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The Effect of Percutaneous Laser Disc Decompression on Reducing Pain and Disability in Patients With Lumbar Disc Herniation

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Abstract

Introduction: As low back pain incidence is increasing, noninvasive modalities are gaining attention for their ability to achieve the best possible outcome with the least complications. Percutaneous laser disc decompression (PLDD) is currently popular for this purpose. This study aims to evaluate the effect of PLDD on disability and pain reduction in patients with lumbar disc herniation.

Methods: Thirty patients were enrolled in this study. Spinal nerve blocks were conducted by laser discectomy single stage injection of a needle into the disc space. The nucleus pulposus of herniated discs were irradiated with laser in order to vaporize a small part of the nucleus pulposus of the intervertebral discs and reduce the voluminosity of diseased discs. Patients were treated with 1000 J of 980 nm diode laser with 5 W energy. In order to measure the severity of pain, visual analog scale (VAS) and also ODI (Oswestry Disability Index) were used. Data were analyzed using SPSS version 12.

Results: Thirty patients participated in this trial including 11 men and 19 women with a mean age (SD) of 40.8 (10.8) years. The mean patients VAS score and ODI level before and after discectomy showed statistically significant differences. The mean VAS and ODI scores showed no statistical difference between males and females ($P<0.05$) and percutaneous laser discectomy decreased the VAS and ODI at both groups of patients similarly.

Conclusion: We found the use of PLDD reduces pain and disability in patients as a noninvasive procedure.

Keywords: Percutaneous laser disc decompression; Disability; Lumbar disc herniation.

Introduction

Low back pain is a common cause of morbidity, with approximately 80% of the population experiencing backache during their lifetime. Nowadays, it gets more prevalent in younger people because of misdirected spinal kinetics due to daily affairs.[1] Continual lifting of heavy burden and inappropriate posturing are known as causes of low backache. The major cause of low backache in this population is herniated disc.[1] Open discectomy is the common surgical treatment for refractory sciatica secondary to lumbar disc herniation. Percutaneous therapy under local anesthesia such as percutaneous laser disc decompression (PLDD) is gaining attention. PLDD as alternative treatment for the patients with herniated lumbar disc disease can be performed in an outpatient setting with rapid recovery and return to daily routine.[2,3] This method was first used in 1986 and received approval from the US Food and Drug Administration in 1991.[4]

PLDD which presents a lower risk of mechanical damage to the bone, nerves, ligaments and muscles, is a minimally invasive procedure.[2] It is reported that over 30 000 individuals underwent PLDD in 2001.

PLDD is performed under local anesthesia via a laser fiber percutaneously inserted into the nucleus pulposus. The irradiation is applied through the fiber to vaporize the nucleus pulposus contents.[6] Discogenic pain can

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be relieved with PLDD which causes disc size decrease through water loss. In vitro studies confirm that a small decrease in volume of inter vertebral disc can cause significantly a large reduction of intradiscal pressure.[7,8] The short-term decrease in pressure within the nucleus pulposus is caused by evaporation of water content; long-time effects may be due to protein denaturation, which in turn decreases the nucleus ability in reducing disc stiffness and reabsorption of additional water.[6,9,10]

This study aims to evaluate the effect of PLDD (PLDD) on disability and pain reduction in patients with lumbar disc herniation.

Materials and Methods

Sampling Method and Sample Size Calculation

Simple Random Sample

$$n = \frac{2(z_{1-\alpha} + 2_{\beta})^2(\sigma^2)}{d^2}$$

$$n = \frac{2(1.96 + 1.28)(3)^2}{(3.5)^2} = 15.4 \sim 15$$

Patients

Participants in this study were all patients with signs of lower limb radicular pain along with herniated lumbar disc proven with CT scan, magnetic resonance imaging (MRI) or myelogram who did not recover after 3 months therapy and referred to Shohada-e-Tajrish Pain Clinic from 2012 to 2014. Their lumbar disc bulging was less than 25% of the annulus environment and the number of affected areas was more than three levels. Thirty patients participated in this trial including 11 men and 19 women. Patients' age ranged from 18 to 80. All patients with previous vertebral surgery, cauda equina syndrome, bone disorders, generalized bulging disc, extruded disc, neurologic disorders (movement disorders, urinary and fecal incontinences), pregnancy, any history of coagulopathic disease, reduction of disc height more than 50%, were excluded from the study.

