Araştırma Makalesi (Research Article)

Percutaneous Laser Disc Decompression: In Low Back Pain or in Radicular Pain?

Perkütan Lazer Disk Dekompresyonu: Bel Ağrısında mı, Radiküler Ağrıda mı?

Kutsal Devrim SECINTI

Kahramanmaras Sutcu Imam University, School of Medicine, Department of Neurosurgery, Kahramanmaraş, Turkey

Amaç: Perkütan lazer disk dekompresyonunun etkinliği, çalışmalar arasındaki tutarsızlıklar nedeniyle hala tartışmalıdır. Oysa bu tutarsızlığın nedeni, başarısının bel ağrısında ve bacak ağrısında birbirinden farklı olması olabilir. Bu çalışmada, her iki ağrı modalitesinin perkütan lazer disk dekompresyonuna yanıtı ayrı ayrı incelenmiştir.

Gereç ve Yöntemler: Yalnızca bel ağrısı nedeniyle perkütan lazer disk dekompresyonu uygulanan 49 hasta ile yalnızca radiküler ağrı nedeniyle perkütan lazer disk dekompresyonu uygulanan 36 hastanın sonuçları geriye dönük olarak incelendi. Perkütan lazer disk dekompresyonunun hangi ağrı tipinde daha etkili olduğu araştırıldı. Ayrıca hastaların manyetik rezonans görüntüleri incelenerek disk herniasyonunun boyutunda değişiklik olup olmadığı belirlendi.

Bulgular: İstatistiksel olarak perkütan lazer disk dekompresyonu her iki ağrı türünde de etkili olmasına rağmen, bu etki bel ağrısı grubunda çok daha belirgindi. İşlemin disk herniasyonunu küçültmediği ancak yine de radiküler ağrıda bir miktar azalma sağladığı belirlendi. Disk herniasyonunu küçültmeden belde çok daha etkili olduğu belirlendi.

Sonuç: Perkütan lazer disk dekompresyonu bel ağrısında daha etkilidir. Ancak disk herniasyonunun boyutunda bir azalma beklenmemelidir.

Anahtar kelimeler: Bel ağrısı, Perkün lazer disk dekompresyonu, Radiküler ağrı

Abstract

Objective: The efficacy of percutaneous laser disc decompression is still controversial due to inconsistencies between the studies. However, the reason for this discrepancy may be due to having different success levels in low back pain and leg pain. In this study, the response of both pain modalities to percutaneous laser disc decompression was examined separately.

Material and Methods: Results of 49 patients who underwent percutaneous laser disc decompression only for low back pain and 36 patients who underwent percutaneous laser disc decompression only for radicular pain were analyzed retrospectively. It was investigated on which pain type that percutaneous laser disc decompression was more effective. In addition, by examining the magnetic resonance images of the patients, it was determined whether there was a change in the size of the disc herniation.

Results: Although statistically percutaneous laser disc decompression was effective in both types of pain, this effect was much more pronounced in the low back pain group. It was determined that percutaneous laser disc decompression did not reduce the size of the disc herniation, but still provided some reduction in radicular pain. It was determined that it was much more effective in low back without reducing the size of the disc herniation.

Conclusion: Percutaneous laser disc decompression is more effective in low back pain. However, a reduction in the size of the disc herniation should not be expected.

Keywords: Low back pain, Percutaneous laser disc decompression, Radicular pain

Yazışma Adresi: Kutsal Devrim SECINTI, Kahramanmaraş Sütçü İmam Üniversitesi, Tıp Fakültesi, Beyin Cerrahi AD, Kahramanmaraş, Türkiye

Telefon: +90 5056057692, Mail: devrimsecinti@yahoo.com

ORCID No: 0000-0003-4345-0805

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INTRODUCTION

Whether percutaneous laser disc decompression (PLDD) is an effective procedure is still controversial. While most of the studies claim that PLDD is effective (1-7), there are also studies stating that it is not effective than placebo (8-11). However, the literature generally focusing only radicular pain or only discogenic pain when evaluating such patients (1,2,4,5,8,9). The effect of the same procedure on two different pain modalities has not been studied yet.

