter of a circle. Unfortunately, in a review of the previous literature, we were unable to find a consented description of the anatomical extent of hemilaminectomy in the unilateral approach to spinal intradural tumors. In this report, the technique we used is described, the relevant literature is reviewed and the anatomical limits of the hemilaminectomy are clearly explained, including the preservation of the facet joint. The specific term, 'quadrantectomy', has been used to name the procedure, while, to help eliminate any confusion in the literature regarding bone drilling, a new

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classification of unilateral approaches for resection of spinal intradural tumors is proposed. The author also describes an innovative tool, which was found helpful in the dissection of cauda equina nerve roots in the resection of ependymoma.

2. Methods

Two patients who underwent surgical treatment for spinal intradural tumor are presented. Preoperative evaluation consisted of physical examination and radiological imaging, including computed tomography (CT) scans, magnetic resonance imaging (MRI) scans with gadolinium and routine radiographs. The patients gave informed consent and underwent a minimally invasive approach with resection of the intradural tumor. The tumors were resected using microscopic dissection techniques and neuro-monitoring. An instrument specifically designed for the dissection of the cauda equina nerve roots facilitated the surgery. The surgical technique is presented with stepwise photographs.

3. Illustrative cases

3.1. Patient 1

3.1.1. Clinical presentation and imaging

A 27-year-old male patient was admitted to our hospital after complaining of a progressively severe low back pain and radicular pain in the lower extremities, more severe on the left side, for the prior eight months. Neurological examination revealed a positive straight leg-raising test at 50 degrees on the left side. The patient's preoperative spinal axial and sagittal contrast-enhanced T1-weighted, and sagittal T2-weighted MRI scans are seen in Fig. 1A–C.

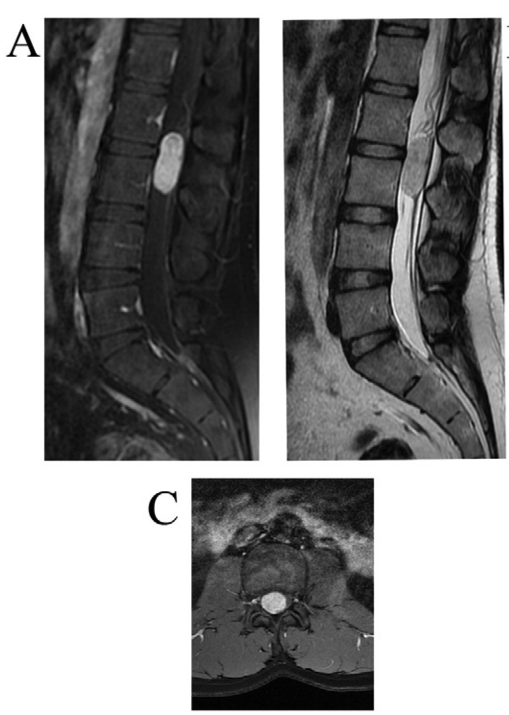

Fig. 1. Pre-operative radiological imaging scans of Case 1. A, T1-weighed sagittal contrast enhanced magnetic resonance imaging scan, B, T1-weighed axial contrast enhanced magnetic resonance imaging scan, C, T2-weighted sagittal magnetic resonance imaging scan.

3.2. Patient 2

3.2.1. Clinical presentation and imaging

A 39-year-old female patient was admitted to our hospital after complaining of a progressively severe low back pain and hypoesthesia in the lower extremities for the prior two years, more prominent on the left side, and radicular pain in the right lower extremity for the prior three months. Neurological examination revealed a positive straight leg-raising test at 40 degrees on the right side and hypoesthesia in both the lower extremities. The patient's preoperative spinal sagittal contrast-enhanced T1-weighted and T2-weighted MRI scans are seen in Fig. 2A–B. There was also a disc protrusion compressing the right L5 nerve root at the level of L4–5.

3.3. Operative technique

In patient 1, one day before the surgery, the level of the spinal mass was defined with the help of a contrast enhanced T1-weighted MRI scan and oil-filled markers stuck on the skin with plasters. This was crucial, since limiting the extent of the bone resection in the planned unilateral approach was vital for the protection of spinal stability. On the day of the operation, the electrodes of the spinal neuro-monitor were inserted. The patient was operated on in the neutral prone position without any bending of the lower back. The level of the spinal mass was checked once again using fluoroscopy in the operating theater. Since the nerve roots were pushed to the left side, a right-sided approach was preferred. A skin incision of approximately 11 cm was made in the skin in the midline at the appropriate level, the fascia was cut and the muscles were dissected subperiosteally without using any unipolar electrocautery. At the stage of the opening of the dura, muscle relaxants were discontinued, and spinal neuromonitoring was started. The L2, L3 laminas were identified in the center of the exposed area, L1 and L4 being in the opposite corners. Then, facet joints were identified in order for them to be protected from damage. A partial hemilaminectomy of about 10 mm in width on the L2 and L3 along their whole length rostrocaudally was made using an electric drill and kerrison punches under a Zeiss surgical microscope (Carl Zeiss Meditec AG, Germany). The bony exposure was enlarged by approximately 2 mm medially

Fig. 2. Pre-operative radiological imaging scans of Case 2. A, T1-weighed sagittal contrast enhanced magnetic. resonance imaging scan, B, T2-weighted sagittal magnetic resonance imaging scan.