

Simultaneous Paraspinal and Midline Approach for Upper Lumbar Disc Herniation : Technique to Prevent Lamina Fracture

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Objective : Upper lumbar disc herniation is rare disease, compared with lower. The lamina of this high level lumbar vertebra is narrower than that of low level, and this have taken surgeon into important consideration for surgical methods because partial removal of lamina for discectomy weakens the base of the articular process and may result in fracture. The authors an accurate preoperative diagnosis that enables the surgeon to operative approach for preserving the facet joint.

Methods : Thirteen patients with upper lumbar disc herniation have underone surgical procedure by midline approach for removal of ruptured disc fragment and paraspinal approach for removal of residual disc materials simultaneously without instrumentation. All patients who underwent surgery were analyzed and long-term follow-up was conducted.

Results : At a mean follow-up of 24months, there were complete resolution of presenting radiating leg pain in 85% of the patients, 7.5% were left with minimal residual discomfort, and 7.5% derived little or no benefit from surgery. The follow-up radiologic findings of all patients shows that lamina and facet joint have preserved safely and no instability.

Conclusion : Simultaneously, paraspinal with midline approach provides highly satisfactory operating methods by simplifying exposure and greatly limiting the risk of complications. This provides the basis for a planned surgical approach in which destruction of the facet joint can be avoided.

KEY WORDS : Upper lumbar disc herniation · Paraspinal approach · Midline approach.

Introduction

In lumbar disc herniation, the upper lumbar disc herniation indicates level of L1-2, L2-3, or L3-4. The incidence has been reported to be less than 5%. Among them, the L3-4 disc herniation has been reported to be most frequent^{1,6)}.

Different from the lower lumbar disc herniation, it is difficult to diagnose accurately as the clinical symptoms and physical examination patterns of this disease are diverse, the results of the sensation test vary, the change of the function of motor nerve varies, and the response to the reflex test varies^{3,5,8,16)}.

There are many surgical methods such as posterior approach, anterior approach, percutaneous nucleotomy, chemonucleolysis, etc. In the upper lumbar disc herniation, as the spinal canal is narrow and the size of the lamina is reduced, special attentions must be paid during conventional laminectomy as it may cause the fracture of lamina, the destruction of the

ventral structure that maintain the stability of the spine, the instability of the spine in future, the possibility of damaging the spinal cord or cauda equina after surgery is high, and the involvement of various neurological complications²⁾.

In the treatment of the upper lumbar disc herniation, we applied the paraspinal and midline approach simultaneously. As the outcome of such procedure was excellent neurologically and clinically without causing the instability of the spine and thus does not require posterior or interbody fusion, we examined its' effectiveness.

Materials and Methods

Among 857 patients underwent surgery for lumbar disc herniation from January 1999 to December 2002, the upper lumbar disc herniation of L1-2, L2-3, and L3-4 was 39 cases (4.6%). Among them, excluding the cases treated

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Fig. 1. Under midline approach, the lamina of the upper lumbar vertebra is removed by 3~4mm from the spinous process without instability by inferior facet joint injury and ruptured disc material was removed (A). Under paraspinous approach, subcutaneous tissues, the multifidus, and the longissimus are splitted. Transverse processes of the upper and the lower vertebrae are exposed and discectomy is performed (B).

by anterior fusion, posterior interbody fusion, and conventional laminectomy, paraspinous and midline approach was performed on 13 cases.

Indication of simultaneous paraspinous and midline approach for upper lumbar disc herniation were 1) possibility of neurological injury by conventional method on the L1-2, L2-3, L3-4 disc herniation due to narrow lamina 2) not accompany spinal stenosis or accompany cauda equina syndrome 3) not recurrent disc herniation 4) There was not indication of fusion due to T-score of mineral bone marrow density lower than -3.0.

All upper lumbar disc herniation patients without myelopathy were treated by conservative treatments first. Among the study population, surgical treatment was performed on patients with disabling severe pain, recurred back pain or radiating pain, over 6 weeks conservative treatment did not improve symptoms, or the straight leg raising test of the lower extremities shows the impairment as well as clinical and neurological symptoms (weakness in muscle strength, paresthesia) were evident.

