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A narrative review of percutaneous laser disc decompression - early experience in Lagos, Nigeria

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ABSTRACT

Overview. Managing chronic pain arising from the degenerative disc disease of the spine has remained a huge challenge while choosing from within a vast array of treatment armamentum ranging from the use of medications only or in combination with other physical treatment options, minimally invasive heat therapy, and operative interventions. Patients with chronic pain referred to as 'contained disc' in cervical, thoracic, and lumbar disc pathology have been successfully managed with percutaneous laser disc ablative therapy. This approach is only for selected patients and advantages derivable from this approach are the preservation of soft tissue anatomy, minimal post-procedure pain, less metabolic responses, and no blood loss when compared to open surgical procedures.

Methodology. This is a one-year retrospective narrative study of six adult patients who presented with chronic low back pain related to the spine and had a lumbosacral spine magnetic resonance imaging (MRI) scan with findings of contained disc herniation. Patients' brief clinical evaluation which involves biodata, history of pain, and pain scores using the visual analogue scale (VAS) pre and post-intervention and Oswestry disability index to assess disability from chronic pain. A narration of these patient's progression to follow-up six months after the procedure was documented.

Results. The results showed significant improvement in the VAS and ODI scores in five of the 6 patients, with one showing marginal improvement.

Conclusion. Percutaneous lumbar disc decompression is effective in the management of chronic low back with concordant clinical and radiological evidence of contained disc pathology.

Keywords: chronic pain, contained disc, laser, percutaneous, decompression

INTRODUCTION

The role of percutaneous laser disc decompression (PLDD) as a minimally invasive option in spine surgery has gained more recognition over the years due to its positive outcomes [1]. It is an effective alternative to other disc surgeries as it is easy to perform, with a high success rate, minimally invasive with minimal metabolic response, and has a rapid rate of symptom resolutions compared to other methods, and the need for long-term rehabilitation programs does not arise with PLDD. Percutaneous laser disc decompression is a procedure in which herniated intervertebral discs are treated by reduction of intradiscal pressure through laser energy leading to nerve root decompression, the thermal destruction of intradiscal nociceptors associated with the pathophysiology of pain [1,2].

It was pioneered in 1986 by Daniel Choy and Peter Ascher at the University of Graz's Neurosurgical Department in Austria [3]. It was performed on a male patient in the L4-5 disc herniation causing sciatica. It was initially planned to deliver 1000 Joules of thermal energy with an Nd: YAG laser to a herniated disc resulting in sciatica but was terminated at 600 Joules as the pain was observed to have completely abated, while the first discectomy surgery was performed by Mixter and Barr in 1932 and later described in 1934 [4].

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The principle of reduction of intradiscal pressure in PLDD is based on the removal of the water content in the nucleus pulposus which is a closed hydraulic space and therefore causes a resultant decrease in pressure [5,6]. An increase in the water content of the nucleus pulposus leads to a disproportional increase in intradiscal pressure. In vitro experiments have shown that an increase in intradiscal volume of only 1.0 mL causes the intradiscal pressure to rise by as much as 312 kPa (2340 mmHg). 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. The nucleus pulposus is the inner core of the intervertebral disc composed mainly of water (60-80%) and provides support for shock absorption, preventing bone-to-bone contact and reducing the chances of injuries. It is a closed hydraulic space because it is surrounded by the annulus fibrosis and the vertebral endplates. The reduction in the intradiscal pressure leads to a small volume reduction, thereby leading to nerve root decompression [5,6]. The photochemical effect of the laser also causes the destruction of neurokinins and cytokines (TNF-a, 1L-1a, substance P) which are mediators of pain

The indications for PLDD are the presence of a contained herniated disc with foraminal stenosis, discogenic spinal stenosis, discogenic pain syndromes, chronic facet syndrome, sacroiliac joint syndrome, and failure to respond to 6 weeks of conservative management [3-7].

The benefits of PLDD include insignificant soft tissue injury in the absence of tissue. dissection as seen in open spine procedures, absence of epidural fibrosis, shortened hospital stay, as the procedure is done on an outpatient basis more often than not, it only requires local anesthesia with or without mild sedation, has shortened recovery time, and reduced costs compared to open spine surgeries [1,7,8]. Proper patient selection is essential in achieving the desirable result. Indications for PLDD include; contained herniated disc with adjoining neural foraminal stenosis, discogenic spinal stenosis, positive and consistent neurological features (leg pain of greater intensity than back pain, positive straight leg raising test, decreased sensation with normal motor response and tendon reflex, failure of conservative management) [8].

