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TRANS-SACRAL EPIDUROSCOPIC LASER DECOMPRESSION FOR LUMBAR DISC HERNIATION

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ABSTRACT

Background Data: Back or leg pain is common in all lumbar disc herniation including the patients who had surgery or not. Trans-Sacral Epiduroscopic Laser Decompression, a new, minimally invasive therapeutic technique, may be useful in many patients with lumbar disc herniation. We investigated the clinical outcomes of this procedure for chronic low back pain and radicular pain in lumbar disc herniation with the comparison between the patients who had surgery and who did not.

Materials – Methods: Patients with lumbar disc herniation (n=144, median age 42,64±10,24 yr) were divided into two groups: a group without any operations and those who have had back surgery. Each patient, in whom relevant findings were present on MR images, was submitted to Trans-Sacral Epiduroscopic Laser Decompression. The patients with motor weakness, spinal stenosis and spondylolisthesis were excluded from the study. Outcomes of the patients were assessed with Visual Analogue Scale score and Oswestry Disability Index. The same procedure was performed in all patients under local anesthesia and sedation. We analyzed the clinical data, median age, symptom duration, radiological findings, and outcome scores. Statistical analysis was performed using appropriate statistical tests.

Results: Significant improvement in low back and lower limb pain was observed on the first day after the procedure. The outcome scores after 6 months and 2 years in both groups were significantly decreased as well.

Conclusion: From these findings, we suggest that Trans-Sacral Epiduroscopic Laser Decompression could be a safe and effective treatment modality for Lumbar Disc Diseases in selected cases.

Key Words: Trans-sacral; epiduroscopic; laser; disc decompression

Level of Evidence: Retrospective clinical study, Level III

INTRODUCTION

Interventional treatments in the spine field have become quiet important recently. For, conservative treatment may fail in many cases and surgery is often considered as the last option [8]. Epiduroscopic approach to disc herniation seems to be one of the most promising method of minimal invasive procedures for spinal pathologies.

We can define Epiduroscopy as a technique that permits direct endoscopic visualization of the epidural space. When compared with conventional surgical techniques, the advantages of Trans-Sacral Epiduroscopic Laser Decompression (SELD) include less invasiveness, reduced operating time, needlessness of general anesthesia, cooperation with the patient during the procedure and repeatability.

First epiduroscopic observations in autopsy cases were reported by Blomberg in 1985 [2]. Then the introduction of flexible endoscopes accelerated the progression of development in epiduroscopy [6,15].

In 1998, Choy had reported his results of percutaneous laser disc decompression [4]. A large series of patients with herniated disc disease was documented with success rate ranged from 75 % to 89 % with a complication rate of less than 1 %. However, to make an attempt directly to the disc from via epidural space seemed to be more difficult for many physicians.

Since then, epiduroscopic techniques have become more popular for treatment of radicular pain caused by especially adhesions or fibrosis in the epidural space. As instruments have become advanced, pain physicians began to apply the laser during the epiduroscopic procedure for the treatment of low back pain and/or radicular pain caused by herniated lumbar disc, adhesions or fibrosis in the epidural space [5,13].

The authors have performed this procedure after a long time experience of microdiscectomy and the other open surgical techniques. According to the data of epiduroscopic procedures of 144 cases, we suggest that trans-sacral epiduroscopic laser disc decompression appears to be a preferable treatment modality for low back pain or radicular pain.

MATERIALS AND METHODS

This study was conducted using retrospective findings from 144 patients who underwent Trans-Sacral Epiduroscopic Laser Decompression (SELD) procedure between October 2013 and May 2016 at a single institution. An informed consent, describing the details and probable complications of the procedure was obtained from all patients. The mean age of the patients was 42.64 ± 10.24 years and 54.9 % (n=79) of them were women while 45.1 % (n=65) were men. (Table-1).

They were divided into two groups: one is the group of patients without any operations (Group-A, n=96), and the other is the group of patients who have had back surgery (Group-B, n=48) (Table-2).

Each patient in whom relevant findings were present on MR images, was submitted to SELD after receiving medical and physical therapy for >2 weeks before the procedure. The patients with motor weakness, spinal stenosis and spondylolisthesis were excluded from the study. The level of lesions were mostly at L4-5 and L5-S1 with high percentages which were 57.6 % and 36.1 % respectively (Fig.-1).

