

Short-term clinical outcomes of percutaneous transforaminal endoscopic discectomy in treating adolescents under 25 years old with massive lumbar disc herniation

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Research article

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Abstract

Background: In the last decades, endoscopic techniques to treat lumbar disc herniation (LDH) have gained popularity in clinical practice. However, few studies have described the safety and efficacy of percutaneous transforaminal endoscopic discectomy (PTED) in treating adolescent massive LDH. This study aims to evaluate the surgical outcomes of PTED in treating adolescent patients with massive LDH.

Methods: Between October 2012 and December 2018, retrospective analysis of 13 adolescent patients with single segment massive LDH at the Department of Spinal Surgery of Affiliated Dongyang Hospital of Wenzhou Medical University. All patients were followed up for at least 12 months (range 12–20 months). The patients' lower limb pain was evaluated using visual analogue scale (VAS) scores and the Oswestry Disability Index (ODI). Patient satisfaction was evaluated using the MacNab outcome scale. Clinical outcomes were measured preoperatively, at 3 days, 1 months, 3 months, 6 month and 12 months postoperatively.

Results: The VAS score for leg pain was 7.08 ± 1.12 preoperatively and 3.23 ± 1.01 , 3.0 ± 1.01 , and 2.62 ± 0.51 , and 2.32 ± 0.48 , and 1.46 ± 0.52 , at 3 days, 1 months, 3 months, 6 months and 12 months postoperatively respectively. The ODI scores was 51.51 ± 3.08 preoperatively and 21.74 ± 1.15 , 14.81 ± 1.50 , and 2.78 ± 0.64 , at 3 months, 6 months and 12 months postoperatively respectively. These postoperative scores were all significantly different when compared with preoperative scores ($P < 0.001$). According to the modified MacNab outcome scale, excellent was obtained in 7 patients, good was obtained in 5 patients, and fair was obtained in 1 patient, and 92.31% of these patients had excellent and good outcomes at the final follow-up. There were no complications related to surgery, and no spinal instability was detected.

Conclusion: The PTED is an effective and safe surgical method for the treatment of adolescent patients with massive LDH, but high-quality randomized controlled trials are still required to further verify these findings.

Background

Lumbar disc herniation (LDH) is a common spinal disease, rare in adolescents, and trauma is the most important pathogenic factor in adolescents [1].

Some LDH of adolescent patients is massive, which is a special type of lumbar disc herniation type. To qualify as a 'massive' herniation at least 50% of the spinal canal had to be occluded by disc material on axial MRI-Magnetic resonance imaging scans [2]. For adolescent patients for whom LDH is massive and conservative treatment is ineffective, open microdiscectomy is considered an effective surgical treatment strategy. Hansraj et al. [3] reported that the intervertebral space is basically hollowed out and unstable after decompression of massive LDH. Therefore, one-stage decompression and fixation fusion can be considered to massive LDH. However, adolescents are different from adults. If they choose fusion surgery prematurely, they will have to face the second revision surgery of adjacent vertebral diseases after some

years. Therefore, interbody fusion should not be the first choice. At present, PTED has become an increasingly popular surgical procedure for treating LDH, since its first application in 1973 [4]. However, there have been few studies on the clinical efficacy of PTED in treating adolescent patients with massive LDH. Thus, this study was conducted to investigate the safety and efficacy of PTED in treating adolescent massive LDH.

Methods

Clinical data

A total of 13 patients were enrolled into this study. Among these patients, 8 patients were male and 5 patients were female. The age of these patients ranged within 18–24 years old, with an average of 21.31 ± 2.14 years old. The lesions were located at L4/5 in 9 patients, at L5/S1 in 4 patients. All patients had typical lumbar and leg pain or numbness symptoms and positive signs in the straight leg elevation test, and all showed obvious massive lumbar intervertebral disc herniation by magnetic resonance imaging (MRI) and computed tomography (CT). The diagnosis was confirmed when combined with the clinical performance. None of the patients showed any significant improvement in symptoms after at least 3 months of strict conservative treatment. Patients with lumbar instability, tumors, infection were excluded.