In the follow up of all patients, the pre-operative and postoperative clinical symptoms and the examinations were compared and analyzed. The outcome of surgery was evaluated by applying McCulloch functional grade as follows. Complete elimination of symptoms resulting in no impairment of daily life was scored as excellent. Elimination of most back pain and radiating pain but minor impairment of daily life that does

not require treatment was scored as good. Partial elimination of back pain, impairment of daily life and requires continuous treatment was scored as fair. No improvement of symptoms after surgery and severe impairment of daily life were scored as poor.

On the prone position, the right and left was selected by the direction of the protrusion of nucleus pulposus. The skin incision was performed on the 2~3cm lateral distant from the midline spinous process. Initially, by midline approach, the lamina of the upper lumbar vertebra was excised away from the spinous process by 3~4mm using air drill without causing the instability by preventing facet joint injury. Hemostasis was achieved by the coagulation of the epidural vessel around the dural membrane, and the ruptured disc fragment

was selectively excised (Fig. 1A). Afterwards, paraspinous approach was performed. From 4~5cm lateral side of the midline spinous process, and subcutaneous tissues, the multifidus, and the longissimus muscle were excised. Intertransverse ligament and the transverse process of the upper and the lower lumbar were exposed by Taylor or Spring retractor, intertransverse ligament was excised with a pair of scissors, the lumbar muscle was excised by approximately 1cm in depth, and the blood vessel together with neuromuscular structures, ganglion, and adipose tissues in the vicinity were able to be verified. After the excision of the yellow ligament, the annulus fibrosus was excised with a knife, and the lumbar disc was removed as much as possible with pituitary forceps (Fig. 1B) (Fig. 2). After the removal of the lumbar disc, the mean surgery time was 3 hours and the average hemorrhage volume was approximately 300CC.

Results

Among patients with the upper lumbar disc herniation, 13 patients were treated by the simultaneous paraspinous and midline approach surgery. The range of their age was from 45 years to 74 years and the mean age was 57.7 years. The incidence of the upper lumbar disc herniation in patients over 50 years was 85%. The onset age was high in elderly. Regarding their gender, male was 69%, which was higher than 31% females. In regard to the lesion location, L1-2 was



Fig. 2. T2 and T1 weighted sagittal magnetic resonance images show that ruptured L3-4 disc material is upward migrated.(A,B). AP lumbar X-ray image shows that paramedian skin incision and upper lamina of L3 is removed(C).

Table 1. Clinical data before and after surgery of upper lumbar disc herniation

| Case | Age/Sex | Level | C / C | N / E | *Op results |
|------|---------|-------|---------------------------|----------------------|-------------|
| 1 | 52/M | L2-3 | LBP,Radiating pain (Rt) | SLRT(+) | Excellent |
| 2 | 62/M | L3-4 | LBP,Radiating pain (Lt) | SLRT(+), Motor(↓) | Good |
| 3 | 45/F | L3-4 | LBP,Radiating pain (both) | SLRT(+) Motor(↓) | Fair |
| 4 | 54/M | L2-3 | LBP,Radiating pain (Lt) | SLRT(-) | Excellent |
| 5 | 74/M | L1-2 | LBP,Radiating pain (Rt) | SLRT(+) | Good |
| 6 | 62/F | L2-3 | LBP,Radiating pain (Lt) | SLRT(-) | Good |
| 7 | 56/M | L3-4 | LBP,Radiating pain (Rt) | SLRT(+) | Excellent |
| 8 | 59/M | L2-3 | LBP,Radiating pain (Lt) | SLRT(-) | Excellent |
| 9 | 58/M | L3-4 | LBP,Radiating pain (Rt) | SLRT(+) Motor(↓) | Poor |
| 10 | 49/F | L2-3 | LBP,Radiating pain (Rt) | SLRT(+) | Excellent |
| 11 | 66/M | L1-2 | LBP,Radiating pain (Lt) | SLRT(-) Motor(↓) | Good |
| 12 | 62/F | L2-3 | LBP,Radiating pain (Lt) | SLRT(+) Motor(↓) | Good |
| 13 | 51/M | L3-4 | LBP,Radiating pain (Rt) | SLRT(+) | Excellent |

* MacCulloch functional grades Rt : Right, Lt : Left, LBP : Lower back pain, SLRT(+): Straight leg raising test limitation, SLRT(-) : No Straight leg raising test limitation, M : male, F : female, C/C : Chief complaint, N/E : Neurologic examination

2cases, L2-3 was 6cases, and L3-4 was 5cases.

The clinical symptoms at the time of visiting our hospital were back pain and radiating pain in the lower extremities in all patients. 9 out of 13patients (68.9%) showed the limitation of the straight leg raising test.