In early stdudies that discussing the mechanism of action of PLDD had been claimed that coagulation of the herniated disc with the termal effect resulted in a reduction in the size of the herniated disc and therefore the radicular pain was alleviated (5,6). Since this theory could not be able explain the mechanism underlying the reduction of discogenic pain, the theory of "decreased intradiscal pressure" begun to be discussed (3,4). According to the theory, some amount of nucleus pulposus evaporates with the termal effect, which reduces the pressure on the annulus fibrosus by decreasing the pressure inside the disc. This, finaly results in a relief in axial pain. However, it has not been clearly explained how the lowered pressure reduces the radicular pain. The proponents of laser discectomy tried to explain both relief in radicular and axial pain by the combined effect of both mechanisms. While all these debates continue, confidence in PLDD were gradually decreased due to lack of proven mechanism of action.

Lumbar and cervical PLDD has been performed in our clinic for years. During our clinical observations, it was seen that there was a significant decrease in Visule Analog Scale (VAS) scores in most of the patients, but when the relief in low back pain and the radicular pain were interrogated separately, it was seen that axial pain was the predominantly alleviated pain type. In the most of the literature, PLDD patients are being selected among those with having only axial pain or those with having only radicular pain. However, the existence of studies evaluating both patient groups in the same study and aiming to reveal in which the PLDD has more success could be useful also to explain the mechanism of action. Since it was seen that there were no such studies in the literature, it was decided to design a study to reveal which modalities of pain positively affected by PLDD.

In our clinical experience, it was also detected that no reduction in the size of herniated discs was seen in patients who had control MRI after PLDD. Existence of pain relief without shrinkage of disc herniation was found interesting, after this determination, patients who underwent PLDD was called for monthly controls, and control MRI was performed if they were benefited. Examination of the change in disc size was adopted as a routine protocol for those patients. For some of patients, control MRI was performed only to decide whether surgical discectomy will be performed or not. However, in the said follow-up period, the patients were not grouped as "those with only low back pain", "those with only radicular pain" or "those with both low back pain and redicular pain" (this identification was made due to the design of the study). The presented study was performed by analyzing the informations obtained retrospectively from the patient's data pool provided by above mentioned way. In the presented study, which type of pain was more sensitive to PLDD and whether there was a difference in the Magnetic Resonance Imaging (MRI) of the patients were examined, possible reasons for the findings were discussed.

MATERIALS AND METHODS

Patient selection and data collection

After the consent obtained from the local ethics committee of our university (2020/17-20), the data of 197 patients who underwent lumbar laser discectomy in our clinic between June 2010 and September 2019 were retrospectively analyzed. It was determined that 82 of the patients were operated only for low back pain, 59 for only radicular pain, and 56 for both low back pain and radicular pain.

The patients' pre-PLDD VAS scores (V0), immediate post-PLDD VAS scores (early VAS: VE) and post operative 1st month VAS scores (V1) were primarily evaluated. Patients found to have missing these scores were excluded. Patients who were found to have missing 3 consecutive follow-ups after the 1st month VAS follow-up, or those VAS score was not recorded despite coming for control were also excluded. Ptients who undergone laser discectomy due to both low back pain and radicular pain, and patients with bilateral radicular pain were also excluded from the study in order not to cause confusion during the evaluation of the data. In the data analysis, it was noticed that also transforaminal steroid injection was applied to some of the patients with radicular pain. These patients were also excluded from the study to ensure homogeneity.

Presence of sequestrated or migrated disc herniation, previous surgery for the same disc pathology, annulus fibrosus rupture on MRI, lumbar spondylosis, discitis/infection suspicion, pregnancy and suspected pregnancy have been known to be accepted as rejection criteria for PLDD in the literature. Becouse of the patients have been also selected according to those criteria, the said criteria have not been reused in this study.

The study designed as 2 groups. The first group was consisted of patients who underwent PLDD only for low back pain, and the second group was patients who underwent PLDD only for unilateral radicular pain. After excluding the patients who did not meet the above mentioned criteria, the study continued with 49 patients in the first group and 36 patients in the second group. The anatomical distribution of affected discs (levels of problematic disc) are listed in **Table 1.** The changes in VAS scores during follow-up were statistically analyzed. In order to simplify the data, only the initial VAS score (V0), the post-op early VAS score (VE) and the post-op 1st moth, 3rd month, 6th month VAS scores (V1, V3, V6 res-

pectively) were taken into account. Which pain modality was more respondable to PLDD was examined. By comparing the MRIs of the patients those with disc bulging at the time of admission and the MRIs obtained in the post operative period, it was examined whether there was a relationship between the relief in pain and the change in the size of the disc herniation. The perpendicular distance of the apex of the herniation to the inner surface of the lamina was used in T2 weighted axial sections for measurement.

