

Surgical Techniques for Far Lateral Lumbar Disc Herniations

Uzak Lateral Lomber Disk Hernilerinde Cerrahi Teknikler

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Abstract: For extra-foraminal localization, the surgical technique of lumbar far lateral disc herniations are distinct from those situated medial to the facet joint. In this study the extra-foraminal space was approached by a posterior route by means of median or paramedian incisions and a posterolateral route with muscle splitting method on 5 cadaveric spine models. Posterior approach, though it is familiar to neurosurgeons and enables the classical interlaminary enterings, can be quite troublesome in case of facet joint hypertrophy. The posterolateral approach though wide enough, is too deep to work on and medially retracted musculature hampers the work from medial aspect of the facet joint. The purpose of this article is to acquaint the reader with the anatomy and the surgical techniques available to treat for extra-foraminal lumbar disc herniations.

Key Words: Extra-foraminal space, lumbar far lateral disc herniation, posterolateral approach, posterior approach

Özet: Nöral foramenin dışında olduğunda, lomber uzak lateral disk herniasyonlarında uygulanan ameliyat teknikleri faset ekleminin medialinde kalanlardan farklıdır. Bu çalışmada 5 kadavra üzerinde nöral foramenin dışındaki mesafeye median veya paramedian insizyonlarla posterior ve kas içinden geçen posterolateral yol ile yaklaşıldı. Posterior yaklaşım nöroşirürjiyenlerin alışık olduğu ve klasik interlaminar girişe olanak vermesine karşın, faset eklem hipertrofinde oldukça zor olabilir. Posterolateral yaklaşım yeterince geniş olmasına karşın derinde kalır ve medialde kalan kaslar faset ekleminin medial yanından girişimi engeller. Bu yazının amacı nöral foramen dışındaki lomber disk herniasyonlarının cerrahi tedavisindeki teknikler ve anatomi hakkında okuyucuyu bilgilendirmektir.

Anahtar Sözcükler: Ekstra-foraminal mesafe, lomber uzak lateral disk herniasyonu, posterolateral yaklaşım, posterior yaklaşım

INTRODUCTION

With the advent of improved imaging techniques the demonstration of lumbar disc herniations lateral to the facet joint has been increasing (8, 9, 13, 14, 16, 19, 20). It seems to occur with a frequency between 1-11 % of all lumbar disc herniations (1, 8, 10, 23).

The surgical exploration of far lateral disc herniation (FLDH) is often difficult since the facet articulation obviates a direct view on the course of the extraspinal nerve (6, 23).

The main aim in the surgery of the FLDH is to safely remove the hidden fragment without complete destruction of the normal facet joint, without damage

to the nerve root and with minimal compromise of the stability of the spinal column (15, 16, 21).

This study examines two different approaches to extra-foraminal space and evaluate each approach anatomically and clinically in terms of literature.

Anatomical Considerations

The intervertebral foramen permits the transmission of the spinal nerve and the blood vessels supplying the vertebra and its contents. It is bordered superiorly by the inferior notch of the vertebra above, inferiorly by the shallow inferior notch of the vertebra below, anteriorly by the intervertebral disc, and posteriorly by the articular process and facet joint. The contents of the foramen include the dorsal root ganglion, spinal nerve, recurrent meningeal nerve of Luschka, segmental artery and vein, lateral extension of the ligamentum flavum adjacent to the facet joint, and considerable fat (2, 12) (Fig 1).

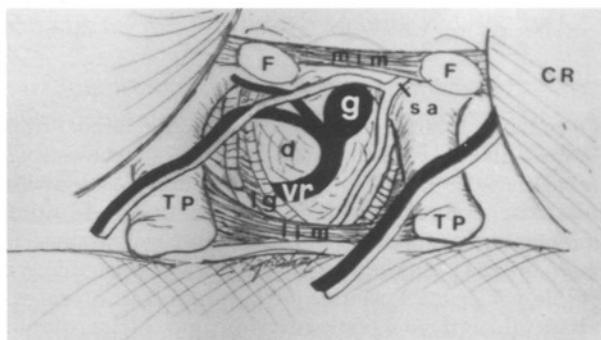


Figure 1. Appearance of lumbar far lateral space from left side. CR: cranial, d: intervertebral disc, F: facet joint, g: ganglion, lg: intertransvers ligament, lim: lateral intertransverse muscle, mim: medial intertransverse muscle, sa: segmental artery, vr: ventral root.