5 out of 13patients (37.4%) showed the weakened strength of lower extremity. 3patients (23%) showed the limitation of hip flexion, 1patient(8%) showed the limitation of knee flexion

and 1patient(8%) showed the limitation of knee extension. 5patients (38%) showed the weakend muscle strength of the lower extremities. 3patients.

The classification of the protrusion pattern according to surgical findings was sequestration pattern in 3cases (23%), extrusion pattern in 7cases (54%), and protrusion pattern in 3cases (23%).

The mean follow up duration after surgery was 24months (12~37months). The results were analyzed in detail by comparing with preoperative symptoms and findings. In all patients, back pain was more improved, back pain stronger than mild remained in 3cases (23%), and radiating pain remained in 1case (8%).

At the final follow up examination, the weakness of muscle strength was detected in 2cases (15%) by limitation of hip flexion. In 1case (8%), the symptoms did not improved in comparison with the preoperative symptoms. The deterioration of muscle strength after operation was not detected.

The results of the final follow up show that excellent was 6cases (46%), good was 5cases (38%), fair was 1case (8%), and poor was 1case (8%) according to MacCulloch functional grade. In all patients underwent operation for the L1-2 or L2-3 disc herniation, high scores, above good, were obtained. The case evaluated as poor was a 58years old male whose muscle strength in the lower extremities have been weakened already prior to surgery and with diabetes. After surgery, deep wound infection was developed and thus the symptoms appear to be deteriorated. Overall, in 12patients that was 92%, the outcome was better than good (Table 1).

Discussion

Lumbar disc herniation occurs preferentially in the lower lumbar area where the movement is frequent. The occurrence in the upper lumbar area has been reported to be rare. Varying incidence of the upper lumbar disc herniation has been reported. It is known to be lower than 5% of total lumbar disc herniation^{7,9,14}. In our study, the incidence was 4.6%, which supports the reports. Since Love and Walsh¹⁴ have reported 2cases of the L1-2 and 1case of the L2-3 disc herniation, Spangfort have reported the incidence of the upper lumbar disc herniation as 2.1%, including the L3-4 disc herniation

in his cases in 1971¹⁹⁾

Miller et al.¹⁵⁾ have reported by anatomical study that the degeneration of the lumbar disc occurs frequently in the L4-5 and the L3-4, which was due to that the size of lumbar disc, mechanical stress, the nutrition supply, and biochemical composition. Compare with the lower lumbar discs, the lamina of upper lumbar vertebra is smaller in size, mechanical stress is lower, and its nutrition supply network is short as nutrition is supplied by diffusion resulting in efficient process. Similarly, due to the same factors, it has been reported that the degenerative change in males occurs earlier than females.

As the degenerative change of the lower lumbar disc progresses upward, the upper lumbar disc herniation occurs frequently in individuals over 50 years old. In the ratio of male and female, similarly to the lower lumbar disc herniation, it occurs more frequently in males than female. In our study, it occurred more in males than females by 2 folds. In patients with the history of surgery for the lower lumbar disc herniation such as failed back syndrome or the degeneration of the lumbar disc may progress more rapidly. In such cases, if patients complained back pain and radiating pain in the lower extremities, the upper lumbar disc herniation must be assessed. However, as clinical symptoms and examination findings were diverse, it was difficult to speculate the location and the pattern, unlike to the lower lumbar disc herniation. We also observed back pain in all patients. Together with back pain, pain in various areas such as the inguinal area, thigh, lower leg, foot, etc. were detected. On the other hand, Bosacco et al.⁵⁾ urged that in the diagnosis of the upper lumbar disc herniation, if clinical symptoms were atypical or not in agreement with other examination results, more precise neurological test and radiologic tests are prerequisite. In addition, Kortelainen et al.¹²⁾ have reported that in patients with the protruded nucleus pulposus located in the center compressing the nerve root in the lower lumbar area, clinical symptoms are atypical and thus neurological findings do not reflect the location of the protruded nucleus pulposus. In such manners, as lumbar disc herniation is not distinct in contrast to the lower lumbar disc herniation, it was difficult to assess the relation with clinical examination findings. Thus, prior to surgery, we performed magnetic resonance imaging on the lumbar area and thus detected the lumbar disc protrusion readily. If required, we performed discogram followed by computed tomography etc. and thus distinguished the lumbar disc herniation from degenerative bony spur.

