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Research Article / Araştırma Makalesi

Sacral Epidural Laser Discectomy Efficacy in Non-Operated Lumbar Disc Herniation-A Single Center Experience

Non-Opere Lomber Disk Herniasyonlu Hastalarda Sakral Epidural Lazer Diskektomi Etkinliği-Tek Merkez Deneyimi

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Abstract

Sacral Epidural Laser Discectomy (SELD) which is an effective and minimally invasive procedure for the direct visualization and therapeutic treatment of pain due to spinal disorders. The aim of this study is to share the effect of SELD on clinical findings and pain. 43 patients who had not undergone back surgery and were found to have lumbar intervertebral disc herniation at L4-5 or L5-S1 level without any indication for back surgery, and who underwent SELD for the treatment patients with low back and/or radicular pain were evaluated. Physical examination findings (the straight leg raising test (SLR) <45 degrees positive(+), SLR >45 degrees negative(-) test were accepted) and visual pain scale (VAS) values were evaluated at admission, on the same day of post-op, 1st and 6th months. Disc herniation was observed at L4-5 level in 27 patients (62.79%) and at L5-S1 level in 16 patients (37.21%). 31 patients (72.09%) benefited from SELD treatment, while surgery was recommended for 10 patients (23.26%). With SELD procedure no permanent complication was observed. The clinical response of SELD according to the lumbar disc level, a more significant improvement was found in both physical examination and VAS scores in patients with disc herniation at the L5-S1 level ($p<0.001$). There was no statistically significant relationship between the SLR (+) side and the outcome. SELD is a more effective option, especially in patients with good physical examination findings at admission and mild-to-moderate soft disc herniation at the L5-S1 level.

Keywords: Sacral epidural laser discectomy, back pain, radicular pain, disc herniation, epidural discectomy, minimal invasive surgery

Özet

Sakral Epidural Lazer Diskektomi (SELD) omurga hastalıklarına bağlı ağrıda doğrudan görüntüleme ve tedavi olanağı sağlayan minimal invaziv bir yöntemdir. Bu çalışmanın amacı SELD tedavisinin klinik bulgular ve ağrı üzerine etkinliğini değerlendirmektir. Omurga cerrahisi geçirmemiş ve cerrahi endikasyonu olmayan L4-5 veya L5-S1 düzeyinde lomber intervertebral disk herniasyonu nedeniyle SELD uygulanmış 43 hasta çalışmaya dahil edildi. Tüm hastalarda başvuru şikayeti olarak bel ve/veya radiküler ağrı mevcuttu. Hastaların başvuru, post-op aynı gün, 1. ve 6.ay kontrollerinde fizik muayene bulguları (düz bacak kaldırma testi (SLR) <45 derece pozitif(+), SLR>45 derece negatif(-) test kabul edildi) ve görsel ağrı skalası (VAS) skorları değerlendirildi. 27 hastada (%62.79) L4-5 düzeyinde, 16 hastada (%37.21) L5-S1 düzeyinde lomber disk hernisi gözlendi. SELD tedavisinden 31 hasta (%72.09) klinik olarak fayda görürken, 10 hastaya (%23.26) omurga cerrahisi önerildi. SELD prosedürü ile hiçbir hastada kalıcı bir komplikasyon gözlenmedi. L5-S1 düzeyinde disk hernisi olan hastalarda SELD hem fizik muayene hem de VAS skorlarında daha anlamlı düzelme sağladı($p<0.001$). SLR (+) tarafı ile klinik yanıt arasında istatistiksel olarak anlamlı bir ilişki saptanmadı. SELD, özellikle başvuru sırasında fizik muayene bulguları iyi olan ve L5-S1 düzeyinde hafif-orta derecede yumuşak disk hernisi olan hastalarda daha etkili bir tedavi seçeneğidir.