Methods

After determination of the affected lumbar spine areas, history taking, physical examination, imaging such as MRI, CT scan and electromyography-nerve conduction velocity (EMG-NCV) were performed. Patients were treated by laser discectomy in an outpatient setting, with single stage injection of a needle into the disc space. Disc material was not removed; in lieu of, nucleus pulposus was evaporated by the laser. Patients were treated with 1000 J of 980 nm diode laser (product of LaserStar Technologies Corp which is manufactured in Germany with a 200micro fiber) with 5 W of power. After sterile skin preparation and draping, the disc space was identified with the help of a C-arm fluoroscope. Disc margins were made clear by Cranio caudal movement of the fluoroscope tube. After rotating the fluoroscope tube obliquely to bring the superior articular process to the mid line, an 18-gauge 7-in needle was applied immediately anterior to the superior articular process and superior to the transverse process via a triangular safe zone. Progress was viewed in the anteroposterior and lateral projections with the C-arm fluoroscope, which had to be strong enough and have a good quality to provide an overview of the area. The needle tip had to be at the center of the disc upon completion. In most patients, the entry points in the skin to treat either the L4-L5 or L5-S1 disc spaces were at the level of the iliac crest (very close to each other). The rubbery texture of the annulus was easily felt with the tip of the 18-gauge needle. Time of follow-up was 3 months.

The visual analog scale (VAS) is a psychometric response scale which can be used in questionnaires. VAS is the most common pain scale for quantification of endometriosis-related pain. But it had been used in a wide range of pain such as trauma or surgery.

Oswestry Disability Index (ODI) is among main assessment tools used in the evaluation of spinal disabilities. ODI has been validated and broadly evaluated in variety of clinical settings and it has been reported to show good psychometric properties. The 10 questions of this questionnaire are designed to give the clinician the information about how the ache in back or leg is influencing the patient's ability to handle daily tasks.[8]

Results

Thirty patients (11 males and 19 females) were enrolled in this study. The mean age of males and females were as follows 40.2 and 45.8 with 8.2 and 11.7 standard deviation, respectively. Minimum and maximum ages of patients were 26 and 69 years. In our study, patients had no history of previous surgery on lumbar areas, thoracic and cervical spines. All of the patients had normal sensory perception and motor force of lower extremity including plantar flexion, dorsiflexion and deep tendon reflexes of left and right leg before procedure.

The Effect of Percutaneous Laser Discectomy on VAS

The mean VAS score in patients before and after discectomy were 6.70 and 2.60 that were compared with Wilcoxon signed-rank test and showed statistically significant difference. The VAS score significantly decreased after discectomy (Table 1).

After percutaneous laser discectomy, the mean decrease of VAS score in patients was 61% (with 6% standard deviation). The minimum decrease of VAS score was 43% (in a 27 year old man with L5-S1 bulging disc), that VAS

Table 1. VAS Score of Patients Before and After Discectomya

	Mean	Median	SD	Min-Max	*P*[a]
Before discectomy	6.70	7.00	0.91	5-9	<0.001
After discectomy	2.60	3.00	0.56	2-4	

[a]Wilcoxon signed-rank test.

score decreased from 7 to 4 and the maximum decrease of VAS score was 71% (in a 45 year old woman with L3-L4 bulging disc), that the VAS score decreased from 7 to 2.

The Effects of Percutaneous Laser Discectomy on ODI

The mean ODI in patients before and after discectomy was 31.03 and 20.60, respectively which were compared with Wilcoxon signed-rank test. There was a statistically significant difference between before and after. It means that the ODI level significantly decreased after discectomy (Table 2).

After percutaneous laser discectomy, the decrease of the ODI level was 33% (with 12% standard deviation). The minimum decrease of ODI level was 8% (in a 36-year-old woman with L4-L5 bulging disc), that ODI level decreased from 25 to 23 and the maximum level of ODI decrease was 56% (In a 53-year-old woman with L5-S1bulging disc), that ODI decreased from 25 to 23 (Table 3).

