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Review

PERCUTANEOUS LASER DISC DECOMPRESSION FOR LUMBAR RADICULAR PAIN: A SYSTEMATIC REVIEW OF PUBMED IN THE LAST FIVE YEARS

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SUMMARY – The most common causes of lumbar radicular pain are pathological changes in the intervertebral disc. Lumbar disc herniation (LDH) is the most common cause of lumbosacral radicular syndrome. It affects 1-2% of the general population, burdening health services and the economy worldwide. Excessive scar tissue after lumbar microdiscectomy can increase postoperative pain. Postoperative fibrosis is one of the most important causes of failed back surgery syndrome after lumbar disc surgery. Percutaneous laser disc decompression (PLDD) is a minimally invasive procedure in which thermal energy produced by a LASER probe is used to reduce the intervertebral disc herniation located within the annulus fibrosus. Evaporation of a small volume in a closed hydraulic space (nucleus pulposus) leads to decreased intradiscal pressure. It causes a thermal "shrinkage effect" with the retreat of the herniated disc and the decompression of the nerve root, which reduces lumbar radicular pain. Previous research has shown effective reduction of pain after PLDD and only a small number of complications of the procedure itself. PLDD is a safe and effective procedure in well-selected patients. Unfortunately, there is still a need for extensive, randomized prospective studies on PLDD in lumbar radicular pain in order to confirm or dispute the results obtained so far.

Key words: *percutaneous laser disc decompression; discectomy; lumbar radicular pain; disc protrusion*

Introduction

The treatment of lumbar radicular pain still represents a great challenge for family medicine physicians, neurosurgeons, and physicians who deal with minimally invasive pain treatment. When taking into account the complications that occur after surgery, such as the static disorder of the spine, and especially the fibrous changes that, a few months after the surgery, cause compression of the roots of the spinal nerves and the intensification of radicular pain that had been successfully reduced for a short time after the surgery, then the complexity of treating patients with lumbar radicular pain can be understood, at least to some extent. It is clear from clinical practice, either from the clinics of primary care physicians or pain

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management specialists, that intervertebral disc herniation is the main cause of sciatica. It affects 1-2% of the general population in the United States annually, placing a significant burden on healthcare services and the economy worldwide[1-3].

Bulging, protrusion, extrusion of the disc, and degenerative changes of the disc can cause of discogenic pain[4]. Disc herniation can be mild where the inner and outer ring of the annulus fibrosus is intact, significant where the inner ring of the annulus fibrosus has ruptured, but with the outer ring preserved, and especially severe where the inner and outer ring of the annulus fibrosus have also ruptured.

In addition to the inflammatory component that is always present with a protruded or extruded disc, and which is important for nociceptor stimulation and pain sensation, nerve root compression also plays a significant role in radicular pain but also in motor weakness that occurs in the lower extremities[5].

The usual way of treating disc protrusion is a surgical discectomy. A discectomy is the surgical removal of abnormal disc material that presses on a nerve root or the spinal cord[6]. Classic discectomy with a traditional surgical incision has been used increasingly rarely, and microdiscectomy with a small incision (under microscope control) up to a maximum of 2 cm is more and more common, especially if there is a pathology at one level demonstrated by compression of the nerve root. Both open and microdiscectomy are used if conservative treatment of radicular pain has been ineffective. Cauda equina syndrome and progressive or new motor deficits are the urgent surgical indications for discectomy[7]. The formation of scar tissue that presses on the nerve root after classic or microdiscectomy can be the cause of pain that is often greater than before surgery. Patients often blame the surgeon for the formation of adhesions, so although, of course, surgical skill is extremely important in any surgical procedure and certainly affects the minor development of adhesions, it is unfortunately the individual characteristics of the patient that plays the dominant role in the development of adhesions. In people who are prone to the development of adhesions, each new surgery means new scar tissue with a worsening clinical picture[8-10]. Postoperative fibrosis is one of the most important causes of failed back surgery syndrome after lumbar disc surgery[11].