Surgical methods

Surgical instruments

The transforaminal endoscopic system provided by jiomax (Germany), and the radio-frequency electrode system provided by Ellman (USA).

Surgical procedures

To perform the PTED, the patient was placed in the lateral position. A soft cushion was placed beneath the waist causing it to protrude slightly towards the operative side, in order to increase the height of the operative intervertebral foramen. The labeled operating space was scanned by a C-arm X-ray machine, the operation was performed under local anesthesia with 1% lidocaine in Subcutaneous and muscular layers and 0.5% lidocaine for articular facet, combined with analgesic drugs. The computer image processing system was used to measure the distance from the puncture point (for L4/5 was 10–12 cm and L5/S1 was 12–14 cm from the middle line). When the puncture needle reached the ventral margin of the articular facet of the superior articular process, under guidance with a C-arm X-ray machine, then 2 to 5 mL of 0.5% lidocaine was locally injected. The puncture needle was slightly pushed to the position between the spinous process and medial margin of the vertebral arch on the anteroposterior X-ray film, while the needle was positioned at the upper edge of the inferior vertebral body on the lateral film. The puncture needle was removed and a guide wire was inserted. Then a 8 mm long incision was made along the puncture site and the work channel was gradually expanded. A small amount of the tip of the facet of the superior articular process was excised by layer with the aid of the expansion tube, guide rod, and

trephine, in order to expand the lateral intervertebral foramen and establish surgical access. An intervertebral foramen mirror light source, camera and washing fluid were connected. The operation for the extirpation of the protruded intervertebral disc, decompression of the nerve root, intradiscal electrothermal annuloplasty, and hemostasis were performed using an endoscope. When the patient's self-feeling symptoms were relieved and the nerve beat was well after decompression, the surgical access was pulled out and the wound was sutured (Fig .1).

Postoperative care

Patients had bed rest for 6 h after the surgery and got out of bed to perform appropriate activities with the aid of a waistline. Bending and weight-bearing activities should be avoided within 6 weeks after surgery, and excessive physical activity and strenuous physical exercise should be avoided within 3 months.

Efficacy evaluation

Lower limb pain was evaluated using visual analogue scale (VAS) scores and the Oswestry Disability Index (ODI) preoperatively and at 3 days, 1 months, 3 months, 6 months, and 12 months postoperatively. The recovery of lumbar function after the surgery was evaluated using the modified MacNab score at the final follow-up.

Statistical analysis

Data were statistically analyzed using statistical software SPSS 22.0. All results were expressed as mean \pm standard deviation ($x \pm SD$). The obtained data were processed by statistical analysis and evaluated using t test. $P < 0.05$ was considered statistically significant.

Results

All 13 patients were successfully operated. There was no CSF leakage or spinal cord injury during the operation. The operation time was 90–120 min, bleeding was 10–20 ml, and the hospital stay was 3–5 days. All patients were followed up for 12–20 months. One patient recurred and the symptoms were relieved by conservative treatment. The leg pain VAS scores and ODI scores were significantly improved after operation compared with those before operation ($P < 0.01$), and the difference was statistically significant (Table 1). At the last follow-up, the modified MacNab score was excellent in 7 cases, good in 5 cases, fair in 1 case, and the excellent and good rate was 92.31%.

Table 1
VAS scores of limb pain and ODI scores in different time among 13 cases

time	VAS scores ($\bar{x} \pm S$)	ODI cores ($\bar{x} \pm S$)
Before surgery [¶]	7.08 ± 1.12	51.51 ± 3.08
3 days after surgery [¶]	3.23 ± 1.01	21.74 ± 1.15
1 months after surgery [¶]	3.0 ± 1.01	14.81 ± 1.50
3 months after surgery [¶]	2.62 ± 0.51	2.78 ± 0.64
6 months after surgery [¶]	2.31 ± 0.48	
12 months after surgery [¶]	1.46 ± 0.52	

