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# Clinical Study of Pereutaneous Laser Disc Decompression Compound Radiofrequency Target Thermocoagulation Ablation to Treat Lumbar Disc Herniation

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## Abstract

**Objective:** To evaluate the clinical effects and safety of Percutaneous Laser Disc Decompression (PLDD) compound radiofrequency targeted thermocoagulation ablation on Lumbar Disc Herniation (LDH).

**Methods:** One hundred and ten patients diagnosed with LDH were selected and divided into two groups. Group A (55 cases) underwent PLDD and radiofrequency targeted thermocoagulation ablation, and Group B (55 cases) underwent PLDD alone. All patients were followed up for 6 to 27 months after the treatment, and the clinical results were assessed separately according to the improved Macnab standard. The adverse reactions were compared between the two groups.

**Results:** The excellent rate of group A was higher than that of group B ($P<0.05$), but showed no significant difference between the two groups in the effective rate ($P>0.05$).

**Conclusion:** PLDD combined with radiofrequency targeted thermocoagulation ablation is a better minimally invasive therapy for LDH treatment, which has a higher excellent rate and lower adverse reactions.

**Keywords: Lumbar disc herniation; Laser disc decompression; Radiofrequency targeted thermocoagulation ablation**

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## Introduction

Treatments for Lumbar Disc Herniation (LDH) include conservative drug and physical treatment, nerve block; minimally invasive pereutaneous puncture, and open surgery. In recent years, minimally invasive surgery has undergone rapid development, and more patients are willing to undergo this operation. One of these includes Pereutaneous Laser Disc Decompression (PLDD). According to Abrishamkar et al. [1], the effect of PLDD showed no differences with the open surgery for the treatment of LDH, as PLDD causes minimal trauma, allows quick recovery, and less expensive. However, simple PLDD might result in insufficient decompression, and can hardly approach the target site. In this study, we performed PLDD-combined radiofrequency target thermocoagulation ablation to evaluate its clinical effects and safety in 110 LDH patients, and obtained satisfactory treatment outcome.

## Materials and Methods

### General information

This study included a total of 110 patients diagnosed with LDH in the local Hospital from October 2012 to December 2015. There were 51 males and 59 females, age ranged between 35 to 76 years, and the disease course ranged between 4 months to 25 years. A total of 149 lumbar discs were treated, including 5 L2/3 discs, 27 L3/4 discs, 63 L4/5 discs, and 54 L5/S1 discs, while 38 patients had intervention for 2 discs. Group A included 55 cases receiving PLDD-combined radiofrequency target thermocoagulation ablation, and group B included 55 cases receiving PLDD alone. Patients in the two groups were insignificantly different in terms of their age, disease course, BMI, or follow-up time ($P>0.05$).

### Inclusion and exclusion criteria

**Inclusion criteria:** 1) patients with LDH, suffering from backache and radiation pain of the lower limbs; 2) abnormal sensation of the affected side and (or) decreased muscle strength and

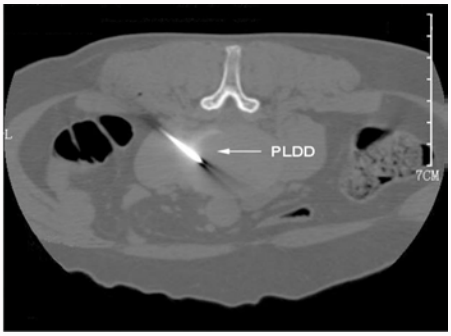


**Figure 1:** Intraoperative CT images of PLDD.

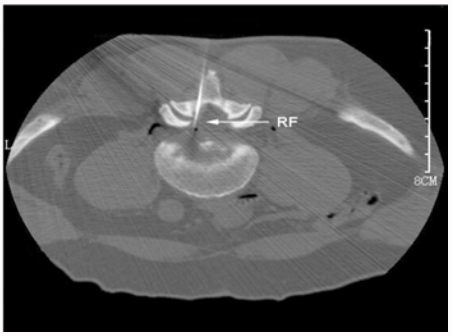


**Figure 2:** Intraoperative CT images of RF.

tendon reflex; 3) positive result for nerve root stretch test; 4) CT and (or) MR imaging suggested LDH compression of the nerve root; and 5) conservative treatment was ineffective for >12 weeks.