To reduce the likelihood of developing perioperative fibrosis, new minimally invasive techniques have been developed to treat disc protrusion, including percutaneous laser disc decompression. Percutaneous laser disc decompression (PLDD) is a procedure using laser energy that ultimately leads to heating and vaporization of the nucleus pulposus and, consequently, to the return of the herniated disc due to the reduction of pressure in the disc itself. Evaporation of a small volume in a closed hydraulic space (nucleus pulposus) leads to decreased intradiscal pressure. It causes a thermal "shrinkage effect" with the retreat of the herniated disc and the decompression of the nerve root, which reduces lumbar radicular pain. Pressure changes drastically in healthy discs, but only slightly in degenerative discs[12]. The photochemical effects of laser light also lead to the destruction of cytokines and neurokinins such as phospholipase A2, NO, TNF-a, IL-1a and substance P, which play an essential role in inflammation and pain[12].

Methods

This systematic review aimed to evaluate and provide an update on the clinical effectiveness of percutaneous lumbar laser disc decompression in managing lumbar radicular pain secondary to contained lumbar disc herniation. We reviewed papers published on PubMed in the last five years dealing with the effectiveness of percutaneous laser decompression in lumbar spine disc protrusion.

Results and discussion

A total of 10 papers were published in a five-year period, which were visible on PubMed and talked about lumbar percutaneous laser disc decompression. When the database was searched for the term "percutaneous laser disc decompression", 25 papers were provided. However, some papers refered to the cervical spine, some papers were just a letter to the editor, and some papers dealt with non-percutaneous laser disc decompression. Finally, when all such papers were excluded, a total of 10 works were published in a five-year period that were visible on PubMed and that talked about lumbar percutaneous laser disc decompression. A total of 536 patients who underwent PLDD were treated in 10 papers.

In the paper entitled CT-Guided Percutaneous Laser Disc Decompression for Lumbar Discogenic Radiculopathy-Performance of a Novel Combi-Therapy, 95 patients were treated, of which the largest number was at one level, namely L4/L5 (88 patients). Oth-

er patients were treated at other levels. All patients had a significant reduction in pain. Before the procedure, the average intensity of pain measured with a visual analogue scale from 0 to 10 was 7.6, and it was after the procedure 0.5[13].

In the paper by Lewandrowski et al., there were a total of 86 patients. The authors concluded that transforaminal endoscopic decompression for symptomatic herniated disc provides satisfactory pain reduction over a longer period of time, even after 6 years, while percutaneous laser decompression of the disc in mild disc protrusions provides short-term pain reduction. After 17 months, the symptoms worsened[14].

Momenzadeh et al., in their study entitled The Effect of Percutaneous Laser Disc Decompression on Reducing Pain and Disability in Patients With Lumbar Disc Herniation on 30 patients, concluded that the mean patient VAS score (visual analogue scale) and ODI (Oswestry Disability Index) levels before and after discectomy showed statistically significant differences. Pain intensity was measured by a visual analogue scale correlated with the degree of disability measured by the Oswestry Disability Index, which is logical, just as it was logical that there was no difference between women and men after percutaneous laser disc decompression[15].

Rahimzadeh et al. compared percutaneous intradiscal ozone injections with laser disc decompression in discogenic pain. In the PLDD group, a significant improvement was found before PLDD and after the first month[16].In the paper by Shekarchizadeh et al. entitled Outcome of patients with lumbar spinal canal stenosis due to discogenesis under percutaneous laser disc decompression, patients with spinal canal stenosis due to disc herniation were studied. The authors concluded that there was a significant statistical improvement in over 90% of patients with spinal stenosis caused by disc herniation, whereas the results were worse in degenerative disc changes, where a significant improvement occurred in only 60% of cases. From all of the above, it can be concluded that PLDD is more effective in patients with disc herniation that causes spinal stenosis than for degenerative disc changes[17].