Immediately outside the foramen the short spinal nerve divides into a large anterior primary ramus, which may contribute to the lumbosacral plexus, a smaller posterior primary ramus (PPR) that arches posteriorly, and a diminutive sinuvertebral or recurrent nerve that reenters the canal to supply the dura and posterior longitudinal ligament. The posterior primary ramus divides into a branch that passes medial to the medial intertransversarius muscle and innervates the transversospinal muscles, and into a lateral branch distributed to the adjacent facet joint and the next inferior facet joint and to the erector spinae muscles and the skin and blood vessels of the back (Fig 2).

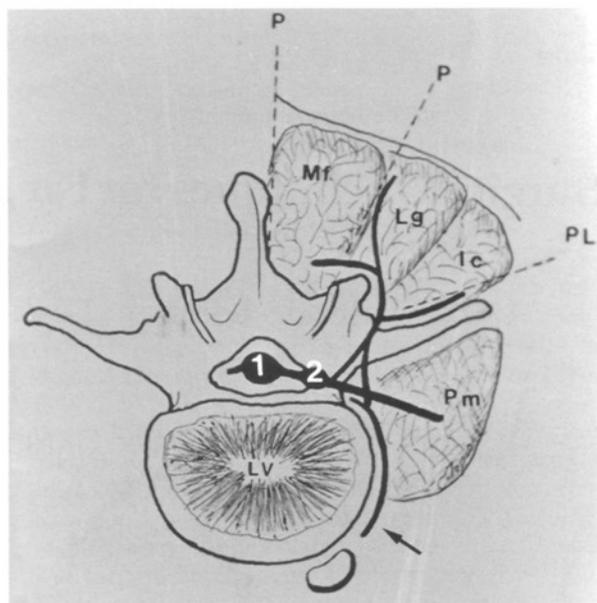


Figure 2. Distribution of PPR, segmental artery and approaches to lumbar far lateral space. 1: spinal cord, 2: ganglion, LV: lumbar vertebra, Mf: multifidus muscle, Lg: longissimus muscle, Ic: iliocostalis muscle, P: posterior route, PL: posterolateral route, Pm: psoas muscle, arrow: segmental artery.

The segmental vessels are identified at the inferior edge of the rostral pedicle, lateral to the existing nerve root. These consistently divide into 5 identifiable branches. These are the branches to undersurface of the transverse process; to dorsal in the waist of the pars; to lateral to the space between multifidus and longissimus; to midlateral aspect of erector spinae and a terminal branch accompanying lateral branch of PPR (18) (Fig 2).

Veins accompany the arteries and nerves often creating a tortuous plexus adjacent to or within the intervertebral foramen, and contiguous with the epidural vessels and are more vulnerable (8, 18, 26).

Material and Method

In this study, bilateral dissections were performed on the lumbar spines of 5 cadavers, the posterior approach (PA) on one side and posterolateral muscle splitting approach (PLMSA) on the opposite simultaneously.

Posterolateral Muscle Splitting Approach

Following the paramedian skin incision 10 cm off the midline, centered over the neural foramen of

interest, fascia was opened curvilinearly. Having palpated the transverse process with index finger, surgical access was gained in a 30° line to the horizontal by longitudinally splitting fibers of the iliocostalis from the longissimus. By hand-held retraction the split-muscle was separated and the tightly stretched neurovascular bundle was followed ventromedially to the pedicle-transverse process junction. Adjacent to the foramen there was often a plague of fat, which when removed, exposed the origin of the PPR, the ganglion and the vertebral route (Fig 3a and 3b).

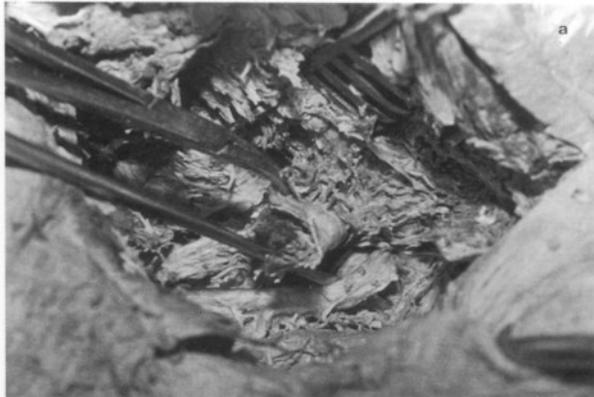


Figure 3a. Posterolateral approach to the left lumbar side on cadaver model, its schematic illustration was seen on b.