Contraindications include sequestered disc or complete rupture of the annulus fibrosis infections (local or systemic), nerve paralysis, spondylolisthesis, central canal stenosis, significant psychological disorders, spinal tumors, and trauma [1,8].

The procedure is done by placing the patient in the prone position, cleaning and draping, a prophylactic antibiotic is given, and local anesthetic infiltration is given dorsolateral from the midline. The needle is then inserted dorsolaterally into the disc about 8 cm from the midline into the posterior one-third of the disc at the site of the pathology either at the 4 or 8'oclock position, using the C-arm fluoroscopy or with a CT scan as a guide to confirm the position of the needle, the laser fiber is inserted through the needle into the center of the nucleus pulposus delivering laser energy and vaporizing its contents [1,8-11].

CASE PRESENTATION

Case 1

67-year-old woman diabetic with a 3-year history of back-related leg pain (VAS of 8) and modified Oswestry disability index (ODI) score of 80. She also had numbness and paresthesia in both lower limbs. No bowel or bladder symptoms. Neurological findings include antalgic gait with reduced left L5 sensation, and right L4 hyperesthesia, power was 5/5 across all lower limb muscle groups. Lumbosacral MRI, (Figure 1) showed L4-L5 and L5-SI contained disc herniation with foraminal stenosis. She had PLDD at both levels, (Figure 2) and VAS and ODI scores were 0 respectively.

FIGURE 1. Sagittal view of lumbosacral MRI scan of a 67–year–old woman with back-related leg pain

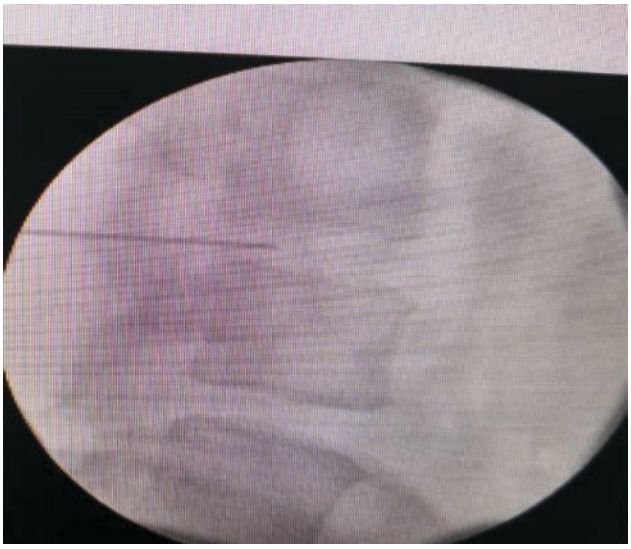

FIGURE 2. A laser procedure under C-arm for the above patient

Case 2

A 40-year-old woman with an 18-month history of back-related leg pain (VAS of 7) and a modified ODI score of 60. She had associated unsteady gait and numbness on the left lower limb. No bowel or bladder symptoms. Neurological findings include antalgic gait with normal sensation, and power was 5/5 across all lower limb muscle groups. Lumbosacral MRI scan, (figure 3) showed L4-L5 and L5-SI contained disc herniation with foraminal stenosis. She had PLDD at both vertebral levels. Post-operatively at 12 months, the VAS and ODI scores were 2 and 30 respectively.

Case 3

A 30-year-old man with a 2-year history of back-related leg pain with a VAS of 8 and modified ODI score of 80. There was associated numbness and paraesthesia on both lower limbs. No bowel or bladder symptoms. Neurological findings include antalgic gait with reduced left L5 sensation, and power 5/5 across all lower limb muscle groups. Lumbosacral MRI scan (figure 4) showed L4-L5 contained disc herniation with foraminal stenosis. She had PLDD at the L4-L5 level and his VAS and ODI scores were 0 respectively.

