Percutaneous laser disc decompression: Clinical experience at SCTIMST and long term follow up


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Background: Low backache (LBA) is now increasing in younger population due to misdirected spinal kinetics secondary to improper posture, heavy load lifting and motorbike driving. Hence minimally invasive procedures are increasingly sought after. Among these, PLDD is currently popular and in use. We present our long term follow-up in the use of Nd:YAG laser for PLDD. Aim: To evaluate the efficacy of PLDD in treatment of contained herniation of lumbar discs & long term follow up results.

Materials and Methods: Forty patients with contained lumbar disc herniation on MRI and who did not respond to 6 weeks conservative treatment were subjected to PLDD. L4-5 disc was treated in 31, L5-S1 in 12 and L1-2 and L3-4 in one each. Nd:YAG laser at 1064 nm was used for the procedure. Total laser energy of 1500-2000 Joules was delivered at the disc space depending upon the size.

Results: There was immediate pain relief in 32/40 (80%). According to MacNab criteria good to fair response was seen in 37/40 (92%) and 3 patients (7.5%) responded poorly to this treatment. On follow up which ranged from 1 to 7 years, 34/40 (85%) had pain relief with no need for further treatment. Complications: Significant pain at local puncture site was experienced by 8 (20%), pain during lasing was experienced by one. One patient developed muscular spasm. Conclusion: Percutaneous laser disc decompression is a safe, relatively noninvasive and effective treatment modality for contained, nonsequestered, herniated lumbar disc disease in carefully selected patients.

Key words: Disc ablation, Nd:YAG laser, PLDD, disc herniation.

Introduction

Low-backache (LBA) is a common cause of morbidity with nearly 80% of the population experiencing backache during their life-time. It is getting commoner in the younger population by virtue of the misdirected spinal kinetics secondary to the occupation or daily routine. Improper posturing, continual lifting of heavy load and motorbike driving are some of the causes of low backache. Majority of this population with LBA has herniated disc as the culprit. It was in 1934 that Mixter & Barr first showed that herniation of lumbar disc is a cause of low backache.

The treatment of herniated disc has evolved from open surgery through chymopapain chemoenucleolysis to microtechniques. Choy and Ascher first introduced the technique of the use of lasers in treatment of herniated disc in February 1986. They delivered Nd:YAG laser energy through an optical fiber to vaporize a small volume of nucleus pulposus. Since the contained disc herniation is an enclosed hydraulic space, a small reduction in volume translates into a disproportionate decrease in the pressure thereby relieving the neural compression. This is the treatment principle of PLDD.

We present our clinical experience in the percutaneous use of Nd:YAG laser for treatment of symptomatic and contained herniation of lumbar discs and long term follow up results in this institute.

Materials and Methods

The detailed patient demography of the included patients (n=40) is given in Table 1. This is a retrospective analysis by long-term follow up of the procedure done during the period 1995 to 1999.

Criteria for patient selection

The patient inclusion criteria of Choy et al were followed in this study. The patients reporting with low backache radiating to either or both lower limbs were subjected to these criteria. The included patients were only those who failed to get any pain relief with 6 weeks of conservative management with bedrest,
Table 1: Patient demography detailing the occupation, clinical features and the discs involved

<table>
<thead>
<tr>
<th>Total patients</th>
<th>40 (28 M, 12 F)</th>
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<tbody>
<tr>
<td>Age range</td>
<td>22-70 years (Mean 41.43 yrs)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
</tr>
<tr>
<td>Labourers/load workers</td>
<td>18</td>
</tr>
<tr>
<td>Housewives</td>
<td>11</td>
</tr>
<tr>
<td>Sedentary/office works</td>
<td>9</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2</td>
</tr>
<tr>
<td>Clinical features</td>
<td></td>
</tr>
<tr>
<td>Duration of radiating LBA*</td>
<td>8 weeks – 14 years (mean 25.1 months)</td>
</tr>
<tr>
<td>Restricted SLR†</td>
<td>29</td>
</tr>
<tr>
<td>EHL‡ weakness</td>
<td>9</td>
</tr>
<tr>
<td>Discs treated: Total</td>
<td>45</td>
</tr>
<tr>
<td>L 1-2</td>
<td>1</td>
</tr>
<tr>
<td>L 3-4</td>
<td>1</td>
</tr>
<tr>
<td>L 4-5</td>
<td>31</td>
</tr>
<tr>
<td>L5-S</td>
<td>12</td>
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*LBA-Low backache, †SLR-Straight Leg Raising, ‡EHL-External hallucis longus.