Surgical technique

1 g of cefazolin sodium was administered to the patients on the morning of surgery. Patients were taken to the operating table in prone position. After determining the relevant disc level under fluoroscopy, the surgical site was anesthesied, the disc was reached by an 18 G Chiba needle entering 4-6 cm lateral to the midline. Disc coagulation was performed with the help of laser energy and a 600 µm-in diameter fiber optic cable through the needle. The maximum power of laser device used was 10 Watts and was capable to adjust 0.5 to 10 Watts (Yuancure Laser Corp, Beijing, China). The device calibration was pre-set to 10 Watt, T on: 1000 ms and T off: 500 ms. (T on: represents the laser energy output time interval when the foot switch is pressed continuously, and T off is representing the time interval which the laser energy ceased even the pedal was still pressed) The total applied energy was minimum 250 Joules and maximum 450 Joules. These parameters were purely empirical and based on our previous clinical observations. The application was continued as long as the patient was not uncomfortable due to pain caused by the heated endplate. When the patient felt pain, the procedure was continued by waiting 10-15 seconds for the warmed endplate to cool. In every painful situation, the procedure was paused for 10-15 seconds in the same way, and ultimately the procedure was completed. The procedure was considered unsuccessful in patients in whom 250 Joules could not be reached and the patients were excluded. Patients whose procedures were completed were discharged by noting the change in VAS scores within the first hour.

Statistical analysis

As the age, V0, VE, V1, V3 and V6 values of the groups (and also the affected disc levels) were not normally distributed in the normality test (Kolmogorov-Smirnov), nonparametric tests were used in the analysis of the data. Wilcoxon paired two sample tests were used for the comparison of dependent groups (comparison of V0, V1, V3, V6 measurements for each group and comparison of affected disc levels). Mann-Whitney-U test was used to compare the age, V0, V1, V3, V6 measurements of the two groups. Pearson Chi-Square test was used to compare the genders. All data were analyzed with SPPS v21 software program and statistical significance value was accepted as $p<0.05$.

RESULTS

The median age of the patients in the low back pain group (Group-1) was 44 (min:29, max:63), and in the radicular pain group (Group-2) was 41 (min:26, max:60). It was seen that the female/male ratio was 22/27 and 16/20, respectively. The median age and gender distributions of the two groups were similar (p=0.314; p=0.473, respectively).

The median of the VAS scores at the time of admission of the patients in group 1 and group 2 were 7 (min:5, max:8 and min:4, max:8, respectively) in both groups.

Immediately after the procedure, it was found that there was a significant decrease in the VAS score in both groups. This decrease was much more pronounced in Group-1. The difference between V0 and VE for both groups was statistically significant (p=<0.001). Although the first month VAS scores (V1) in both groups were higher than the postope-

Table 1. Anatomical distribution of problematic discs (The disc levels that PLDD procedures were performed).

Group	Affected disc level (number of cases)			
	L3-L4	L4-L5	L5-S1	Total
Group-1	9	19	21	49
Group-2	2	15	19	36

PLLD : percutaneous laser disc decompression

Table 2. Comparison of the demographic data of the groups and VAS median values.

Group	N	Age Median	F/M	V0 Median (min-max)	VE Median (min-max)	V1 Median (min-max)	V3 Median (min-max)	V6 Median (min-max)
Group- 1	49	44	22/27	7 (5-8)	2(0-8)	3(0-8)	3(0-9)	3(0-8)
Gorup-2	36	40.50	16/20	7 (4-8)	5(2-7)	6(5-8)	6(4-8)	6(4-8)
p		0.314[a]	0.473[b]	0.269[a]	<0.001[a]	<0.001[a]	<0.001[a]	<0.001[a]

[a]:Mann-Whitney-U tes was applied. [b]: Pearson Chi-Square test was applied. VAS: Visuel Analog Scale

rative early VAS scores (VE), they were still lower than the initial VAS scores (V0). The difference between VE and V1 was statistically significant for both groups (p<0.001 and p=0.004 respectively). However, when **Table 1** is examined, it will be seen that said difference is the "continuation of the good outcomes" for Group-1, but means "return to the beginning" for Group-2. It was determined that there was no significant difference between the 1st month VAS scores (V1) and the later follow-up VAS scores (V3 and V6) for group 1 (p=0.285 and p=0.190 respectively) and also for group 2 (p=0.808 and p=1.000 respectively). This was interpreted as 1-month follow-up is sufficient to determine the success or failure of PLDD.