[¶] compared with Before surgery, P < 0.01

Discussion

LDH is a common and frequently occurring disease of the spine and is the most common cause of lumbocrural pain. In recent years, due to the lifestyle changes of people, the prevalence of LDH has gradually increased in adolescents, reaching between 1 to 5% [5]. The main pathogenesis includes degeneration, genetic and developmental malformation and, especially, trauma [6]. Some LDH of adolescent patients is massive, which often lead typical lumbar and leg pain or numbness symptoms and positive signs in the straight leg elevation test. The treatment goal of adolescent LDH is to relieve symptoms and allow for routine daily activities. Kurihara and Kataoka [7] reviewed 70 adolescents with disc herniation, Only 40% of patients responded to conservative treatment, while recurrence of symptoms was common after returning to normal activity. Results after surgical discectomy were generally excellent. So when conservative treatment is ineffective, surgery is a better option.

In the surgical treatment of LDH, open nucleotomy through an open window has been used for a long time. However, this method may cause instability of the spine and lead to long-term bed rest. In 1975, Hijikata et al. [8] reported the use of percutaneous lumbar discectomy in the treatment of adult LDH. PTED has gradually become the mainstream of discectomy with the popularization and application of Hoogland TESSYS technology [9]. PTED is a better minimally invasive surgical method, compared with fenestration discectomy (FD), with such advantages as less trauma, less blood loss, early function recovery, less effect on lumbar spinal stability. It is a safe and effective minimally invasive technique for adolescent lumbar disc herniation (ALDH), and the outcomes of PTED are similar to that of FD, which is also recognized by other authors [10–12]. However, few publications reported the efficacy of PTED in the treatment of adolescent patients with massive LDH. Therefore, we conducted this study to evaluate the efficacy and safe of PTED in the treatment of adolescent massive LDH.

In the present study, differences in leg pain VAS scores and ODI scores before and after the operation were statistically significant ($P < 0.01$). According to the modified MacNab scale, the postoperative excellent and good rate was 92.31%. The above results suggest that the short-term curative effect of this surgical procedure is significant, and its postoperative recovery is rapid. The nerve root of the patients

with massive disc herniation are often jacked up and wrapped by the protruding nucleus pulposus tissue, which can not be seen clearly. The pressure of the spinal canal is large, so the first decompression can be performed in the disc. The disc herniation in adolescents is fragmentary, unlike a large mass in adults. The standard of complete removal should be judged by the degree of nerve root falling and the relaxation degree of nerve root during the straight leg raising test. After the removal of the huge lumbar disc herniation, there is a large gap between the posterior longitudinal ligament and the posterior edge of the vertebral body, whose repair and reconstruction need a relatively stable internal environment. The premature lumbar bending and load-bearing will lead to the recurrence of the lumbar disc herniation. Therefore, the patients should avoid excessive activity within 3 months after the operation. In our study, One patient developed LDH of the operated segment again at 10 weeks after operation because of stooping and weight-bearing activities. PTED can keep the stability of the spine of adolescent patients with lumbar disc herniation, and prevent postoperative instability and lumbosacral pain caused by removal of lamina and part of articular process bone in traditional operation. It has been found that 82% of ALDH patients have a disc grade of Pfirrmann I-II [13], the improvement of intervertebral disc degeneration in PELD group is better than that in laminectomy group [10], which is especially important for young patients and a good indication for long-term curative effect.

The advantages of PTED to adolescent massive lumbar disc herniation are as follows: First, PTED is performed under local anesthesia and in the safe triangle of the foramen, the muscle tissue is not extensively stripped, articular process is not damaged, so patients recover faster after surgery, and postoperative lumbar instability is prevented [14–15]. Second, the patients can not completely avoid the recurrence after the operation. The PTED has less damage to the surrounding muscles, small soft tissue and extradural scar, which provides conditions for the future revision and reoperation.