In the treatment of the upper lumbar disc herniation, similarly to the treatment of the lower lumbar area and the thoracic area, conservative methods must be considered first. Saal et al.¹⁸⁾ emphasized the importance of conservative treatments.

We applied conservative treatments initially. Subsequently,

we performed surgery on patients if the root compression was evident on MRI, the sequestration of the protrusion of the nucleus pulposus was detected, back pain or radiating pain in the lower extremities was too severe to carry out normal daily life, the symptoms were not improved by conservative treatments for over 6 weeks, or the impairment of the straight leg raising test and the evidence of neurological symptoms (weakness in muscle strength, paresthesia).

As surgical approach techniques, anterior and posterior approach are available. Bohlman and Zdeblick⁴⁾ have reported that anterior approach is advantageous for the excision of the protruded discs and the degenerative bony spur, and for the reduction of neurological complications after operation. However, the disadvantages of the anterior approach technique are that as the wide area is incised during surgery, it may cause hemorrhage, a long operation time, the damage of soft tissues in a wide area, and the operative technique may not be familiar to neurosurgeon¹⁰⁾. Particularly, in the L1-2 disc herniation cases, as anterior approach may excise the diaphragm and the rib, a long operation time and surgical technique are required, and the damage of the soft tissues in the vicinity may be accompanied. The posterior approach is Love's method that is generally performed in the lumbar disc herniation¹³⁾. This technique is the interlaminar approach that has been generally applied to lumbar disc herniation presently. The technique is less invasive, the procedure is familiar, and decompresses by excising the herniated disc directly. However, in the upper lumbar disc herniation, due to the anatomical structure, sufficient traction of the dura mater can not be performed, neurological symptoms may develop after surgery, the instability of the vertebral body may occur, and thus special attentions must be paid¹⁰⁾.

The advantages of the transfacetal pedicle sparing approach for the thoracic lumbar disc herniation reported by Spangfort et al. are reduced hemorrhage, minimum excision of the vertebra, and the reduction of the damage in soft tissues^{19,20)}. In the upper lumbar disc cases, the wide excision of the facet joint and the wide excision of disc cause the instability of the vertebra. Thus the disadvantage is the limited indication of the surgery as it requires the posterior interbody fusion using mesh cage and bone fragments or posterolateral fusion¹²⁾.

In posterior approach technique, extralaminar approach or extraforaminal approach is a technique for the foraminal or extraforaminal lumbar disc herniation. This techniques has the difficulty of distinguishing anatomical structures in the vicinity of the foraminal area, and handling of the nerve root without damaging the nerve root for the identification of the herniated disc and to remove it. Of course, the advantage of this technique is to spare the stability of movement segments. The disadvantage, however, is the difficulty of identifying

disc that is herniated to the center macroscopically¹⁷⁾.

Among these techniques, numerous surgical methods that compensate the shortcomings of each other, improve patient's symptoms, reduce the surgery time, without causing the instability of movement segments, and conserve the stability have been attempted. In our study, we performed the paraspinal approach on the following patients with the upper lumbar disc herniation : (1) in the upper lumbar disc herniation of L1-2, L2-3 or L3-4, conventional technique may cause neural damage or lamina fracture, (2) the cases without the spinal stenosis, (3) the cases absent the cauda equina syndrome, (4) the cases that are not the recurred lumbar disc herniation, and (5) on BMD, the T-score is lower than 3.0 and thus the interbody fusion is not applicable. Pathologic disc or disc with pathologic potential was excised, 3~4mm of the lamina was excised, and thus maintained the integrity of lamina and the inferior articular process while excising the ruptured disc sufficiently. Interbody fusion for the instability was not required. In all patients applied this surgical technique, the instability did not occur. Except the case with the poor result due to the deep wound infection after surgery, clinical and neurological symptoms improved. In the upper lumbar disc herniation, anterolateral approach leaves a number of surgical scars, the approach method is rough, and the long recovery period after surgery is required. In posterior approach, because of the damage of the ventral structure may cause the instability of the vertebrae, the disc excision technique applying simultaneous paraspinal and midline approach may be suitable to patients described above.

Conclusion

In the upper lumbar disc herniation, we consider simultaneous paraspinal and midline approach as an useful surgical approach as it excises herniated discs without neurological damage and improves symptoms, it does not induce the instability of movement segments in comparison with conventional surgical methods, it does not require the interbody fusion, and the operation time is reduced.

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