In the comparison of two groups with each other, it was determined that there was no statistically significant difference in terms of initial VAS scores (p=0.269), that is, the two groups were similar to each other at the beginning. When the postoperative early VAS scores (VE) of both groups were compared, there was a significant difference in favor of Group-1 (p<0.001). When the 1st month VAS scores (V1) of both groups were compared, the statistical difference in favor of Group-1 was significant (p<0.001).

When V0 and V1 scores were compared, the difference was significant in both groups (Group 1 and Group 2) (p=<0.001 and p=0.005 respectively), which was indicating that both pain types relief after PLDD but it was prominent in low back pain. The results of VAS scores comparisons and statistical differences were summarised in **Table 2, Figure 1** and **Figure 2.**

In the comparison of affected disc levels, the comparisons were made only within the belonging group. group 1 and group 2 have not been compared with each other. No statistical difference was found between the disc levels, in the manner of the anatomical levels of affected disc and effectivenes of the prosedure (p=0.784).

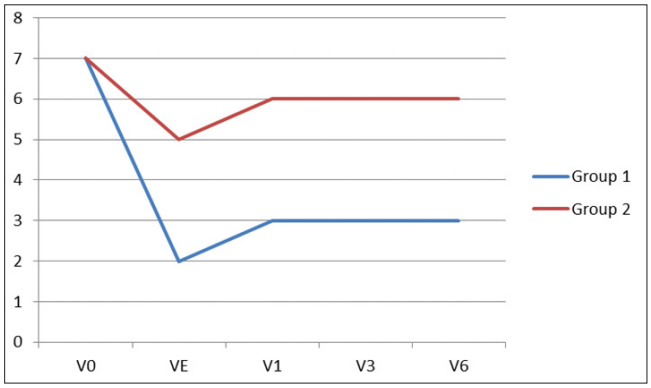

Figure 1. The changes of VAS scores depending on time for both groups are shown. Although PLDD is effective in both pain modalities, it is much more prominent in low back pain (V0: initial VAS score, VE: post operative early VAS score, V1: 1sth month VAS score, V3: 3th month VAS score and V6: 6th month VAS score).

It was noticed that a total of 43 patients from both groups had control MRIs. 19 of those were belong to Group-1 and 24 were to Group-2. It was determined that 11 of 19 patients in Group-1 had disc protrusion that did not cause radicular pain. It was thought that the control MRI was obtained in those patients for eveluating the regression in protrusions, but the reason for the remaining 8 patients was not determined and therefore they were not evaluated. All 24 patients in group 2 had disc protrusions. Decreases in the VAS scores (except VE) of patients were not higer than 1 point. The reason for those patients to have a control MRI was not decrease in VAS (although the statistical significance was found), but to decide whether to undergo surgery or not. In the MR comparisons of the patients, no difference was found, that is, it was observed that the PLDD did not change the size of the disc herniation.

DISCUSSION

When the VAS data of both groups were focused, it was seen that post operative early VAS scores (VE) were insufficient to make a decision about the success or failure of the procedure, and the data after the 1st month would not affect the results. It was concluded that comparing the initial VAS score (V0) with the first month VAS score (V1) was adequate to evaluate the effectiveness of the procedure. While lumbar PLDD resulted clinical improvement in axial pain, it could not serve the same success in radicular pain.

The presence of conflict in the literature was attributed to the inadequacy of studies that address the effect of PLDD separately on these two pain modalities.

The relief of radicular pain with PLDD is explained by the shrinkage of the coagulated disc and the reduction of the pressure on the nerve root. In this case, there should be a visible improvement in the control MRI. However, in the presented study, there was no difference between pre-PLDD images and post-PLDD images in the 35 MR images taken into consideration. The study results claiming that PLDD has no efficacy in radicular pain was consistent with the lack of difference between MR images. Perhaps some shrinkage can be seen in soft discs, but such a situation was not found in the presented study.