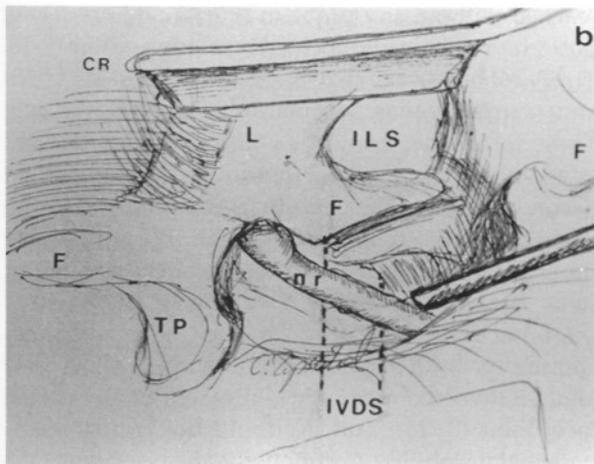


Figure 3b. CR: cranial, d: dissector, Lg: intertransvers ligament, NR: nerve root, TP: transvers process.

Posterior Approach

The skin incision either midline or paramedian (3 cm off the midline) was carried down to the lumbodorsal fascia, which was opened in a gentle arc fashion. Paraspinous insertions of the sacrospinalis and multifidus muscles were detached from the spinous

processes and the interspinal ligaments in the first technique; the access was gained by entering to the natural cleavage between multifidus and longissimus in the latter. In both techniques the laterally located muscles were pushed transversely at least 1 cm beyond the facet joint. The medial portion of the intertransverse ligament lying between the two facet was transected. The bone was removed from pars interarticularis and superior aspect of the superior facet of caudal vertebra. After defining the lateral margin of the foramen with a small angled curette, foraminotomy was performed. Thus, the distal part of the ganglion and the spinal nerve become visible in the paravertebral space (Fig 4a and 4b).

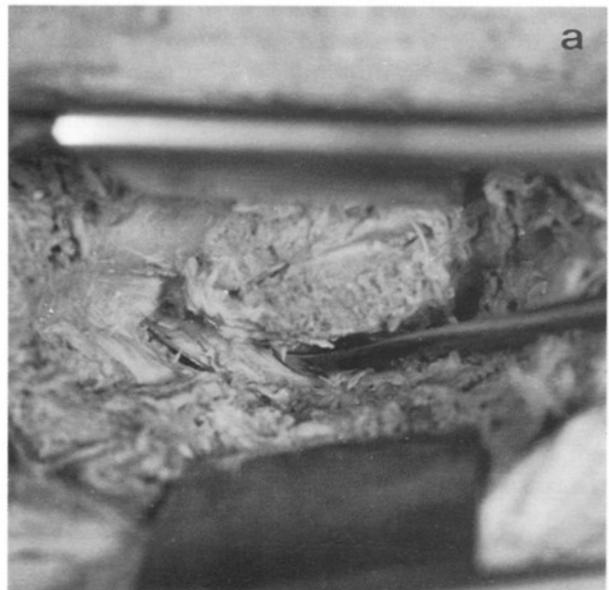


Figure 4a. Posterior approach to the right lumbar side on cadaver model, its schematic illustration was seen on b.

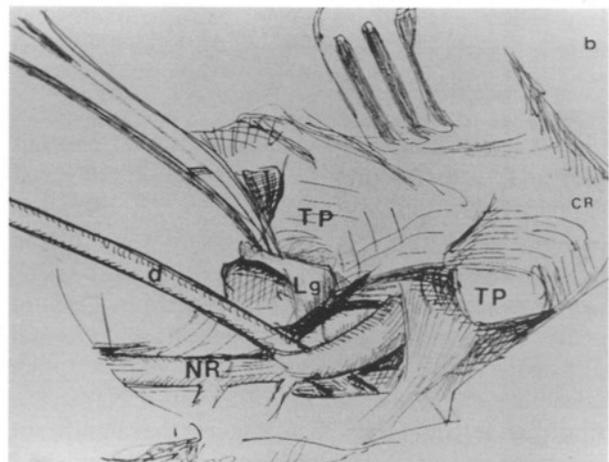


Figure 4b. F: facet joint, CR: cranial, nr: nerve root, ILS: interlaminar space, IVDS: intervertebral disc space, L: lamina of vertebra, TP: transvers process

Results

In PLMSA the far lateral space was clearly delineated. The segmental arteries were easily handled. Interlaminary approach was not easy because of the presence of the muscle groups lying over facet joints medially. Radiological verification was necessary for the exact level.

In PA, the paravertebral muscles were to be retracted laterally beyond the transverse processes. The segmental arteries could not be handled as easy as PLMSA. Posterior approach could be combined with the classical interlaminary approach. It was hard to expose the far lateral space in the case of facet joint hypertrophy, otherwise the joint continuity would be compromised. Radiological verification was not necessary below L3 level.

