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Original Article

Management of discogenic low back pain with intradiscal electrothermal therapy or microendoscopic discectomy/interbody fusion: a retrospective study of 48 cases

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Abstract: This study was to evaluate the outcome of intradiscal electrothermal therapy (IDET) and microendoscopic discectomy (MED)/interbody fusion for discogenic low back pain. Forty-eight patients with symptoms of discogenic low back pain and treated with IDET or MED between April 2003 and May 2011 were enrolled in the study. The Degree of annular disruption was evaluated according to "Modified Dallas Discogram Description" method. The patients with Degree II annular disruption were performed with IDET; the patients with Grade III annular disruption and level III-IV of annular degeneration were treated with MED/interbody fusion. All patients were followed up on a regular basis. The treatment outcome was evaluated by visual analogue scale (VAS) and oswestry disability index (ODI) scores. There were 14 cases of Degree II annular disruption and 34 cases with Degree III annular disruption. The patients were followed-up with an average of 50 (range, 1-72) months. Of the 14 cases treated with IDET, the average VAS score of 13 cases at the final follow-up reduced significantly compared with preoperatively ($P<0.01$). Of the 34 patients treated with MED/interbody fusion, 32 cases showed obvious VAS score decrease at the final follow-up with statistical difference compared with preoperatively. The ODI scores of the 48 cases at the final follow-up had significant difference ($P<0.01$) comparing with preoperatively. In conclusion, a significant improvement was obtained in patients with chronic discogenic low back pain treated with IDET or MED/interbody fusion. A prospective randomized control study with a large sample is needed.

Keywords: Discogenic low back pain, annular disruption, discography, intradiscal electrothermal therapy, microendoscopic discectomy

Introduction

Discogenic low back pain is a common and challenging clinical problem. It is recurrent and seriously affects patients' lives [1]. Discogenic low back pain was caused by structural disease of lumbar discs without disc herniation or radicular pain syndrome. The most common characteristic of discogenic low back pain was low back pain with or without referred pain, and usually lack of objective neurological signs [2, 3]. It is reported that annular disruption was the main and common pathological reason for chronic low back pain [4].

Current management of suspected discogenic pain, despite its affirmation in the literature and many resources regularly devoted to it, lacks standardized diagnostic criteria and treatment [4, 5]. There are a multitude of treatment methods for chronic low back pain in clinical practice. As to which therapy is the best, little consensus was reached among clinicians [6]. The treatments includes non-surgical methods, such as physical therapy and sports therapy, and surgical methods including anterior or lateral removal of lumbar discs and inter-body fusion treatment. However, both non-surgical and surgical treatments showed some unsatisfactory effects. Besides, surgical treatment was prone to result in some complications, such as nerve adhesions [1, 3, 7].

In the present study, 48 patients with symptoms of discogenic low back pain and treated with intradiscal electrothermal therapy (IDET)

Table 1. Demographic information and clinic features for both groups

	IDET (N=34)	MED (N=34)	*P* values
Age, years	37.7±7.0	45.5±11.0	P<0.001
Sex			0.986
Male	5	13	
Female	9	21	
VAS	8.5±0.2	9.1±0.2	P<0.001
ODI	67.0±5.2	71.7±5.0	P<0.001
Disease of duration, months	35.4±26.3	50.0±44.4	P<0.001
Dallas grade			
Anular disruption			0.998
II	14	0	
III	0	18	
IV	0	9	
Annulus fibrosus degeneration			0.992
II	0	0	
III	0	0	
IV	0	7	

VAS, Visual analogue scale score; ODI, Oswestry disability index.

or microendoscopic discectomy (MED)/interbody fusion between April 2003 and May 2011 were evaluated retrospectively to assess the outcome of the two therapies.

Methods

Patients

This study was approved by the Ethic Committee of the hospital and the signed informed consents were obtained from all patients. Eighty-two patients (36 males, 46 females; average age of 39.8±9.8, range of 24-70; average medical history of 3.5 years, range of 6 months to 20 years) with refractory low back pain admitted to the hospital between April 2003 and May 2011. The patients met the inclusion and exclusion criteria were treated with IDET or MED. The inclusion criteria were: patients with recurrent low back pain of above 6 months duration; lack of satisfactory improvement after non-operative treatment; patients without pain in lower limb; patients without symptoms of radicular pain; X ray and CT examination didn't show any abnormal sign; negative results on the straight leg raise (SLR) test; magnetic resonance imaging (MRI) scans did not demonstrate a neural compressive lesion; concordant pain reproduction. The exclusion criteria were: X-ray, CT and MRI showed disc herniation, disc prolapse, spinal stenosis or nerve root compression. All patients underwent MRI and computerized tomography discography (CTD). Demographic information and clinic features for both groups were summarized in **Table 1**.