The alleviation in axial pain was quite evident in the presented study. However, trying to explain this situation only with the theory of "decreased intradiscal pressure" seems to be inadequate. This is of course a possible factor, but it should be taken into account that the pain fibers within the disc are also denervated by the use of thermal energy (4,5). In the first years when intradiscal thermal applications (PLDD, IDET, Nucleoplasty) were first populated, since it was suggested that coagulated part of the intervertebral disc was especially nucleus pulposus which was believed not to have nerve fibers, the theory of "denervation of pain fibers" was quickly ruled out.

However, some recent studies have determined that the degenerated nucleus pulposus, unlike the healthy nucleus

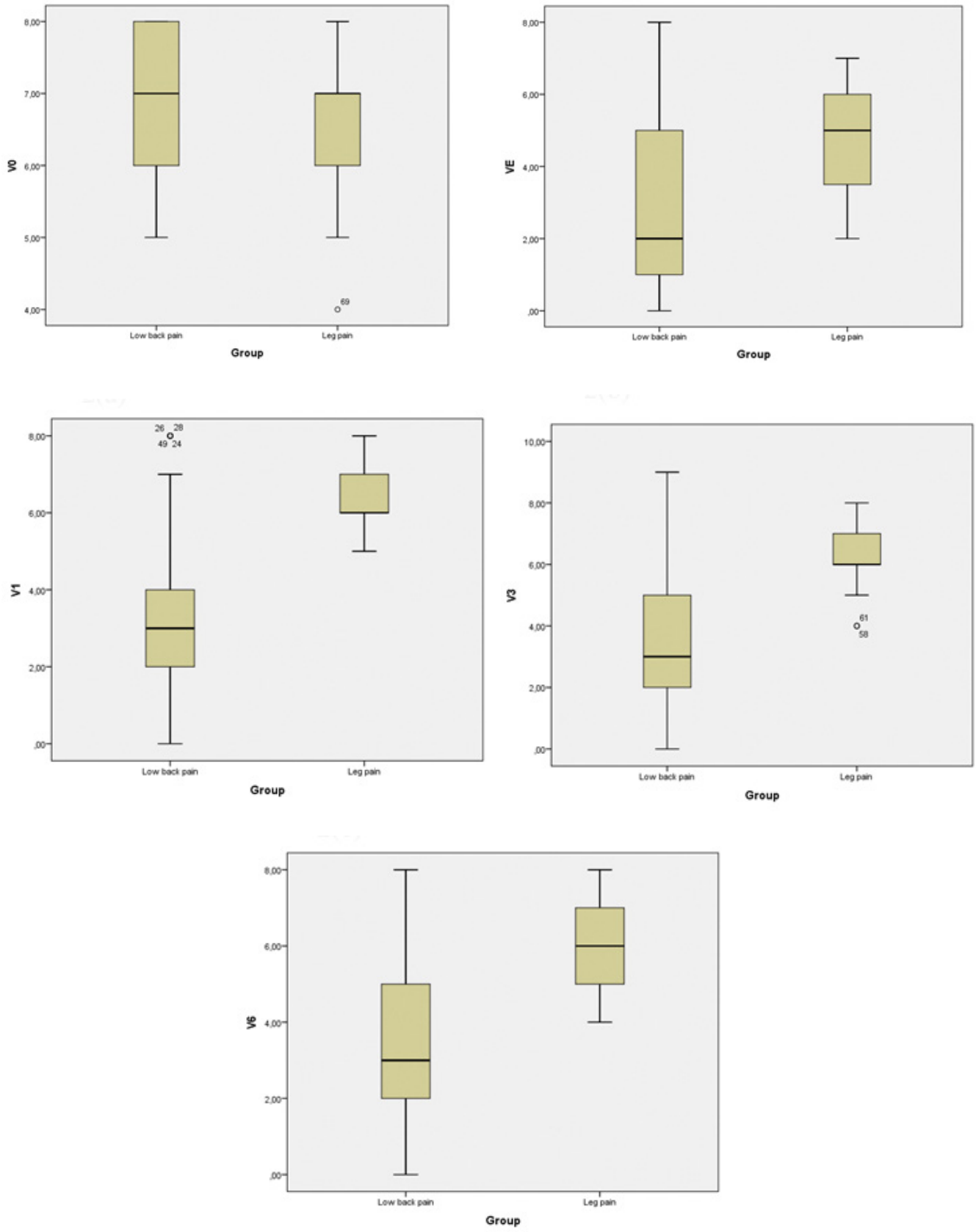

Figure 2. Box plot graphs of the VAS scores of group 1 and group 2 are shown. Perpendiculary axis and horizontal axis are representing the VAS scores and the pain modalities respectively. Groups were compared in terms of initial VAS scores (a), post operative early VAS scores (b) and follow-up VAS scores ((c)V1, (d)V3 and (e)V6)).