Discussion

With the advent of improved imaging techniques, the FLDH have been encountered 1-11 % of all lumbar disc herniations (1, 8, 10, 13, 23).

The major technical cause of failure with FLDH surgery appears to be due to the use of surgical techniques for intracanalicular herniations, which do not allow direct visualization and decompression of the far lateral space (8, 9).

Unilateral partial hemilaminectomy and complete facetectomy (5, 6); partial hemilaminectomy with medial facetectomy (1, 3, 10, 20); posterior approach with median (8, 11) or paramedian (16, 21, 23, 26) incision utilizing bone resection from pars interarticularis and posterolateral approach with muscle splitting technique (18, 24, 25) have been used by spinal surgeons.

It is obvious that if the intervertebral disc has protruded lateral to foramen, the classical interlaminar exposure is less favourable (16, 19, 21, 23). Such incomplete exploration may explain some of the negative results with persistent sciatica (20, 21). Generous laminectomy with facetectomy (3, 5, 6) provides an excellent exposure to entire intervertebral disc space (10), but may lead to postoperative spinal instability (8, 15, 16, 18, 20, 22). Even if Haher (7), Abdullah (1) and others (5, 6) suggest that significant instability should not be a problem with unilateral facet resection, the altered paths of loading created when coupled with the increased forces experienced in the anterior and middle column may precipitate early

degeneration in adjacent discoligamentous structures (4, 7, 15, 16, 18) and may lead to poor clinical results.

In PLMSA, as described by Watkins before (24, 25), we identified constant anatomic landmarks in cadaveric dissections that facilitate access to the intervertebral foramen. This technique allowed rapid localization of the lateral branch of the PPR with the terminal branch of the segmental artery and safe evacuation of far lateral space (Fig 3a and 3b). We have been able to note every neurovascular structure during this approach on cadavers. However, this is somewhat unfamiliar to neurosurgeons (18). The paucity of anatomical landmarks and the longer distance to the foraminal outlet, working in relatively deeper planes made it somewhat a disorienting approach as mentioned before (8, 23). In addition, if the patient is obese or muscular, these problems are to be unequivocally aggravated (23). It should also be noted that this technique is not found to be appropriate for cases that require exploration within the spinal canal cephalad or caudad to the neural foramen (8). Moreover, the pertaining level should be verified by radiological methods during operation.

Posterior route in our dissections also allowed orientation and precise identification of anatomical structures and the lateral border of the foramen was reached without any problem (Fig 4a and 4b). These posterior routes are advocated by many authors (8, 16, 21, 23, 26) because of their supposed ease of approach and neurosurgeons' familiarity with that anatomy. These techniques could be combined with classical interlaminary approach for thoroughly exploration and decompression of the extradural space caudal to disc when necessary (8, 11, 16, 21, 23, 26). We noticed that the facet joint hypertrophy could hamper approaching to far lateral space and while doing so, the extent of the bone resection could handicap the facet joint continuity. In the presence of averagely sized facet joints, it involved relatively minimal disruption of the facet joint (8, 21), and it should not contribute to potential instability. Additionally, the resection of the intertransverse ligament seemed to result in an additional dorsal relief (23). On the other hand, by retracting the muscles laterally it should take into account that the PPR of the spinal nerves (extension) and the retracted muscles (pressure and ischemia) could be injured (23). It is well known that in order to prevent recurrences, the disc space should be cleared of remaining material as completely as possible (17) since PA with minimal bone resection from pars interarticularis makes it possible without creating instability if combined with interlaminary approach

when necessary (21). The other advantage of PA was found to be the obviation of radiological verification of L3-4, L4-5 and L5-S1 levels during cadaveric studies.

As a result, the anatomical exposure in PLMSA is superior to that of PA. However, this is not a familiar approach to neurosurgeons, moreover it does not give way easily to interlaminary approach; radiological justification is mandatory preoperatively. On the other hand, PA is well known by neurosurgeons, enables interlaminary approach. Radiological verification is not necessary below L3 level but facet hypertrophy hardens far lateral approach. In this study it is concluded that PLMSA is superior in the case of facet hypertrophy while PA is favorable in those cases where classical interlaminary approach is to be combined to far lateral approach.

Conclusion

Contemporary imaging techniques now reveal these herniations commonly. The anatomy of the foraminal and extra-foraminal (far lateral) regions has been described and should be familiar to all spine surgeons. While approaching the disc fragment, regardless of the technique employed, a complete destruction of the facet joint has to be avoided because it harbours the danger of severe postoperative complaints due to intervertebral instability.

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