Anahtar Kelimeler: Sakral epidural lazer diskektomi, bel ağrısı, radiküler ağrı, lomber disk hernisi, ağrı tedavisi

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1. Introduction

Epiduroscopy, also known as epidural spinal endoscopy, is the percutaneous minimally invasive examination of the epidural space by entering the sacral hiatus with the aid of a flexible endoscope. With the developing technology, since the 2000s, the trans-sacral epiduroscopic decompression (SELD) technique has been developed to treat symptomatic pathologies of the lumbosacral spine, with small-caliber flexible optical and light sources, video-guided catheters and video systems, and laser technology (1). The SELD technique not only demonstrates epidural space pathologies, but also enables the diagnosis and treatment of lesions that cannot be detected even with MRI, by directly seeing them (2). SELD is a very successful method in the treatment of chronic low back and/or radicular pain due to spinal disorders. It provides treatment by eliminating the pathology in the epidural space (such as protruded disc material or epidural adhesion and fibrosis around nerve roots)(3-12). The aim of this study is to share our SELD experience for the treatment of patients with mild to moderate soft lumbar disc herniation with low back and/or radicular pain who have not had low back surgery and have no back surgery indication.

2. Material and Methods

Patient Selection

Between January 2016 and January 2017, the files of 43 patients who applied to Ankara University Faculty of Medicine, İbni Sina Hospital Pain outpatient clinic, who had not undergone back surgery and were found to have lumbar intervertebral disc herniation without any indication for back surgery, and who underwent SELD for the treatment of patients with low back and/or radicular pain were evaluated. Ethical approval of our study was obtained from the ethics committee of Ankara University Faculty of Medicine (ethics committee approval number: 02-56-17). Physical examination findings and visual pain scale (VAS) values were evaluated at admission, on the same day of post-op, 1st and 6th months. For physical examination the straight leg raise test (SLR) was performed all patients in a supine position. The examiner gently raised the patient's leg by flexing the hip with the knee in extension, and the test was considered positive when the patient experiences pain along the lower limb in the same distribution of the lower radicular nerve roots (usually L5 or S1). Furthermore, a positive SLR test was determined when pain was elicited by lower limb flexion at an angle lower than 45 degrees. Complications that developed were recorded. Indications for SELD are mild to moderate soft disc herniation confirmed by magnetic resonance imaging (MRI) consistent with clinical symptoms, low back pain and/or radicular leg pain that causes limitation of daily living activities despite adequate conservative treatment. Contraindications for SELD are cauda equina syndrome or severe paresis (motor grade 3 or less), hard disc, foraminal disc herniation inaccessible using SELD, advanced spinal stenosis or instability, infection, bleeding coagulation disorder, and anatomical abnormalitiessuch as sacral hiatus anomaly or peridural cyst are inaccessible catheterization. Patients with multiple disc herniation, previous history of lumbar surgery, patients with insufficient follow-up period or incomplete information were not included in the study.

Technic

The SELD procedure is performed under operating room conditions with sedoanalgesia and local anesthesia and does not require hospitalization. First, the patient is placed on the operating table in the prone position, and an elevation is placed under the abdomen to exclude the lumbar lordosis and reveal the sacral hiatus. The patient's vital signs are monitored, after sterile cleaning and dressing of the sacral region, local anesthesia with 1% lidocaine and a 5 mm skin incision is applied to the sacral hiatus. A fluoroscopically-guided trocar is passed through the sacrococcygeal ligament. After advancing the trocar to the S2-3 level, a 3.2 mm diameter video-guided catheter (Spinaut V, Imedicom Inc., Seoul, Korea) containing two 1.2 mm diameter lumens is inserted into the trocar towards the target site. The video-guided catheter is advanced to the target level using

bidirectional guidance features and injected radio-opaque through an infusion port, fluoroscopic imaging is performed to confirm the position of the catheter in the ventral epidural space, to detect the outline of the herniated disc and opaque flow obstruction caused by adhesion around the pathological site. A 1.0 mm diameter flexible epiduroscope (Spinaut S, Imedicom Inc., Seoul, Korea) and a 550 µm diameter Holmium YAG flexible laser are advanced to the tip of the catheter via the video-guided catheter to visualize the epidural space and clarify the pathological lesion. Irrigation with saline is applied to sharpen the endoscopic video image and cool the ablation site. Epiduroscopy visualizes herniated disc material, adhesive bands, inflammation tissue, fibrotic connective tissue, and adipose tissue around the dura and nerve root. After confirming with flexible epiduroscopic imaging that the catheter tip is inferior to the herniated disc covered by the posterior longitudinal ligament, laser ablation (power range 2.5 W-5W) is applied to the herniated disc material and adhesive bands. First, the posterior longitudinal ligament bulging material is ablated with Holmium YAG 2.5 W laser , looking at the patient's response. After the patient tolerates the low-grade laser, the posterior longitudinal ligament is penetrated using a 5 W (0.5 J and 10 Hz) laser. Then, the herniated disc under the posterior longitudinal ligament is shrunk with an 8–10 W (0.8–1.0 J and 10 Hz) high-energy laser, until decompression is observed in the thecal sac and nerve root. As the herniated disc shrinks, the epidural space between the dura and the pathological lesion widens. After adequate decompression with repeated epidurograms, a flattened line and free flow should be observed in the target area. After ablation, if adhesion and/or fibrosis is observed, 1500 units of hyaluridase are applied, if not, 16 mg of dexamethasone is injected, the procedure is terminated by removing the epiduroscopic catheter. The skin is closed with sutures, all procedures are applied by the same pain physician.