Conclusions

According to our results, leg VAS scores and ODI scores improved significantly after PTED. Based on our research, PTED is an effective and safe surgical method in treating adolescent patients with massive LDH. However, the sample of patients was relatively small, which could affect the results of this study, and this is a retrospective analysis. Further prospective studies are required to confirm our results.

Abbreviations

LDH: Lumbar disc herniation; PTED: Percutaneous transforaminal endoscopic discectomy; VAS: Visual analogue scale; ODI: Oswestry Disability Index; MRI: Magnetic resonance imaging; CT: Computed tomography; FD: fenestration discectomy; ALDH: adolescent lumbar disc herniation

Declarations

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Availability of data and materials

We declared that the materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Authors' contributions

Hai-Chao He carried out the studies and drafted the manuscript. All authors participated in the design of the study and performed the statistical analysis. Yong-jin Zhang revised it critically for important intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

I confirm that I have read the Editorial Policy pages. This study is a retrospective study, which conducted with approval from the Ethics Committee of Affiliated Dongyang Hospital of Wenzhou Medical University. This study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Written informed consent for publication of their clinical details and clinical images was obtained from the patient.

Competing interests

The authors declare that they have no competing interests

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References

1. Ozgen S, Konya D, Toktas OZ, Dagcinar A, Ozek MM. Lumbar disc herniation in adolescence. *Pediatr Neurosurg.* 2007;43:77–81.
2. Cribb GL, Jaffray DC, Cassar-Pullicino VN. Observations on the Natural History of Massive Lumbar Disc Herniation. *J Bone Joint Surg Br.* 2007;89:782-784.
3. Hansraj KK, OLeary PF, Cammisa FP Jr, Hall JC, Fras CI, Cohen MS, et al. Decompression, fusion, and instrumentation surgery for complex lumbar spinal stenosis. *Clin Orthop Relat Res.* 2001;384:18-25.
4. Wang B, Lu G, Liu W, Cheng I, Patel AA. Full-endoscopic interlaminar approach for the surgical treatment of lumbar disc herniation: the causes and prophylaxis of conversion to open. *Arch Orthop Trauma Surg.* 2012;132:1531–8.
5. Smorgick Y, Floman Y, Millgram MA, Anekstein Y, Pekarsky I, Mirovsky Y. Mid- to long-term outcome of disc excision in adolescent disc herniation. *Spine J.* 2006;6:380–4.
6. Benifla M, Melamed I, Barrelly R, Aloushin A, Shelef I. Unilateral partial hemilaminectomy for disc removal in a 1-year-old child. *J Neurosurg Pediatr.* 2008;2:133–5.
7. Kurihara A, Kataoka O. Lumbar disc herniation in children and adolescents. A review of 70 operated cases and their minimum 5-year follow-up studies. *Spine.* 1980; 5: 443-451.
8. Hijikata S, Yamagishi M, Nakayama T. Percutaneous discectomy: a new treatment method for lumbar disc herniation. *J Tokyo Den Hosp.* 1975;5:39–41.
9. Hoogland T, Schubert M, Miklitz B, Ramirez A. Transforaminal posterolateral endoscopic discectomy with or without the combination of a low-dose chymopapain: a prospective randomized study in 280 consecutive cases. *Spine.* 2006 ;31(24):890-897.
10. Li J, Ma C, Li Y, Liu DW, Wang D, Dai W, et al. A Comparison of Results Between Percutaneous Transforaminal Endoscopic Discectomy and Fenestration Discectomy for Lumbar Disc Herniation in the Adolescents. *Zhonghua Yi Xue Za Zhi.*2015;95:3852-3855.
11. Liu W, Li Q, Li Z, Chen L, Tian D, Jing J. Clinical Efficacy of Percutaneous Transforaminal Endoscopic Discectomy in Treating Adolescent Lumbar Disc Herniation. *Medicine (Baltimore).* 2019; 98: e14682.
12. Chen Y, Song R, Huang W, Chang Z. Percutaneous Endoscopic Discectomy in Adolescent Lumbar Disc Herniation: A 3- To 5-year Study. *J Neurosurg Pediatr.* 2018; 23:251-258.
13. Griffith JF, Wang YX, Antonio GE, Choi KC, Yu A, Ahuja AT, et al. Modified pfirrmann grading system for lumbar intervertebral disc degeneration. *Spine.* 2007;32(24): E708-712.
14. Zhou YL, Chen G, Bi DC, Chen X. Short-term Clinical Efficacy of Percutaneous Transforaminal Endoscopic Discectomy in Treating Young Patients With Lumbar Disc Herniation. *J Orthop Surg Res.* 2018;13:61.
15. Ahn Y, Lee SH, Park WM, Lee HY, Shin SW, Kang HYe. Percutaneous endoscopic lumbar discectomy for recurrent disc herniation: surgical technique, outcome, and prognostic factors of 43 consecutive cases. *Spine (Phila Pa 1976)* 2004; 29:326–32.