**Exclusion criteria:** 1) patients with bleeding tendency or infection at the puncture site; 2) patient had bony narrowing of the spinal canal; 3) patient had significant herniation and cauda equine damage; 4) imaging suggested calcification of the fibrous ring and posterior longitudinal ligament; 5) lumbar instability and spondylolisthesis; and 6) patient with mental illness or difficult to communicate.

## Methods

**Group B:** Patients were asked to lie prostrate on the examination bed. The belly was raised by 15 cm to 20 cm, and the lumbar was scanned at a layer sickness of 2 mm. By using a gating-localizer, the level of puncture was determined, and the distance as well as the angle of the puncture path was determined. After skin disinfection and local anesthesia (2% lidocaine) application, an 18G 15 cm needle was punctured along the planned path, and the target lumbar disc was approached through the safe triangle (Figure 1). For L5/S1 discs, the tail of the needle was tilted by about 25° towards the head to avoid the iliac crest or the medial margin of the small joints (Figure 2). When the needle pierced into the intervertebral disc tissue, the resistance would increase obviously, and some patients might feel mild-to-moderate root pain, which lasts for about 10 s. Then, CT scanning was performed to ensure that the needle was pointed to the center of the nucleus pulposus, and a quanta-808 laser machine was turned on, with the power set at 10 W, pulse radiation for 1.0 s, and interval for 1.0 s. A light-guide fiber, with 400 μm diameter, was pointed 5 mm out from the needle. The total laser energy was set at 1200 J for each lumbar disc. During vaporization, patients were asked about their feelings of the waist and lower limbs. If the patients felt an obvious distending pain, vaporization would be paused until the gas was

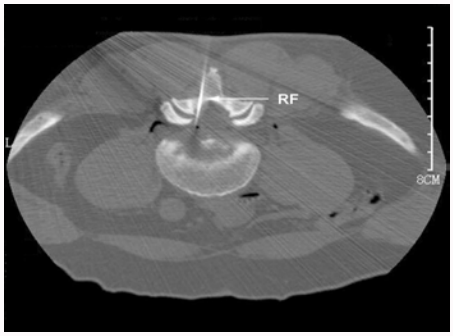


**Figure 3:** Intraoperative CT images of RF.


**Figure 4:** Preoperative MRI.

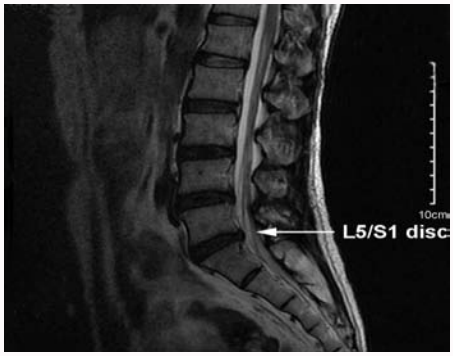


**Figure 5:** Postoperative MRI.

aspirated slowly and carefully. There could be a smell of burning, and sounds of gas leakage or bubbles. Laser vaporization was terminated after reaching the set energy. Then the fiber was withdrawn and the naked part was cut. The disc cavity after vaporization was measured by another puncture, and the fiber as well as the needle was withdrawn, followed by aseptic dressing application. **Group A:** Patients were asked to lie prostrate, and CT localization was performed in the same way as done in group B patients. The responsible disc was determined based on the clinical symptoms and signs. Laser vaporization was first performed. Contralateral to the radiofrequency needle, the puncture needle was pointed at 1/3 of the posterior intervertebral space, and a light-guide fiber was exposed by 3 mm for vaporization with the output power, radiation time and pulse interval similar to those of group B. The total energy was set at 600 J. The fiber was withdrawn after termination, and aspiration was performed if needed. Patients in group A further received radiofrequency treatment with a 22G radiofrequency needle. For optimal approach, the needle was

punctured through the medial margin of the posterior lumbar facet joint or through the lumbar safe triangle to reach the ablation target (Figure 3). If no cerebrospinal fluid or blood backflow occurs, high-frequency current (50 Hz, 0.8 to 1.0 mA) was given for sensory test and low-frequency current (2 Hz, 0.8 to 2.0 mA) for motion test. If the stimulation did not cause pain or motion of the innervation area, 30 s of thermocoagulation from 60°C to 70°C, 80°C and 90°C was given sequentially to identify the highest tolerable temperature for the patient. Then, 4 treatment cycles were performed at the highest tolerable temperature, with 60 s each cycle, and patients were asked about their feelings during the radiation period. Finally, the needle was withdrawn, followed by wound dressing.