They underwent a detailed neurological examination. All the patients of this study had MRI documentation of a contained, nonsequestered herniation of the disc and had clinical symptoms of radiating pain corresponding to the level of disc involvement. The presence of disc extrusion and sequestered discs were excluded from the present study. None of the selected patients had contraindications like haemorrhagic diathesis, pregnancy, spondyloolisthesis, scoliosis, osteoarthritis or significant degeneration of the disc. Two patients selected depending on clinical status with a MRI picture of doubtful contained herniation were excluded from study as discography revealed rupture of the annulus fibrosus.

Equipment/material used:
1. Fluoroscopy unit
3. Long needle 18 G x 15 cm
4. Sterile 400 µm optical fiber for delivering laser energy.

Technique

After selecting the patient with the help of the above-mentioned criteria, the procedure was explained to the patient in detail so as to ensure total patient cooperation during the procedure under local anesthesia. An informed consent was also obtained. The patient was placed in prone position for the procedure. After cleaning and draping 2% lignocaine was infiltrated about 8-10 cm from the midline on the affected side. Then an 18 G x 15 cm needle was inserted into the disc with posterolateral approach at an angle of 45° with the midline under fluoroscopic control. The needle position was midway between the two endplates and inserted until the tip was 1 cm posterior to the center. The angulation of the needle towards the superior or the inferior endplate was avoided so as to achieve a near parallel position of the needle to the endplates. This was followed by insertion of sterile 400 µm optical fibre with the tip 1 cm beyond the needle tip (to avoid blockage to the passage of vapor through the needle which may result in pain) [Figures 1 and 2].

The energy, delivered with a 1064 nm Nd:YAG Medical laser machine, was initiated with 40 watt 1-2 pulses of 1 second duration. Lasing was completed with 10-20 Watts –1second pulses totaling to 1500-2000 Joules. The total energy to be delivered was standardized by both in vitro and in vivo experimental studies on canine intervertebral discs with the histopathological correlation at our institute. The use of higher power of 40W (2 pulses) for the initialization of the procedure was found to be more effective during the in vitro studies to overcome the threshold for ablation rather than using 5 to 8 low power pulses. Post procedure the patients were discharged the next day with advice of bed rest for 2-7 days at home, to avoid weight bearing and regular physiotherapy to strengthen the back muscles.

Results

The patients were evaluated according to MacNab Criteria.[4] [Table 2] Of the forty patients, whose 45 discs were treated, 32 (80%) reported immediate pain relief, 4 patients were equivocal
Table 2: MacNab criteria for response to treatment

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>Good</td>
<td>Resumed preoperative function&lt;br&gt;Occasional backache or leg pain&lt;br&gt;No dependency-inducing medications&lt;br&gt;Activity appropriate&lt;br&gt;No objective signs of nerve root impairment.</td>
</tr>
<tr>
<td>Fair</td>
<td>May be nonproductive if unchanged from preoperative status&lt;br&gt;Intermittent episodes of mild lumbar radicular pain and or lowback pain&lt;br&gt;No dependency-inducing medications&lt;br&gt;Activity appropriate.&lt;br&gt;No objective signs of nerve root impairment.</td>
</tr>
<tr>
<td>Poor</td>
<td>Subjective&lt;br&gt;No productivity&lt;br&gt;Continued pain behaviour&lt;br&gt;Medication abuse&lt;br&gt;Inactive&lt;br&gt;Compensation and or litigation focus&lt;br&gt;Objective&lt;br&gt;Objective signs of continuing radiculopathy</td>
</tr>
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and remaining 4 did not have immediate pain relief. According to MacNab Criteria good to fair response was seen in 37 (92%) – good in 30/40 (75%) and fair in 7/40 (17.5%). The response to the treatment was poor in 3/40 (7.5%).

Complications

Almost all patients had local pain at puncture site that was significantly more in 8 (20%) patients. Pain during delivery of laser energy was reported by only one patient, which was tackled by proper positioning of the optical fiber within the needle to allow the escape of vaporized disc material. One patient developed muscular spasm for which he remained hospitalized for 1 week. However, on follow up he is relieved of pain.

