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Combined intra-extracanal approach to lumbosacral disc herniations with bi-radicular involvement. Technical considerations from a surgical series of 15 cases

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Abstract Large lumbosacral disc herniations effacing both the paramedian and the foraminal area often cause double radicular compression. Surgical management of these lesions may be difficult. A traditional interlaminar approach usually brings into view only the paramedian portion of the intervertebral disc, unless the lateral bone removal is considerably increased. Conversely, the numerous far-lateral approaches proposed for removing foraminal or extraforaminal disc herniations would decompress the exiting nerve root only. Overall, these approaches share the drawback of controlling the neuroforamen on one side alone. A combined intra-extraforaminal exposure is a useful yet rarely reported approach. Over a 3-year period, 15 patients with bi-radicular symptoms due to large disc herniations of the lumbar spine underwent surgery through a combined intra-extracanal approach. A standard medial exposure with an almost complete hemilaminectomy of the upper vertebra was combined with an extraforaminal exposure, achieved by minimal drilling of the inferior facet joint, the lateral border of the pars interarticularis and the inferior margin of the superior transverse process. The herniated

discs were removed using key maneuvers made feasible by working simultaneously on both operative windows. In all cases the disc herniation could be completely removed, thus decompressing both nerve roots. Radicular pain was fully relieved without procedure-related morbidity. The intra-extraforaminal exposure was particularly useful in identifying the extraforaminal nerve root early. Early identification was especially advantageous when periradicular scar tissue hid the nerve root from view, as it did in patients who had undergone previous surgery at the same site or had longstanding radicular symptoms. Controlling the foramen on both sides also reduced the risk of leaving residual disc fragments. A curved probe was used to push the disc material outside the foramen. In conclusion, specific surgical maneuvers made feasible by a simultaneous extraspinal and intraspinal exposure allow quick, safe and complete removal of lumbosacral disc herniations with paramedian and foraminal extension.

Keywords Combined approach · Disc herniation · Foraminal · Lumbar

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Introduction

Most lumbosacral disc herniations compress a single nerve root. Up to 93% of these lesions involve the paramedian space, thus compressing the descending (lower) nerve root [16]. These disc herniations have traditionally been managed through a standard interlaminar approach. Laterally located disc herniations occasionally involve the exiting (upper) nerve root either within or outside the neuroforamen. Extraforaminal disc material is conveniently exposed through an extraspinal intertransverse approach [6, 13, 14, 16]; purely intraforaminal disc fragments can be reached from both the intraspinal and extraspinal perspectives [2, 4, 10].

When a herniated disc with broad medio-lateral extension intercepts both the descending and the exiting nerve roots bi-radicular symptoms may develop. These uncommon conditions are usually managed by trying to decompress the two nerve roots through the same interlaminar window. This strategy, involving additional bone removal in a lateral direction, nevertheless has the drawback of controlling the neuroforamen on one side alone. The presence of disc remnants within or outside the foramen cannot be excluded. A sound alternative to the traditional approaches would be a combined interlaminar and extraforaminal approach [8, 9]. This sporadically reported procedure has the advantage of allowing the foramen to be inspected on both sides, but adds technical difficulties and operating time to the standard procedure. In this study, we report our experience with a refined intra-extracanal approach to large disc herniations with paramedian and lateral extensions that compressed both nerve roots related to the disc space. Our primary aim was to reappraise the procedure from a technical viewpoint, illustrating the usefulness of

specific surgical maneuvers we developed to simplify problematic intraoperative steps.

Materials and methods

Between September 2000 and September 2003, 15 consecutive patients with broad disc herniations causing bi-radicular symptoms, underwent surgery through a combined intra-extracanal approach. All disc herniations comprised a paramedian portion which compressed the lower nerve root and a lateral portion compressing the upper root within or outside the foramen (Fig. 1). The patients' charts were retrospectively reviewed. The herniations were located at L4–L5 in 11 patients and L3–L4 in four. In all cases, the diagnosis was made by magnetic resonance imaging (MRI) (Fig. 1). In selected cases, diagnostic imaging included computerized tomographic (CT) scans of the affected level. The predominant preoperative complaint in all patients was unremitting radicular pain radiating along more than one dermatome. Radicular pain was graded from 4 to 9 (mean 6.6) on a 0–10 visual analogue scale (VAS) for pain/discomfort. Non-specific low-back pain, graded 1–4 on the VAS (mean score 2) was an accompanying symptom in three (20%) patients and in all of them was occasionally present before the onset of radiculopathy. Radicular motor weakness was clinically appreciable in eight (53%) patients. Electromyographic examination showed abnormalities in 13 (87%) patients. In all the patients, the bi-radicular involvement was inferred from overall evaluation of clinical and radiological data. The duration of radicular symptoms ranged from 3 months to 5 years; two patients had undergone previous lumbar surgery, in both cases involving the same side. In one of them the herniation recurred at the