Imaging examination

All patients underwent MRI examination and CTD. MPR was reconstructed to display the scope of contrast agent dispersed inside and outside the annulus [8]. Based on the scope of contrast agent dispersed in the annulus, the extent of annular disruption and degeneration was assessed with "Modified Dallas Discogram Description" [9].

Protocol of IDET and MED/interbody fusion

The patients with Grade II annular disruption and level I-II of annular degeneration were performed with IDET. Patients were in prone position and under local anesthesia by 2% lidocaine. C-shaped arm X-ray machine was used to guide the surgery. An incision was made in the posterior median line. A 17-gauge needle was placed into the center of the disc to be treated. Thereafter, a flexible electrode was passed through the needle into the disc and navigated until it assumed a circumferential placement within the annulus fibrosus needle. Heating temperature was preset at 90°C. The surgery was finished when the tissue temperature reached 60-65°C [10].

The patients with Grade III annular disruption and level III-IV of annular degeneration were treated with MED/interbody fusion. Patients were in prone position and under local anesthesia by 2% lidocaine. C-shaped arm X-ray machine was used to guide the surgery. A longitudinal paramedian skin incision of 1.5 cm was made. After dissection of the fascia, a dilator with the diameter of 5.3 mm was inserted toward the caudal edge of the upper vertebral lamina. Dilators with larger diameters were inserted sequentially, and a tubular retractor with a diameter of 16 mm was finally put in

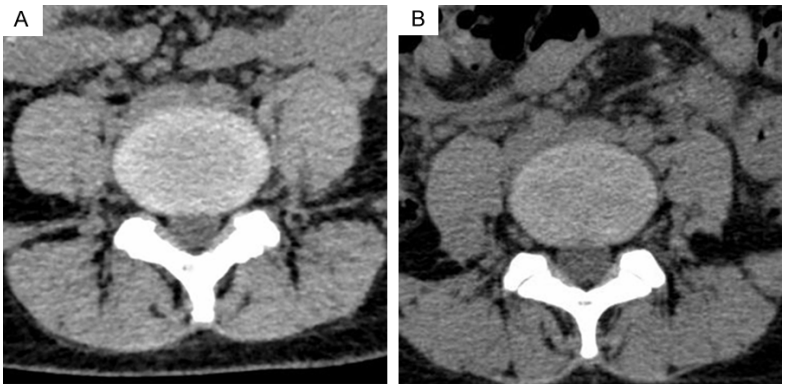

Figure 1. A 39-year old female patient with low back pain for 1 year. A: CT before treatment in IDET group, B: CT image at 1 month after treatment in IDET group.

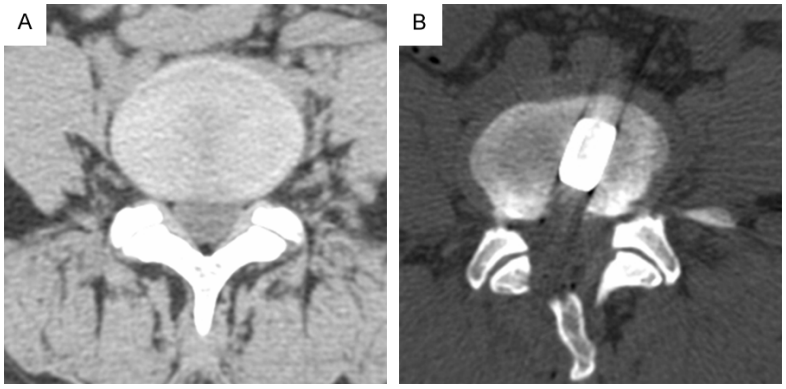

Figure 2. A 46-year old male patient with relapsed low back pain for 2 years. A: CT before treatment in MED group, B: CT image at 1 month after treatment in MED group.

place. The intervertebral disc and the ligamentum flavum was resected and removed. Curettage of the remaining disc was not performed. Cage was placed and the incision was closed.

During the first month, all patients were encouraged to walk and do some leg stretches. In the second month, the patients were allowed to begin light training. All patients were followed up and evaluated by imaging and clinical symptoms examination on a regular basis (1, 3, 6, 12, 24, 48 and 72 months postoperatively). Visual analogue scale (VAS) and oswestry disability index (ODI) scores [11] were used to evaluate the therapeutic effects. As for the improvement scale, it was assessed according to the following: the improvement scale = [(the preoperative score-the postoperative score)/the preoperative score] ×100%) [12]. As for therapeutic effect, the improvement scale ≥75% was considered as effective, the scale of 25%-75% was considered as fine and the scale <25% was ineffective.