Case 4

A 45-year-old man with a 4-year history of back-related leg pain (VAS of 6) and modified ODI score of 60. He had associated numbness and paresthesia on the right lower limb. No bowel or bladder symptoms. Neurological findings include antalgic gait with reduced left L5 and S1 sensation, and power was 5/5 across all lower limb muscle groups. Lumbosacral MRI scan, (figure 5) showed L4-L5 and L5-SI contained disc herniation with foraminal stenosis. She had PLDD at both levels, and his VAS and ODI scores were 1 and 10 respectively 6 months post-operatively.

FIGURE 3. Lumbosacral MRI, showing L4-5 and L5-S1 disc herniation for the above patient

FIGURE 4. Lumbosacral MRI scan showing L4-5 disc herniation for the above patient

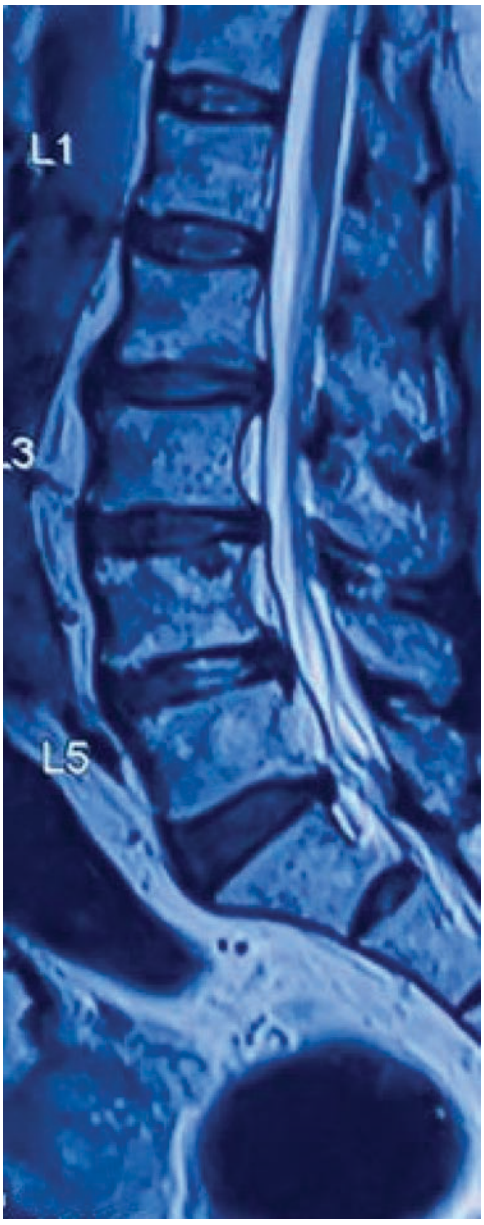

FIGURE 5. The lumbosacral MRI, showed multiple contained disc herniation of the above-named patient

Case 5

A 44-year-old woman with a 20-month history of back-related leg pain (VAS of 8) and modified ODI score of 80. There was associated unsteady gait, numbness, and paraesthesia on both lower limbs. No bowel or bladder symptoms. Neurological findings include antalgic gait with reduced left L5 sensation, and power was 5/5 across all lower limb muscle groups. Lumbosacral MRI scan (figure 6) showed L4-L5 and L5-SI contained disc herniation with foraminal stenosis. She had PLDD at both levels, and her VAS and ODI scores were 2 and 10 respectively.

Case 6

A 39-year-old woman with a 2-year history of back-related leg pain (VAS of 8) and modified ODI score of 60. He had associated numbness and paraesthesia in the lower limbs. No bowel or bladder symptoms. Neurological findings revealed reduced left L5 sensation, power was 5/5 across all lower limb muscle groups. MRI showed L4-L5 and L5-SI contained disc herniation with foraminal stenosis. She had PLDD at both levels, and the six-month postoperative VAS and ODI scores were 2 and 30 respectively.

FIGURE 6. The lumbosacral MRI, of the above-named patient showing contained multi-level disc herniation

FIGURE 7. Lumbosacral MRI scan, of the above patient with contained disc herniation at L4-5 and L5-S1

DISCUSSION

The study showed case narration of six patients who had clear indications and consented to PLDD, and these patients were assessed for their clinical presentation taking into account the VAS and modified ODI scores in our local spine practice over the last year. There was significant improvement with the majority of the VAS reducing from 6-8 to 0-2 after intervention. However, the disability as defined by

ODI scores showed significant improvement except that of case 2 with moderate disability.