Fig. 1 Illustrative case. Axial (*left*) and sagittal (*right*) T1-weighted MRI scan showing a large disc herniation (*arrow*) effacing both the left paramedian and foraminal areas at L4–L5

same level where it had been removed 8 years previously.

Surgical technique

We begin with a standard interlaminar approach, extended superiorly to remove most of the upper hemilamina until the inferior margin of the exiting nerve root is visualized. Only afterwards do we expose the extraforaminal intertransverse area. In most patients with degenerative changes, such as hypertrophic apophyseal joint, and, as a rule, at L5–S1 the extraforaminal space is nearly virtual. Drilling the superolateral aspect of the facet joint along with the lateral 2 mm of the pars interarticularis and the inferior margin of the superior transverse process is usually sufficient to expose a 15-mm circular operative window. Resecting the intertransverse ligament exposes adipose tissue embedding the exiting nerve root, the outer part of the foraminal disc and the extraspinal portion, if any, of the disc herniation. At this stage, dissecting the extraforaminal structures is greatly facilitated by retracting the dural sac, along with the proximal nerve root medially, and, at the same time, keeping the extraforaminal area under observation. This maneuver makes the nerve root easy to identify because movement of the dural sac is constantly transmitted to the distal segment of the nerve itself (Fig. 2). Once the anatomical relationship between the nerve root and the disc herniation is clear, the disc can be incised and then removed. Again from the inside, the preforaminal portion of the disc herniation, compressing the lower nerve root, can be removed in a standard fashion. The final

Fig. 2 This drawing shows the operative field once the extraforaminal and interlaminar compartment have been exposed (dotted lines indicate the original bone margins). The extraforaminal nerve root can be identified early by observing its movement (arrows) while retracting the proximal nerve segment medially

Fig. 3 This drawing shows clearance of the foramen at the end of the procedure. Under direct visualization of the exiting nerve root, a curved dissector is passed medially to laterally through the foramen. In this way, a hidden disc fragment is extruded out of the foramen

step is to clear out the neural foramen. This can be done by probing the foramen medially to laterally with a curved instrument, pushing any residual fragments outside the foramen where they can be grasped (Fig. 3).

Results

The disc herniation was completely removed in all cases without disrupting the facet joint. In all cases, proximal mobilization of the exiting nerve root allowed easy identification of its extraforaminal segment. In the two patients who had undergone previous surgery on the same side—even though the initial operation consisted of a simple medial approach—as well as in four patients with symptoms lasting for more than 12 months, abundant adhesions surrounded both nerve roots. In these cases, we found the extraforaminal nerve root easier to identify than it would have been with a conventional approach. In four of the 15 cases (27%), the final maneuver of probing the foramen extruded residual disc fragments. In one patient, who had undergone previous surgery on the same side, the dura ruptured. The tear was sutured with 6-0 non-adsorbable sutures and a lumbar drain was kept in place for 5 days. The wound healed satisfactorily, with no evidence of cerebrospinal fluid (CSF) leak.

On the first postoperative day, patients were allowed to walk without a brace. Postoperatively, radicular pain abated to VAS 0 in 11 (73%) patients. The remaining four (27%) patients complained of radicular discomfort, manifesting as dysesthesia or mild hypoesthesia graded as 1 on the VAS. The

problem invariably disappeared within 1–6 weeks. Nine (60%) patients reported self-limiting non-radicular low-back pain around the surgical wound in the early days after surgery. The follow-up period ranged from 12 months to 42 months (mean 28.1 months). At the latest follow-up examination, of the eight patients with clinically appreciable preoperative motor deficits, seven (87%) showed a variable degree of recovery. One patient who had persistent lumbar pain underwent CT scanning and flexion–extension X-rays of the lumbar spine to rule out late fractures of the pars or segmental instability. Because no abnormalities were found, the patient underwent postural therapy, obtaining partial pain relief. Two patients complained of occasional aspecific low-back pain, present also before the onset of the radiculopathy. Overall outcome was graded according with the Macnab outcome scale [11], as excellent (no pain), good, (some back pain), fair (moderate radiculopathy) or poor (unchanged or worse). Of our 15 patients 12 (80%) patients had an excellent outcome and three (20%) a good outcome.