In the paper by Masoud Hashemi et al., seventy-two patients were randomly selected from either a previous strategy of PLDD or DiscoGel®, which had been performed. In both groups, there was a significant reduction in pain intensity, which was statistically significant even after 12 months. There was also a reduction in disability in both groups, but more significantly in the group receiving DiscoGel® after 12 months, which was statistically significant. Between-group comparison of NRS scores after two follow-ups was not statistically different (P=0.62), but the ODI score in DiscoGel® was statistically lower (P=0.001). Six cases (16.67%) from each group reported undergoing surgery after the follow-up period, which was not a statistically significant difference. The authors concluded that both techniques were equivalent in pain reduction, but DiscoGel® had a more significant effect on decreasing disability after 12 months[18]. Chao Meng et al. examined the effects of using a modified optical fiber in percutaneous laser disc decompression to treat of lumbar disc herniation. The effects were worse after three months compared with those after one week and three months in the assessment of pain intensity, but such effects were maintained after three months for up to 36 months. In contrast to pain intensity, the degree of disability (Oswestry Disability Index and Short Form Health Survey) improved. The effects were better after six months compared with a week or a month after the procedure. The effects were also better in patients younger than 50 years compared with older patients[19]. Hashemi et al. followed patients with disc herniation for two years after PLDD. They demonstrated that even after two years, there was a statistically significant reduction in pain intensity compared with the state before PLDD was performed[20]. Beyaz et al. treated 41 patients with simultaneous epiduroscopic laser neural disc decompression and percutaneous laser disc decompression. They found that effective PLDD reduced pain intensity and degree of disability 12 months after PLDD[21]. Beloborodov et al. in their retrospective study, monitored complications 30 months after PLDD. Unsatisfactory results after PLDD were recorded in 26% of patients, which was associated with risk factors such as the duration of the disease, low quality of life, increased body weight, severe degenerative changes of the intervertebral disc and facet joints, as well as reduced height the of the intervertebral disc[22].

Conclusion

Previous research has demostrated effective reduction of pain after PLDD and only a small number of complications and side effects of the treatment itself. PLDD is a safe and effective procedure in well-selected patients

Unfortunately, further randomized prospective studies on PLDD in lumbar radicular pain are needed, and more studies like those described above are needed in the future to confirm or dispute the results obtained so far.

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Sažetak

PERKUTANA LASERSKA DEKOMPRESIJA DISKAZBOG LUMBALNE RADIKULARNE BOLI: SISTEMSKI PREGLED PUBMED ZADNJIH PET GODINA

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Najčešći uzrok lumbalne radikularne boli su patološke promjene intervertebralnog diska. Lumbalna diskus hernija (LDH) je najčešći uzrok lumbosakralnog radikularnog sindroma i pogađa 1-2% opće populacije, stavljajući značajan teret na zdravstvene usluge i gospodarstvo u cijelom svijetu.

Prekomjerna količina ožiljnog tkiva nakon lumbalne mikrodiscektomije može povećati postoperativnu bol. Postoperativna fibroza je jedan od najvažnijih uzroka sindroma neuspjele operacije leđa nakon operacije lumbalnog diska.

Perkutana laserska dekompresija diska (PLDD) je vrsta minimalno invazivnog zahvata u kojem se toplinska energija proizvedena LASER sondom koristi za smanjenje hernije interverterbralnog diska koja se nalazi unutar fibroznog prstena. Isparavanje malog volumena u zatvorenom hidrauličkom prostoru (nucleus pulposus) dovodi do smanjenja intradiskalnog tlaka i implicira termički „učinak skupljanja“ sa povlačenjem hernije diska i dekompresiju živčanog korijena što ima za posljedicu smanjenja lumbalne radikularne boli.

Dosadašnja istraživanja pokazala su učinkovito smanjenje boli poslije PLDD, te mali broj komplikacija samog zahvata. PLDD je siguran i djelotvoran zahvat kod dobro probranih bolesnika. Nažalost, ne postoje još velike, randomizirane prospektivne studije iz PLDD kod lumbalne radikularne boli, te su navedena istraživanja potrebna u budućnosti kako bi potvrdila ili osporila dosadašnje rezultate.

Ključne riječi: *perkutana laserska dekompresija diska, diskektomija, lumbalna radikularna bol, protruzija diska*