Follow up

The follow up period ranged from 1 to 7 years with a mean follow up of 4.6 years. These patients were followed up till date on yearly basis. Of the 3 patients with poor response, two went in for conservative management. The third patient had 40-50% pain relief initially but deteriorated later and hence a second sitting of laser ablation was performed. However, the response was still poor and hence he was referred for open surgery. The cause of poor pain relief was the associated canal stenosis. The other 37 patients went on to lead a normal life with occasional pain reported by 14 patients at 1 year. Two of these patients had recurrent severe pain (similar to their first episode) and one patient went in for elective open surgery. The other patient had symptoms pertaining to disc levels other than the treated one with increased arthritic changes and hence was referred for open surgery.

In long term follow up 34/40 (85%) had long-term relief from the radiating pain and are doing regular physiotherapy without restriction of routine activities.

Imaging

The MRI done at 6 months follow up revealed a normal disc with no neural compression. [Figure 3]

Discussion

Choy and Aserh pioneered the use of Nd: YAG laser in human intervertebral disc with the first ablation performed in L4-5 disc of a male patient in Graz, Austria in February 1986.[2]

Choy et al reported the use of hydraulic mechanism in cadaver spines to increase the load using metal frames.[3,4] The intradiscal pressures were recorded before, during and after laser ablation. The intradiscal pressures showed an initial rise and then a continued fall with a total decrease in mean intradiscal pressure of 55.6% representing the continued denaturation of disc material adjacent to the laser tract. It is this decrease in the intradiscal pressure that creates a vacuum and causes the disc to move towards its near normal position away from the affected nerve root.

A careful selection of the patients with herniated discs is a must as not all patients can undergo this therapy. The previously mentioned hydraulic system of the disc is true as long as there is no extrusion. Black has reported only 8% failure rate in treatment of disc treatment of disc herniation with Nd:YAG as compared to 25% with KTP laparoscope and 26% with automated percutaneous discectomy.[7] The 8% failure included patients with extruded disc because of which he has emphasized the role of proper clinical examination, MRI evaluation and discography if there is any doubt. Two of the patients not included in our present study had clinical or radiological disparity and hence were subjected to discography. It revealed a rupture in the annulus and they were hence excluded. However, there are studies that have reported the use of laser for protruded and extruded discs.[8]

Our overall long term success rate of 85% by MacNab’s Criteria is comparable to that reported by the pioneers Choy et al in

Figure 3: Pre (a) and post (b) PLDD Sagittal Gradient MRI of the lumbar spine showing the significant decrease in the protrusion of the L4-L5 disc after one year
1992 and also by Gangi in 1996.\textsuperscript{[6,9]} The latter reported a success rate of 76.5%. An overall success rate of 91.5% has also been reported in the immediate post procedure period comparable (92%) to that of the present study.\textsuperscript{[10]} In our series, the poor response to this treatment in one patient was due to spinal canal stenosis. The results would have been improved by excluding this patient at the recruitment stage itself. However, if the cases are not properly selected the treatment may not be effective. Disc herniation with a free fragment, spinal stenosis caused by bony changes alone, second and third degree spondylothesis, facet arthritis, malignancy constitute absolute contraindications for PLDD. Bleeding diathesis and haemangioma are relative contraindications for the therapy.\textsuperscript{[3]} The indications for PLDD are therefore a contained herniation of nucleus pulposus as demonstrated by imaging preferably MRI and no response to 6 weeks of conservative management (bed rest, physiotherapy, muscle relaxants with or without anti-inflammatory agents).

The advantages of the therapy are its minimally invasive nature, avoidance of general anaesthesia and the short procedure time. This leads to decrease in the hospital stay and minimal recovery time. PLDD can be done repetitively and it does not preclude future surgery.

The strength of this retrospective study lies in the long-term follow up results of the procedure. The lack of comparison with the other treatment modalities for disc disease like endoscopic discectomy is a drawback of this study. The future extension of the procedure could be in terms of laser ablation of extruded discs and alcohol ablation.

**Conclusion**

Percutaneous laser disc decompression is a safe, relatively noninvasive and effective treatment modality for contained, non-sequestered, herniated lumbar disc disease in carefully selected patients.

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**References**


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