Statistics

SPSS statistical package program SPSS version 23.0 was used in the study. Categorical candidates were considered as percentage and continuous standards were 'mean± deviation'. Frequency analysis, single Anova test, test and time graphs were used in the analysis. A p value of <0.05 was accepted.

3. Results

A total of 43 patients, 22 (51.16%) female and 21 (51.16%) male, were included in our study. The mean age of the patients was 43.23 ± 12.50, and no statistically significant difference was found between male and female patients (p>0.05) (Table 1). It was evaluated on which side the straight leg raising test (SLR) was positive due to low back and radicular pain at the time of admission. SLR <45 degrees positive and SLR >45 degrees negative test were accepted. Accordingly, at the time of admission, 39.53% of our patients (17 patients) had SLR positive in both legs, while 32.56% (14 patients) had SLR positive in the left leg and 27.91% (12 patients) in the right leg. Disc herniation was observed at L4-5 level in 62.79% (27 patients) of our patients, and at L5-S1 level in 37.21% (16 patients). The SLR degree, which was 45.00 ± 15.96 before SELD, ranged from 76.86 ± 13.18 in the post-op period, 78.95 ± 12.70 at the first month, and 79.30 ± 12.79 at the sixth month. It was found that the SLR value increased as time progressed. A statistically significant difference was found between the patient's pre-SELD, post-op, 1st month and 6th month SLR values (p<0.001). Patients with disc herniation at the L5-S1 level have higher mean SLR averages than patients with disc herniation at L4-5 level, while their mean increase in SLR is similar to each other (Figure 1).

The VAS score, which was 8.02 ± 0.59 in the initial evaluation before SELD, was 5.44 ± 0.90 in the postoperative period, 4.33 ± 1.14 in the first month, and 2.86 ± 1.75 in the sixth month. It was determined that the VAS score decreased in the follow-up. In addition, a statistically significant difference was found between VAS scores according to measurement times (p<0.001). When the VAS scores are evaluated according to the disc herniation level; patients with disc herniation at L4-5 level had higher values than patients

with disc herniation at L5-S1 level. However, although VAS scores were similarly decreased in follow-up evaluations, it is observed that patients with disc herniation at the L5-S1 level experienced a faster decrease in VAS scores (Figure 2). In our study, 72.09% (31 patients) of our patients benefited from SELD treatment, while surgery was recommended for 23.26% (10 patients).In addition, complications were observed in 4.65% (2 patients) of our patients. Transient headache was observed in 1 patient, dural puncture was observed in 1 patient, no permanent complication was observed. When we evaluated the clinical responses obtained from SELD treatment according to sex, 14 of our female patients (63.6%) benefited from the treatment, while 17 (80.9%) of 21 of our male patients benefited from the treatment. However, no relationship was found between the rates of clinical responses and sex (p:0.393). Disc herniation levels and clinical response rates are shown in Table 2. In Table 3, the initial SLR values and outcome status of our patients are compared. Accordingly, 16 out of 27 patients with a baseline SLR value below 45 degrees benefited, while 15 out of 16 patients with a baseline SLR value above 45 degrees benefited from treatment. In Table 4, the SLR side of our patients and their outcome were compared. Accordingly, 8 out of 12 patients with SLR (+) on the right and 11 out of 14 patients with SLR(+) on the left benefited from treatment, while 12 out of 17 patients with bilateral SLR (+)benefited from treatment. In addition, whether there is a relationship between the SLR (+) side and the result was tested with the chi-square relationship test and the chi-square value was found to be 2.24, and the corresponding p value was found to be 0.692. In other words, there was no statistically significant relationship between the SLR (+) side and the outcome.