### Postoperative treatment

Patients were asked to rest in bed for 1 day. This is followed by intravenous administration of antibiotics and mannitol for 3 days. After 1 week, patients could return to regular work or activities, but the waist support was required for 8 weeks. After 3 months, patients could perform light physical work, and continue lumbodorsal muscle exercises for more than 6 months.

### Outcome evaluation

Based on the improved MacNab standard [2], excellent was defined as patients feeling no pain, and could participate in the routine work or activities; good was defined as patients feeling occasional back pain or sciatica, but would not affect the work; fair was defined as incomplete remission, and patients require drug treatment; poor was defined as no improvement, and physical activities were limited. The percentage of excellent and good patients was defined as the excellent rate; the percentage of excellent, good and fair patients was defined as the effective rate.

### Statistical analysis

Statistical analysis was performed using the SPSS 19.0 software. Measurement data were compared by t test or Chi-square test. P<0.05 was defined as statistical significance.

## Results

Comparisons of two groups of patients are listed in (Table 1).

### Adverse reactions

One patient in group B developed endplate osteochondritis. No adverse reactions or complications were found in other patients.

## Discussion

Most LDH patients could be improved by conservative treatment, and those with poor outcome could also be treated by minimally invasive or open surgeries. Compared to open surgery, minimally invasive surgery has several advantages due to less trauma and bleeding, shorter hospital stay, less cost, and fewer complications. A study followed up PLDD patients for 8 years, and found that the treatment efficacy was long-lasting [3]. The main mechanism of PLDD involves intervertebral decompression [4], which can remove the pain-causing substances, thereby alleviating inflammatory stimulation [5]. Other studies also suggested that PLDD could improve blood flow and microcirculation inside the nerve root [6]. With stable efficacy and low cost, radiofrequency ablation has become the most commonly used technique for the treatment of LDH. The technique utilizes an ablation electrode, which pierces into the lumbar disc and emits radiofrequency power to produce heat. This in turn causes denaturation, solidification and contraction

**Table 1:** Treatment outcome of the two groups of patients.

| Groups | N | Last follow-up | | | | | |
|---|---|---|---|---|---|---|---|
| | | Excellent | good | Fair | poor | Excellent rate | Effective rate |
| Group A | 55 | 30 | 19 | 3 | 3 | 89.9%* | 94.5%# |
| Group B | 55 | 21 | 18 | 7 | 9 | 70.90% | 83.60% |

* *P*<0.05 when compared with group B; # *P*>0.05

of the nucleus pulposus, and reduces its volume to decompress the peripheral nerve root, blood vessel and spinal cord, and eliminate or relieve clinical symptoms. In the meantime, the high-heat produced during ablation could improve the local circulation and muscle spasm. Thermocoagulation also helps to remove pain-causing factors, and reduces inflammation and edema [7]. Than targeting at the herniation of responsible discs, ablation could be more precise, and the outcome could be more satisfactory. The power of radiofrequency is lower than that of the laser, and it could approach the target more closely, so that the targeted radiofrequency ablation actually underwent thermocoagulation of the nucleus pulposus of the herniated lumbar disc. For intervention of LDH, PLDD-compound targeted radiofrequency ablation combines the decompressing effect of PLDD and the targeting property of radiofrequency, which in turn helps to obtain better clinical results.