Statistical analysis

All data were presented as mean ± SD. VAS scores and ODI scores preoperatively and postoperatively were analyzed by paired-t test and SNK analysis using SPSS 15.0. $P<0.05$ was considered as statistical difference.

Results

There were 48 cases that met the inclusion and exclusion criteria for the surgery. The baseline characteristics of patients were shown in **Table 1**. According to Dallas classification, there were 14 cases (14 discs) with Grade II annular disruption, and 18 cases (18 discs) with Grade III annular disruption and 9 cases (10 discs) with Grade IV. Seven cases (8 discs) suffered level IV of annular degeneration. The 14 cases (14 discs) with Grade II annular disruption and level I-II of annular degeneration were treated with IDET. The 34 cases (36 discs) with Grade III annular disruption and level III-IV of annular degeneration were treated with MED/interbody fusion. **Figures 1** and **2** shows the representative preoperative and postoperative CT radiographs of two of the patients in this study. All surgeries were performed successfully without any infection or complication. The patients were followed up with an average of 50 months (range, 1-72 months) with 2 cases of ineffective treatment.

Of the 14 cases treated with IDET, VAS scores of 13 cases at the final follow-up reduced significantly compared with the preoperative VAS scores ($P<0.01$) (**Table 2**). The VAS score of one case didn't decrease obviously (preoperative 8.5 and postoperative 6.5). After treated with MED, the patient was relieved (VAS of 3.1 and ODI of 9.5). As for the 34 patients treated with

Table 2. Visual analogue scale score (VAS) and Oswestry disability index (ODI) score preoperatively and postoperatively

Parameter	IDET group	MED group	t-test/x^2	*P*-value
VAS				
Pre-treatment	8.5±0.2	9.1±0.2	3.60	0.000
1 month post	2.6±0.2	2.4±0.2	0.38	0.001
3 month post	2.0±0.1	2.2±0.2	0.39	0.004
6 month post	1.8±0.1	2.0±0.1	0.39	0.000
12 month post	1.6±0.1	1.8±1.0	0.39	0.000
ODI				
Pre-treatment	67.0±5.2	71.7±5.0	219.6	0.006
1 month post	24.8±5.7	23.2±3.0	24.75	0.214
3 month post	20.0±2.7	18.2±2.2	29.4	0.028
6 month post	17.7±3.3	13.8±1.8	146.89	0.000
12 month post	10.0±2.3	8.4±1.1	25.95	0.002

Table 3. Therapeutic effect of intradiscal electrothermal therapy (IDET) and microendoscopic discectomy (MED)/ interbody fusion

Follow-up	Methods	Effective	Fine	Ineffective	Efficacy rate
1 month	IDET	57%	36%	7%	93%
	MED	79%	15%	6%	94%
3 month	IDET	71%	22%	7%	93%
	MED	82%	12%	6%	94%
6 month	IDET	78%	15%	7%	93%
	MED	85%	9%	6%	94%
12 month	IDET	86%	7%	7%	93%
	MED	88%	6%	6%	94%

MED/interbody fusion, obvious VAS score decrease was observed in 32 cases at the final follow-up with statistical difference comparing with preoperatively. The postoperative VAS score of the other 2 cases didn't decrease obviously, with postoperative VAS score of 7.0 and 5.5 respectively and preoperative score of 9.0 and 9.0. After treated with acupuncture therapy, the lower back pain was relieved. The ODI scores of the 48 cases at the final follow-up had significant difference ($t=13.39$, $P<0.01$) comparing with preoperatively.

As for lumbar function, the total efficacy was 94% with 88% effective and 6% fine (**Table 3**).

Discussion

Current treatment methods for discogenic back pain range from medicinal anti-inflammation strategy to invasive procedures including spine fusion and recently spinal arthroplasty [2, 7, 13]. The anti-inflammation strategy is to inactivate or remove the source of the pain, namely to inactivate the tiny painful nerve near the disrupted annulus or repair the tearing annulus. In the present study, IDET was used to repair and remove the tiny painful nerve in patients with Grade II annular disruption; MED/intetbody fusion was used to remove disrupted annular tissue and correct lumbar instability in patients with Grade III annular disruption and level III-IV of annular degeneration. Satisfactory treatment results were achieved in most patients (45/48, 94%).