Table 1. Analysis of Age Distribution of Our Patients by sex

Sex	Mean ± Standard Deviation	P value
Female	46.64 ± 13.52	0.067
Male	39.67 ± 10.49	
TOTAL	43.23 ± 12.50	

Table 2. Comparison of Level of disc herniation and Outcomes of Our Patients

Outcome	Level of disc herniation		TOTAL
	L4-5	L5-S1	
Surgery recommended	10	0	10
Benefited	15	16	31
Complication has developed	2	0	2
TOTAL	27	16	43

Table 3. Comparison of initial SLR Value and Outcome Conditions

Initial SLR Value	Outcome			TOTAL
	Surgery recommended	Benefited	Complication has developed	
<45 Degree	9	16	2	27
>45 Degree	1	15	0	16
TOTAL	10	31	2	43

Table 4. Comparison of SLR Side and Outcome Situations of Our Patients

Side	Outcome			TOTAL
	Surgery recommended	Benefited	Complication has developed	
Right SLR+	3	8	1	12
Left SLR+	2	11	1	14
Bilateral SLR+	5	12	0	17
TOTAL	10	31	2	43

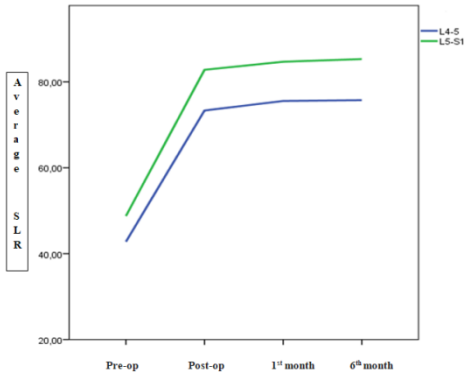

Figure 1. Change of SLR Value Averages According to Disc Hernia Levels of our Patients

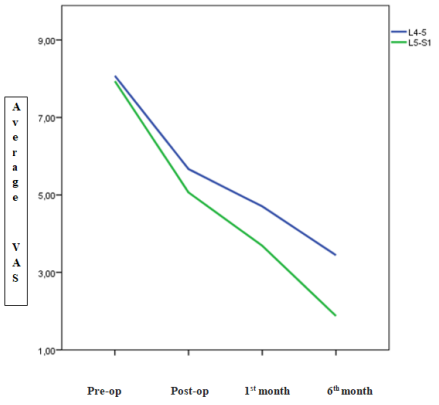

Figure 2. Change of VAS Value Averages According to Disc Hernia Levels of our Patients

4. Discussion

SELD; is an interventional treatment method used in the treatment of chronic low back and/or radicular pain due to spinal disorders like intervertebral disc herniation, fibrosis, spinal stenosis or failed back surgery syndrome. Compared to other conventional algological interventional treatment options (such as drug injection, epiduroscopic adhesiolysis, and neuroplasty), laser ablation with SELD has a higher rate of permanent benefit because it can shrink the disc material(13-16). In a double-blind randomized study comparing caudal injection and epiduroscopic drug injection into the target nerve root in chronic sciatic pain, it was found that the two methods were not superior to each other (17). In a study comparing the clinical efficacy and safety of percutaneous epidural neuroplasty (PEN) and SELD in the treatment of lumbar disc herniation, SELD was found to be more effective and superior to PEN(18).In line with this information, SELD stands out as an optimal treatment option for patients with mild or moderate soft disc herniation (18,19).In many previous studies SELD stands out as a very effective treatment with significant improvement in the pain and quality of life indexes of patients, and it shows rapid efficacy (20,21).However, this may be due to the short follow-up patients and the lack of data reliability. In our study, we evaluated our patients with a control period of 6 months. Although a significant decrease in VAS score and improvement in physical examination were observed in 31 patients (72.09%), surgery was required in 10 patients (23.26%) during the follow-up period.In addition, complications that did not cause permanent damage developed in 4.65% (2 patients) of our patients.In the study of 82 patients by Son et al., patients were followed for 6 months, similar to our study, and clinical