The mean level of VAS score and ODI score in males and females compared with Mann-Whitney U test showed no statistical difference ($P<0.05$) and percutaneous laser discectomy decreased the VAS and ODI at both groups of patients similarly (Table 4).

The mean VAS score and ODI level in patients less and more than 40 years of age decreased significantly after procedure. They were compared with Mann-Whitney non parametric test and there was a statistically significant difference between them ($P<0.05$; Table 5).

The decline in ODI for patients more than 40 years was the same as for patients less than 40 years of age ($P>0.05$).

Discussion

Patients with herniated disc disease in whom a 3-month conservative therapy had failed are candidate for surgery and minimally invasive techniques to improve the clinical outcomes.[11] Open surgery which has been used since 1934, can further weaken compromised posterior wall in the disc.[12] If patients do not respond to the palliative therapy, minimally invasive therapies should be considered before traditional open surgery.[13]

PLDD is one of the minimally invasive treatment methods. PLDD is able to decrease the volume of the nucleus pulposus and vaporize it. A small reduction of the nucleus pulposus volume is associated with a disproportionate intradiscal pressure falling. PLDD could improve the complaints of patients associated with lumbar disc herniation so it is appropriate for their treatment.[13]

Choy in 2001 reported the clinical manifestations of patients with herniated intervertebral disc. They showed that patients with non-sequestered and extruded disc herniation are appropriate for PLDD.[19] Zhao et al reported that patients with extrusion and lumbar canal stenosis have a high cure rate with PLDD.[20]

In our study we demonstrated that the mean VAS score in patients before and after discectomy showed statistically significant difference. The VAS score after discectomy statistically significantly decreased.

The mean ODI in patients before and after discectomy was extracted and there was a statistically significant difference between two groups. It means that the ODI level significantly decreased after discectomy. The mean VAS and ODI scores showed no statistically significant difference between males and females ($P<0.05$), and percutaneous laser discectomy decreased the VAS and ODI at both groups of patients similarly.

The mean VAS and ODI levels in patients with less and more than 40 years of age significantly decreased after the procedure.

The decrease of ODI in patients more than 40 years old was similar to the one in patients less than 40 years of age ($P>0.05$).

Conclusion

To conclude, we found the use of PLDD reduces pain and disability in patients as a noninvasive procedure.

Ethical Considerations

The ethical committee of Shahid Beheshti University of Medical Sciences approved the study.

Table 2. ODI Level of Patients Before and After Discectomya

	Mean	Median	SD	Min-Max	*P* Value[a]
Before discectomy	31.03	30.00	5.39	23-45	<0.001
After discectomy	20.60	20.00	5.36	15-30	

[a]Wilcoxon signed-rank test.

Table 3. The Effect of Percutaneous Laser Discectomy on VAS and ODI Reduction

Variables	After	Before	*P* Value[a]
	Mean ± SD	Mean ± SD	
VAS	2.60 ± 0.56	6.70 ± 0.91	<0.001
ODI	20.60 ± 5.36	31.03 ± 5.39	<0.001

[a]Wilcoxon signed-rank test.

Table 4. The Effects of Percutaneous Laser Discectomy on Decreasing VAS and ODI Levels in Males and Females

Variables	Sex	Before	After	*P* Value[a]
		Mean ± SD	Mean ± SD	
VAS	Male	6.54 ± 0.68	2.45 ± 0.68	<0.001
	Female	6.79 ± 1.3	2.63 ± 0.49	<0.001
ODI	Male	32.10 ± 6.28	20.47 ± 2.79	<0.001
	Female	29.18 ± 2.71	20.81 ± 4.33	<0.001

Table 4. The Effects of Percutaneous Laser Discectomy on Decreasing VAS and ODI levels With Age

Variables	Age	Before	After	*P* Value[a]
		Mean ± SD	Mean ± SD	
VAS	≤ 40	6.38 ± 0.87	2.69 ± 0.63	<0.001
	> 40	6.94 ± 0.90	2.52 ± 0.51	<0.001
ODI	≤ 40	29.61 ± 5.18	20.61 ± 4.27	<0.001
	> 40	32.11 ± 5.45	20.58 ± 2.62	<0.001

Conflict of Interests

None to bedeclared.

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