Discogenic low back pain has no obvious morphological abnormalities in lumbar disc. It is impossible to determine the diseased disc according to clinical symptoms and general physical examination. Although there are controversies about the role of discography as a diagnostic test, provocation discography still is the only available means by which to identify a painful disc [6, 14]. In the present study, 0.8-2 mL of contrast agent omnipaque was injected for CTD. MPR reconstruction was performed to determine the dispersion of contrast agent in annulus. Based on the scope of contrast agent dispersed in the annulus, the extent of annular disruption and degeneration was assessed according to Modified Dallas Discogram Description [9]. The patients with Grade II annular disruption and level I-II of annular degeneration were performed with IDET. The patients with Grade III of annular disruption and level III-IV of annular degeneration were treated with lumbar herniotomy and embedding cage vertebra fusion with MED.

There were some non-surgical treatments such as local anesthetic injections and acupuncture for discogenic low back pain, but they could only relieve symptoms and the disease is easy to relapse [6]. The anterior or lateral discectomy and vertebra fusion is an optional treatment, but which has some disadvantages, such as big trauma and nerve root adhesions [8, 15].

IDET is minimally invasive technique for treating discogenic low back pain. The efficiency is

reported to be 50%-80%, with satisfactory short-term efficacy in particular [16]. IDET is not a universally successful treatment. Some 50% of patients do not benefit appreciably, or at all. Moreover, there are several literatures showing that in double blinded studies of IDET, there was no difference between treated and sham procedures [10]. Nevertheless, a previous study found statistically significant benefits in favor of IDET. These features were also evident in the categorical outcomes. And few patients treated by IDET deteriorated, but a significantly greater proportion of sham-treated patients did so [10]. In this study, there were 14 patients performed with IDET, the average VAS score of the 13 cases at the final follow-up reduced significantly compared with the preoperative VAS score ($P<0.01$). The VAS score of one case didn't decrease obviously (preoperative 8.5, postoperative 6.5). The symptom of the patient was not relieved and the complication of nerve adhesion and intervertebral stenosis was observed. The patient was relieved after treated with MED and interbody fusion (VAS of 3.1 and ODI of 9.5). The long-term follow-up will be done to evaluate the final efficacy.

The high efficacy of IDET in the present study was possibly attributed to the followings. First, the cases treated with IDET were with Grade II annular disruption and level I-II of annular degeneration. Second, the peripheral nerve fibers that caused pain concentrated in the outer 1/3 of annulus and formed granulation tissue, with extensive innervation in fissures extending from the outer part of the annulus into the nucleus pulposus. It had been proved that the tissue would be irreversibly damaged at 45°C, and the nerve receptors in outer 1/3 of annulus would be inactivated at 46-48°C. The molecular structures of the fibrous tissue will be reconfigured; the relaxed and unruptured fibers will be repaired. However, the ruptured fibers can't be repaired [16]. Therefore, maybe IDET is suitable for partial annular disruption, namely the grade II annular disruption.

MED/interbody fusion has many advantages such as less trauma, less complications and safety, and is one of the promising methods for discogenic low back pain [13]. In the present study, 34 patients (36 discs) with Grade III annular disruption and level III-IV of annular degeneration were treated with MED/interbody fusion. This method resolved the following issues. First, the diseased disc was removed. Second, cage was implanted for fixation. As for the treatment results, 32 cases (32/34, 94%) showed that the symptom of low back pain significantly reduced or disappeared. VAS score decreased at the final follow-up with statistical difference comparing with preoperatively. The postoperative VAS score of the other 2 cases didn't decrease obviously, with postoperative VAS score of 7.0 and 5.5 respectively and preoperative score of 9.0 and 9.0. It was resulted from posterior longitudinal ligament edema. After treated with acupuncture therapy, the lower back pain was relieved.

There are some limitations in the present study. First, the study group is too small to demonstrate the efficacy of the treatment. A comprehensive evaluation method is needed to evaluate the efficacy. Second is the short-term follow up. A long-term efficacy will be followed. Third, the approach cannot be applied universally and selection criteria should be laid down depending on the type of the disease and more cohort studies.

Conclusions

The patients with discogenic low back pain were treated with IDET or MED/interbody fusion according to the extent of annular disruption and degeneration. After the average follow up of 50 (range, 1-72) months, the symptom of low back pain significantly relieved or disappeared. In conclusion, a statistically significant improvement in outcome was obtained in patients with chronic discogenic low back pain treated with IDET or MED. A prospective randomized control study with a large sample is needed.

Disclosure of conflict of interest

None.

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