Figures

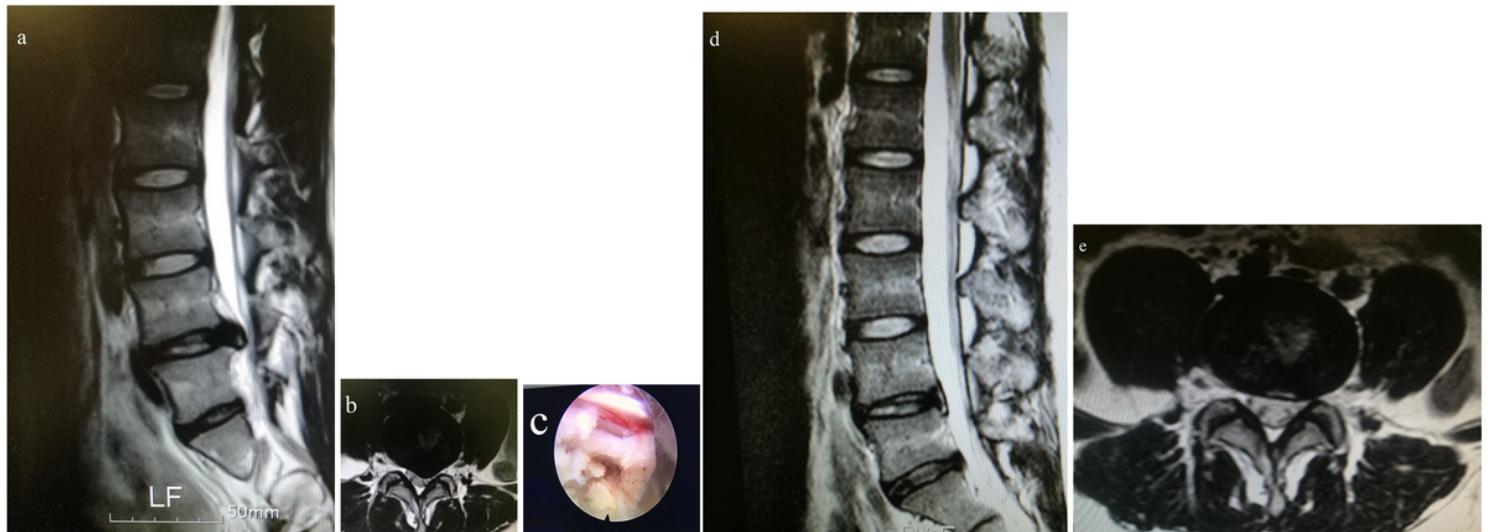


Figure 1

The patient was a male adolescent and had a massive protrusion at L4/5. a MRI revealed a L4/5 massive intervertebral disc protrusion in the sagittal section. b In the cross section, it revealed a massive protrusion in the posterior center and left portion of the L4/5 intervertebral discs, which compressed the left L5 nerve root. c The spinal nerve root was exposed during the operation. d After 3 months, MRI revealed no significant protrusion in the L4/5 intervertebral discs. e After the operation, in the transverse section, it revealed no significant protrusion in the L4/5 intervertebral discs, and the nerve roots were not compressed