**The Effect of Percutaneous Laser Disc Decompression (PLDD) On Reducing Pain and Disability in Patients with Lumbar Disc Herniation**

**Abstract:**

**Introduction**: As low back pain incidence is increasing, non-invasive 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 with one-step insertion of a needle into the disc space. The nucleus pulposus of herniated discs were irradiated with laser in order to vaporize a small portion of the nucleus pulposus of the intervertebral discs and reduce the volume of diseased discs. Patients were treated with 1000 J of 980 nm Diode laser with 5W energy. In order to measure the severity of pain, VAS (l visual analog scale) and also ODI (Oswestry Disability Index) were used. Data were analyzed using SPSS ver.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 V.A.S score and O.D.I level before and after discectomy showed statistically significant differences. The mean V.A.S and O.D.I scores showed no statistical difference between males and females (p<0.05) and percutaneous laser discectomy decreased the V.A.S and O.D.I at both groups of patients similarly.

**Conclusion**: We suggest the use of percutaneous laser disc decompression to reduce pain and disability in patients as a non-invasive procedure.

**Key words**: 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 a viable alternative treatment of 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 U.S. Food and Drug Administration in 1991(4).

Percutaneous Laser Disc Decompression 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 30000 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 be relieved with Percutaneous Laser Disc Decompression 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 larger decrease 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 reabsorbtion of additional water (6, 9, and 10).

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

**Materials and methods:**

**Sampling method & Sample size calculation:**

|  |
| --- |
| Simple Random Sample |

Patients:

Participants in this study were all patients with signs of lower limb radicular pain along with herniated lumbar disc proven with CT scan, MRI or Myelogram who did not recover after 3 months therapy who referred to Shohadaye Tajrish Pain Clinic from 2012-2014. 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 EMG-NCV were performed. Patients were treated by laser discectomy in an outpatient setting, with one-step insertion of a needle into the disc space. Disc material was not removed; instead, 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 enough quality to give a clear view 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](https://en.wikipedia.org/wiki/Psychometrics) response scale which can be used in [questionnaires](https://en.wikipedia.org/wiki/Questionnaire). VAS is the most common [pain scale](https://en.wikipedia.org/wiki/Pain_scale) for quantification of [endometriosis](https://en.wikipedia.org/wiki/Endometriosis)-related pain.But it had been used in a wide range of pain such as trauma or surgery.

The Oswestry Disability Index (ODI) is one of the principal condition-specific outcome measures used in the management of spinal disorders. The ODI is the most commonly outcome measures in patients with low back pain. It has been extensively tested, showed good psychometric properties, and applicable in a wide variety of settings. There are 10 questions (items). The questions are designed in a way that to realize how the back or leg pain is affecting the patient's ability to manage in everyday life. The questionnaire can be found on the bottom of this page. (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, dorsi flexion and deep tendon reflexes of left and right leg before procedure.

**The Effect of Percutaneous Laser Discectomy on V.A.S:**

The mean V.A.S score in patients before and after discectomy were 6.70 and 2.60 that were compared with Wilcoxon signed Ranks Test and showed statistically signiﬁcant difference. The V.A.S score significantly decreased after discectomy. (Table 1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Wilcoxon | Min – Max | Standard-deviation | Median | Mean | |  |
| P<0.001 | 5-9 | 0.91 | 7.00 | 6.70 | Before discectomy | |
| 2-4 | 0.56 | 3.00 | 2.60 | After discectomy | |

Table 1: V.A.S score of patients before and after discectomy

After percutaneous laser discectomy, the mean decrease of V.A.S score in patients was 61% (with 6% standard deviation). The minimum decrease of V.A.S score was 43% (In a 27 year old man with L5-S1 bulging disc), that V.A.S score decreased from 7 to 4 and the maximum decrease of V.A.S score was 71% (In a 45 year old woman with L3-L4 bulging disc), that the V.A.S score decreased from 7 to 2.

**The Effects of Percutaneous Laser Discectomy on O.D.I:**

The mean O.D.I in patients before and after discectomy was 31.03 and 20.60, respectively which were compared with Wilcoxon Signed Ranks Test. There was a statistically significant difference between before and after. It means that the O.D.I level significantly decreased after discectomy. (Table 2)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Wilcoxon | Min – Max | Standard-deviation | Median | Mean | |  |
| P<0.001 | 23-45 | 5.39 | 30.00 | 31.03 | Before discectomy | |
| 15-30 | 5.36 | 20.00 | 20.60 | After discectomy | |

Table 2: O.D.I level of patients before and after discectomy

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

|  |  |  |  |
| --- | --- | --- | --- |
| P-value \* | Before | After | Variables |
|  |  |  |  |
|  | Mean ± SD | Mean ± SD |  |
| <0.001 | 6.70 ± 0.91 | 2.60 ± 0.56 | VAS |
| <0.001 | 31.03 ± 5.39 | 20.60 ± 5.36 | ODI |

\* Wilcoxon T-test

Table 3: The effect of Percutaneous Laser Discectomy on VAS and ODI reduction

The mean level of V.A.S score and O.D.I score in males and females compared with Mann-Whitney U test showed no statistical difference ( p<0.05) and percutaneous laser discectomy decreased the V.A.S and O.D.I at both groups of patients similarly . (Table 4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P-value \* | After | Before | Sex | Variables |
|  | Mean ± SD | Mean ± SD |  |
| <0.001 | 2.45 ± 0.68 | 6.54 ± 0.68 | Male | VAS |
| <0.001 | 2.63 ± 0.49 | 6.79 ± 1.3 | Female |  |
| <0.001 | 20.47 ± 2.79 | 32.10 ± 6.28 | Male | ODI |
| <0.001 | 20.81 ± 4.33 | 29.18 ± 2.71 | Female |  |

Table 4: The Effects of Percutaneous Laser Discectomy on decreasing V.A.S and O.D.I levels in males and females

The mean V.A.S score and O.D.I 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 O.D.I for patients more than 40 years was the same as for patients less than 40 years of age. (p>0.05)

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

\* Wilcoxon T-test

Table 5: The Effects of Percutaneous Laser Discectomy on decreasing V.A.S and O.D.I levels with age

**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)

Percutaneous laser disc decompression 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 V.A.S score in patients before and after discectomy showed statistically signiﬁcant difference. The V.A.S score after discectomy statistically significantly decreased.

The mean O.D.I in patients before and after discectomy was extracted and there was a statistically significant difference between two groups. It means that the O.D.I level significantly decreased after discectomy. The mean V.A.S and O.D.I scores showed no statistically significant difference between males and females (p<0.05), and percutaneous laser discectomy decreased the V.A.S and O.D.I at both groups of patients similarly.

The mean V.A.S and O.D.I levels in patients with less and more than 40 years of age significantly decreased after the procedure.

The decrease of O.D.I in patients more than 40 years old was similar to the one in patients less than 40 years of age. (p>0.05)

We suggest the use of percutaneous laser disc decompression to reduce pain and disability in patients as a non-invasive procedure.

**Conflict of interests:**

The authors declare no conflict of interest, financial or other, exists

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