pulposus, has newly sprouted vessels and nerve structures (12,13). As aresult, it is now accepted that discogenic pain may arise not only from the annulus fibrosus but also from the degenerated nucleus pulposus, as previously thought. This discovery seems to finish the debate about the effectiveness of PLDD and its mechanisim of action.

The data of the presented study has conflicts with some of the known literature information. According to the results of the study; PLDD does not cause shrinkage in disk size, contrary to what is claimed (3-7). Also, its effect on radicular pain is almost nonexistent. It shows its main effect especially in axial pain. It would be a much more concrete and evidence-based approach to explain the success of PLDD in axial pain with the histopathologically proven "denervation of the nerve fibers sprouting towards the degenerated nucleus pulposus" instead of explaining with the unproven "decreased intradiscal pressure theory".

CONCLUSION

PLDD does not cause shrinkage in herniated disc size and is nearly ineffective in radicular pain. It should be kept in mind as an option in patients who do not respond to conservative treatments in low back pain accompanied by disc degeneration.

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REFERENCES

1. Ceylan A, Asik I. Percutaneous navigable intradiscal decompression in treatment of lumbar disc herniation: a single-center experience. Turk J Med Sci. 2019;49:519-524.
2. Davis TT, Delamarter RB, Sra P, Goldstein TB. The IDET procedure for chronic discogenic low back pain. Spine 2004;29:752-756.
3. Hijikata S. Percutaneous nucleotomy: a new concept technique and 12 years' experience. Clin Orthop Relat Res. 1989;238:9-23.
4. Saal JA, Saal JS. Intradiscal electrothermal treatment for chronic discogenic low back pain. A prospective outcome study with a minimum 1-year follow-up. Spine (Phila Pa 1976). 2000;25:2622-2627.
5. Saal JS, Saal JA. Management of chronic discogenic low back pain with a thermal intradiscal catheter: a preliminary report. Spine (Phila Pa 1976). 2000;25:382-388.
6. Singh V, Piryani C, Liao K, Nieschulz S. Percutaneous disc decompression using coblation (nucleoplasty) in the treatment of chronic discogenic pain. Pain Physician. 2002;5:250-259.
7. Webster BS, Verma S, Pransky GS. Outcomes of workers' compensation claimants with low back pain undergoing intradiscal electrothermal therapy. Spine (Phila Pa 1976). 2004;29:435-441.
8. Pauza KJ, Howell S, Dreyfuss P, JH Peloza, K Dawson. A randomised, placebo-controlled trial of intradiscal electrothermal therapy for the treatment of discogenic low back pain. Spine J. 2004;4:27-35.
9. Freeman BJC. IDET: a critical appraisal of the evidence. Eur Spine J. 2006;15 (Suppl. 3):448–457.
10. Freedman BA, Cohen SP, Kuklo TR, Lehman RA, Larkin P, Giuliani JR. Intradiscal electrothermal therapy (IDET) for chronic low back pain in active-duty soldiers: 2-year follow-up. Spine J. 2003;3:502-509.
11. Cohen SP, Larkin T, Abdi S. Risk factors for failure and complications of intradiscal electrothermal therapy: a pilot study. Spine (Phila Pa 1976). 2003;28:1142-1147.
12. Binch ALA, Cole AA, Breakwell LM, Michael ALR, Chiverton N, Creemers LB et al. Nerves are more abundant than blood vessels in the degenerate human intervertebral disc. Arthritis Res Ther. 2015;17:370.
13. Wu B, Yang L, Peng B. Ingrowth of Nociceptive Receptors into Diseased Cervical Intervertebral Disc Is Associated with Discogenic Neck Pain. Pain Med. 2019:20(6):1072-1077.