Single-needle puncture at the affected side is most commonly performed in PLDD. This strategy showed an obvious decompression effect at the backside of herniation, but for central or paracentral LDH, simple decompression at the affected side might not obtain a satisfactory outcome. Sometimes, laser vaporization could not reach the intervertebral disc tissues that protrude to the lateral recess and form adhesion, and so combined application of radiofrequency targeting the herniation could significantly improve the curative effect and alleviate the patient symptoms. Besides, during single-needle PLDD, excessive gas causes overpressure of the disc cavity, and vaporization should be terminated until the gas is aspirated and removed. When decompression was unsatisfactory, targeted radiofrequency often helps to improve the treatment outcome. Also, needle adjustment and multi-point burning should be avoided during PLDD, as this would cause heat damage and increase the risk of discitis. This is the major complication of PLDD and has an incidence of 0.3% to 1.0% [8]. Still, good operation skills are needed to reduce the complications. During laser vaporization, the head of the needle should always be kept parallel to the end plate to avoid endplate burning, prevent inflammation and intervertebral space infection. The head of the needle should reach the nucleus pulposus area between the upper and lower endplates. Targeted radiofrequency ablation might cause damage to the thecal sac or nerve root during puncturing, and so the CT-guided localization should be performed to reduce the risk, and sensory as well as motion tests should be performed during treatment.

By now, the best indication for PLDD includes patients with mild or small LDH and has no fibrous ring rupture. Though in 2001 Choy et al. [9] reported the use of PLDD in patients with extruded LDH, we also have cases of treatment of patients with extruded LDH, and have achieved good symptoms and imaging changes ( Figure 4 and 5), there are very few studies reporting such results. So we also exclude it from indications. Radiofrequency ablation is also mainly used for non-ruptured LDH, and open surgery is suggested for patients with an intervertebral disc height <50% of the normal, ruptured LDH, huge non-ruptured LDH (occupying more than 1/3 of the vertebral canal), or LDH combined with spinal fractures, spondylolisthesis,

vertebral instability, obvious spinal stenosis, or extensive osteophyte [10]. Last but not the least, the spinal stability of patients was also considered as a factor that affects the long-term efficacy.

## Conclusion

PLDD-combined targeted radiofrequency ablation is a safe and effective treatment that reduces the risk of simple PLDD and improves the long-term outcome of patients after treatment.

## References


1. Abrishamkar S, Kouchakzadeh M, Mirhosseini A, Tabesh H, Rezvani M, Moayednia A, et al. Comparison of open surgical discectomy versus plasma-laser nucleoplasty in patients with single lumbar disc herniation. J Res Med Sci. 2015;20:1133-7.
2. Le H, Sandhu FA, Fessler RG. Clinical outcomes after minimal-access surgery for recurrent lumbar disc herniation. Neurosurgical Focus. 2003;15:E12.
3. McCormick ZL, Slipman C, Kotcharian A, Chhatre A, Bender FJ 3rd, Salam A, et al. Percutaneous lumbar disc decompression using the dekompressor: A prospective long-term outcome study. Pain Med. 2016;17(6):1023-30.
4. Hirohashi T. Effects of Holmium(HO)-YAG laser irradiation on rabbit lumbar discs. Kurume Med J. 2000;47:73-8.
5. Iwatsuki KI, Yoshimine T, Sasaki M, Yasuda K, Akiyama C, Nakahira R. The effect of laser irradiation for nucleus pulposus: An experimental study. Neuro Res. 2005; 27(3): 319-23.
6. Hellinger J, Linke R, Heller H. A biophysical explanation for Nd: YAG Percutaneous Laser Disc Decompression Success. J Clin Laser Med Surg. 2001;19(5):235-8.
7. 7. Chen YC, Lee SH, Chen D. Intradiscal pressure study of percutaneous disc decompression with nucleoplasty in human cadavers. Spine. 2003;28(7):661-5.
8. Choy DS, Hellinger J, Hellinger S, Tassi GP, Lee SH. 23rd Anniversary of Percutaneous Laser Disc Decompression (PLDD). Photomedicine & Laser Surgery. 2009;27(4):535-8.
9. Choy D. Response of extruded intervertebral herniated discs to percutaneous laser disc decompression. J Clin Laser Med Surg. 2001;19(1):15-20.
10. Bhagia SM, Slipman CW, Nirschl M, Isaac Z, Elabd O, Sharps LS, et al. Side effects and complications after percutaneous disc decompression using coblation technology. Am J Phys Med Rehabil. 2006;85(1):6-13.