Discussion

Sporadic reports have underlined the advantages of a combined approach [8, 9]. Basically, the double exposure brings the whole extension of the disc herniation into view, without compromising spinal stability. The recent report from Hejazi et al. [9] provided a detailed technical description of this procedure for the treatment of osseous foraminal stenosis but excluded patients with disc herniations. Our study extends the previously reported experiences and focuses on some technical aspects involved in the removal of broad-based disc herniations. In our approach, the medial exposure precedes, rather than follows, the extraforaminal exposure. Laminectomy should be almost complete or stop a few millimeters away from the upper yellow ligament. Under normal circumstances, this is the only maneuver that brings the proximal segment of the upper nerve root into view. We consider this a key requisite for the second part of the operation. In this phase, working simultaneously on the extracanal and intracanal compartments achieves two objectives: it enables the surgeon to identify the nerve root early, thus reducing the risk of accidental nerve injury, and allows safe removal of disc fragments hidden within the foramen.

We remove the disc herniation from the extraforaminal side first. At this stage, as in any lumbar discectomy, preliminary identification of the nerve root is essential to avoid accidental nerve injury. As a rule, a lateral disc herniation displaces the nerve root upward, against the pedicle of the superior vertebra. The root may be troublesome to identify, however, within a 1.5×1.5-cm window. Particularly in patients with a his-

tory of previous surgery at the same level (two patients in our series) and in those with long-standing symptoms (four patients), the nerve root can be discolored, thin and covered with scar tissue [3]. Occasionally, the herniated disc can raise, rather than displace, a pale, ribbon-like nerve root. We found that the combined exposure helps in identifying the root, because movement of the dural sac is constantly transmitted to the extraforaminal portion of the nerve, even in patients with severe foraminal stenosis. Hence by retracting the sac medially along with the nerve root through the interlaminar opening while keeping the extraforaminal area under observation, the position of the nerve root in relation to the disc can be unmistakably located (Fig. 2).

During the second phase, we worked from the inner side of the canal. We first removed the preforaminal portion of the disc herniation, thus decompressing the lower nerve root. We subsequently focused on eventual remnants of the herniated disc within the foramen. Purely foraminal disc herniations have traditionally been approached from this perspective alone. In addition to a standard interlaminar approach, unilateral facetectomy is still considered an option to obtain an unobstructed view of the exiting nerve root [4, 5, 7]. To minimize the risk of postoperative instability, the disc herniation can be reached by extending the interlaminar exposure upward and undercutting the medial articular facet (i.e. inferior facet of the superior vertebra). Undercutting must be quite cautious, however, because too generous use of the Kerrison rongeur might fracture the facet either directly or indirectly by disrupting the pars interarticularis. As a price to pay for maintaining the facet joint intact, a very lateral herniation must be removed blindly, accepting the risk of leaving disc fragments within the foramen. The numerous “far-lateral” approaches proposed for treating extraforaminal herniations [4, 12, 14–16] share the same drawback—they control only one side of the foramen—if an intraforaminal extension of the herniated disc has to be removed. In a technical note, Di Lorenzo et al. [1] proposed removing purely foraminal disc herniations by unroofing the foramen directly through a fenestration of the pars interarticularis. This approach has been criticized because it affords a restricted exposure, leaves the disc space uncontrollable and increases the risk of late fracture of the pars [17]. The combined approach described here solves the aforementioned problems by allowing safe removal of any disc fragment hidden within the foramen without compromising spinal stability. The curved end of the dissector can be repeatedly passed medially to laterally through the foramen, to push out purely foraminal disc fragments (Fig. 3). With the extraforaminal nerve root under direct visualization, this maneuver poses no risks. This “clean up”, which proved useful in four of our 15 patients, virtually eliminates the risk of incomplete removal.

In conclusion, the combined intra-extracanal exposure allows excellent management of large disc herniations with bi-radicular involvement. These lesions can be safely and completely removed using the surgical steps we propose. Patients who benefit most from this

procedure are those with previous surgery or a long history of radicular symptoms.

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