Several studies have supported the role of PLDD in the management of chronic LBP from contained disc degenerative diseases [8,12]. A pioneering study by Choy involving 518 patients who underwent PLDD over 12 years gave an overall success rate of 75-89% and showed that PLDD is safe, effective, reduces rehabilitation time, and does not affect open surgery if subsequently indicated [12]. Erbas et al. [8] in their study involving 197 patients. L4-L5 and L5-S1 were the most common two-level PLDD, the procedure was repeated in 3 patients, 25(12.7%) patients had microsurgical discectomy after PLDD, and discitis secondary to the possible thermal injury occurred in 2(0.1%) patients which improved conservatively. This shows that PLDD is a safe and effective method of minimally invasive management of discogenic pain, it is not an alternative to open surgery as seen in the work by Erbaş et al.[8] Another study was done in 2019 by Momenzadel et al.[13] showed that PLDD reduces pain and disability as a minimally invasive procedure, and it should be considered after failed conservative/palliative therapy before open surgery because open surgery can further weaken the posterior wall in the disc. Our narrative study assessed the pre-PLDD and post-PLDD pain severity using the VAS and ODI and showed a significant improvement in all six patients discussed except one with an ODI score who still has a moderate disability, though the improvement was noted.

A prospective study of 680 patients by Menchetti et al. [14] showed an average success rate of 89% with PLDD, and this showed that PLDD is a safe, effective, and cost-reducing procedure.

The time to recovery was also noted as the majority, five out of 6 had significant improvement within 24 hours of the procedure, however, the exception was that of case 2 whose noticeable improvement was observed after one week of the procedure.

Vijay Singh et al, [15] and Brouwer et al. [16] showed that PLDD could be an effective, cost-preserving, time to recovering was faster, and better option to open surgery option for discogenic back pain and other indications for PLDD

Hashemi et al. [17] study on 40 patients with lumbar disc protrusion showed that the commonest sites for two-level PLDD were L4-S1 and L3-L5, and one-level PLDD was L5-S1 and L4-L5. There were significant positive outcomes in the pain and functional disability levels using the ODI and Numeric Rating Scale with no significant differences in outcomes between men and women, all buttressing that PLDD is a safe treatment option in chronic low back pain caused by disc protrusion. Duarte et al. [2] in their study validated PLDD as the next step before spine surgery for patients not responding to conservative treatment.

A study done by McMillan et al.[18] involving 32 consecutive patients with discogenic lumbar spinal pain which aim to evaluate the short-term efficacy of PLDD using the neodymium-YAG laser showed improvement in sciatica symptoms in 80% of patients using the standardized symptom score on the American Academy of Orthopedic Surgery (AAOS) at three months, during the 3-month follow-up period, there were no instances of infection, nerve injury, or significant bleeding, however 63% complained of new-onset back pain or worsening of back pain following PLDD, although self-limited, or responsive to analgesics. This was a similar scenario to case 2 in this narrative study with a response maximum at 4 weeks after the procedure.

This shows that PLDD with neodymium-YAG laser is safe and effective, and minimal complications such as post-procedural low back pain are easily managed without sequelae. (McMillan et al). Another clinical trial study was done by Shekarchizadeh et al. [19] involving 43 patients with spinal canal stenosis divided into discogenic canal stenosis and complex degenerative disorder who had PLDD and post-surgical manifestations such as back pain, and claudication was followed up until one-year post-operation. There was a clinically significant reduction in back pain after one year of surgery, the claudication reduced significantly, the discogenic canal stenosis outcomes were 91.7% excellent, and 8.3% fair and in the complex degenerative disorder, 64.5% excellent, 19.4% good and 16.1% fair.[19] Thus, PLDD is a better procedure for discogenic canal stenosis than complex degenerative disorder.

CONCLUSION

Percutaneous lumbar disc decompression is effective in the management of chronic low back with concordant clinical and radiological evidence of contained disc pathology. This procedure is cost-effective and obviates the need for open spinal procedures in certain categories of patients.

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