results were not positive in all patients.As the reasons for this situation; It has been suggested that laser ablation may show a lower than expected decompression effect and although reduction in disc material is observed with ablation during the procedure, this may not be reflected as an objective reduction in MR imaging (23,24).In addition, the late effects of laser ablation and dehydration of herniated soft disc may cause various clinical responses in patients(25). Although SELD is an easier procedure than other endoscopic surgical procedures, it requires access through the sacral hiatus, safe entry into the ventral epidural space, reaching the target area with a flexible endoscope, and the ability to use a very narrow and enlarged endoscopic view. In a study evaluating the effectiveness of SELD learning curve and surgical adequacy on clinical response, depending on the operation time and results, the learning curve of SELD is not as difficult as other minimally invasive spinal surgeries and the procedure time gets shorter as the number of operations increases found to have no effect (22).Many factors such as demographic and ethnic characteristics of the patients, the level of the disc, the degree of degeneration and the morphology of the pathology affect the clinical response variability of the patients (23).Although no significant difference was found in terms of efficacy in a study comparing SELD at the L5-S1 level with the microscopic open interlaminar approach, SELD seems to be more advantageous because it provides healing without scar tissue and a quick return to daily life(26).At the L5-S1 level, the location of the epiduroscope is more advantageous than other anatomical levels, it is closer to the sacral hiatus and has a wider disc space. At other anatomical levels (L1-L5), the epiduroscope has to pass through multiple intervertebral structures (26). In our study, when we evaluated the clinical response of SELD according to the lumbar disc level, a more significant improvement was found in both physical examination and VAS scores in patients with disc herniation at the L5-S1 level. In addition, none of the patients with disc herniation at the L5-S1 level required surgery. We found that L5-S1 level discs can be treated more effectively during the SELD procedure. Therefore, we think that further case-controlled studies are needed to investigate the effectiveness of SELD according to the level of disc herniation. We know that SELD is an effective treatment especially for central extruded discs (26). But we did not include only patients with central hernia in our study. SLR positivity side gave us information about the patient's disc herniation area. The SLR test also called the Lasegue test, is a fundamental neurological maneuver during the physical examination of the patient with lower back pain aimed to assess the sciatic compromise due to lumbosacral nerve root irritation. This test can be positive in a variety of conditions (facet joint cyst or hypertrophy) being lumbar disc herniation the most common. Overall, this test is one of the most commonly performed maneuvers across clinical practice and provides important information when making the clinical decision to refer a patient to a specialist as well as among spinal surgeons to guide therapeutic decision-making. Sciatic pain is radiating pain from the buttocks to the leg and is frequently associated with low back pain. In this regard, the neurological examination is fundamental in discriminating patients with isolated lower back pain from those with associated radiculopathy. Consequently, early recognition of radiculopathy allows a targeted treatment and diminishes disability. The specificity of the straight leg raise test has been reported to be low, making the diagnosis accuracy limited. However, the clinical usefulness of this test remains important both for general practitioners as for spine surgeons and should still be considered a relevant component of the physical examination that, associated with proper imaging studies can lead to an accurate diagnosis and treatment (27). In our study in epiduroscopic imaging; right-sided herniation was observed in patients with right SLR(+), left-sided herniation in patients with left SLR (+) and central herniation was observed in patients with bilateral SLR (+). Accordingly, SLR positivity side and SELD efficiency were evaluated in the admission examinations of the patients, but no statistically significant difference was found. In our study, it was found that patients who have worse pre-SELD examination findings (SLR <45 degree) benefited less from SELD than patients with

good initial examination findings (SLR >45 degree).SELD treatment was an effective method in our patients in accordance with the literature. The limitations of our study are that it is retrospective, the number of cases is small and there is no control group. And no scale was used for clinical evaluation, except for physical examination and VAS. SELD, which is an effective and minimally invasive procedure in patients with low back and radicular pain unresponsive to conservative treatment and without an indication for operation, is an effective treatment option as well as surgical methods with the right patient selection. Additionally, SELD proved to be advantageous, with significantly shorter hospital stays. Many factors such as demographic and ethnic characteristics of the patients, the level of the disc, the degree of degeneration and the morphology of the pathology affect the clinical response variability of the patients. SLR test is a physical examination method that is frequently used in daily practice and guides patients with low back and radicular pain in making treatment decisions. We evaluated SELD treatment as a more effective option, especially in patients with good physical examination findings (SLR >45 degrees) at admission and mild-to-moderate soft disc herniation at the level of L5-S1. We think that further case-controlled studies are needed to evaluate the clinical efficacy of SELD treatment.

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