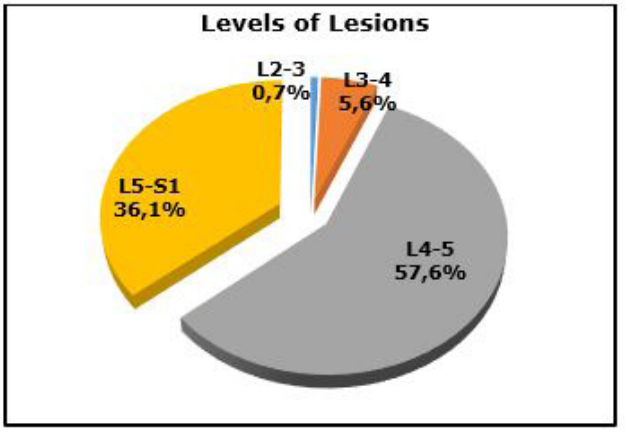

Figure-1. Distribution of lesions according to levels

Table-1. Demographic Characteristics of the Patients

		Min-Max	Mean±Sd
Age (years)		19 – 70	42,64±10,24
Duration of symptom before SELD (months)		0,17 – 48,0	7,17±7,16
		n	**%**
Sexuality	**Female**	79	54,9
	Male	65	45,1

Table-2. Demographic Characteristics according to Groups

		Group A (n=96)	Group B (n=48)	*p*
Age (years)	*Mean±Sd*	41,51±10,37	44,90±9,69	[a]***0,061***
	Min-Max (Median)	19-69 (40,0)	28-70 (44,0)	
		n (%)	**n (%)**	
Sexuality	**Female**	50 (52,1)	29 (60,4)	[b]***0,441***
	Male	46 (47,9)	19 (39,6)	

[a]*Student-t Test* [b]*Yates Continuity Correction Test*

The same procedure was performed in all patients under local anesthesia with mild sedation. Each patient was placed in prone position with spacer placed under the hips to decrease lumbosacral lordosis. After the identification of sacral hiatus with the aid of C-arm fluoroscope in a latero-lateral view, the sacrococcygeal ligament was punctured with a Tuohy needle. A guide wire, dilator and finally steerable video guided catheter were inserted into the sacrococcygeal ventral epidural space respectively. The position of the catheter in the ventral epidural space was verified in anterior/posterior and lateral views by fluoroscope. The first epidurogram was taken under A-P and L-L views administering radio-opaque dye in order to show filling defects and margins of herniation (Fig.-2.a).

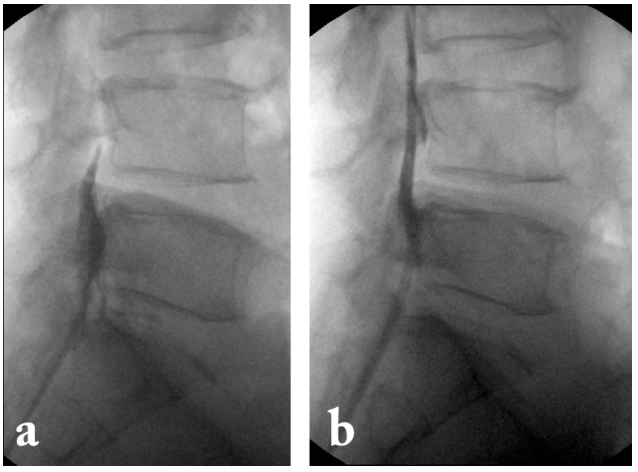

Figure-2. Fluoroscopic Images During Procedure **a.** The first epidurogram demonstrating the filling defects under L-L views administering radio-opaque dye **b.** Final epidurogram demonstrating flattened outline of herniation and decompression of the neural tissue

Direct visualization of the disc and neural tissue was provided by epiduroscope that was advanced into the end of the catheter and leveling of the epidural space was achieved by irrigation of physiological solution (Fig.-3.a). By using fiber optic scope, herniated disc was identified in patients of Group A (Fig.-3.b). Adhesions and mass effect of fibrotic tissue was also localized in group-B likewise. Adhesiolysis, degradation of granulation tissue and the shrinkage of herniated disc were rendered by the use of Ho:YAG laser. To prevent the complications of increased pressure, the total volume of irrigation water was restricted less than 200 cc. At the end of the operation, decompression of nerve root was observed by epiduroscope (Fig.-3.c) and a final epidurogram was performed using the same amount of contrast medium in order to demonstrate flattened outline of herniation and decompression of the neural tissue (Fig.- 2.b). We did "not" use corticosteroids and analgesic drugs except for very few patients who had severe leg pain and impatience during the procedure.

Pain scores were measured by the visual analog scale (VAS) for low back pain. Disability was evaluated by the Oswestry Disability Index (ODI). Efficacy was prospectively evaluated by an independent neurosurgeon at follow-up interviews on the first day and 6 months and 2 years after the operation. We analyzed the clinical data, median age, symptom duration, radiological findings, VAS and ODI scores. Statistical analysis was performed with NCSS (Number Cruncher Statistical System) 2007 Statistical Software (NCSS LLC, Kaysville, Utah, USA). Data were evaluated with definitive statistical methods.

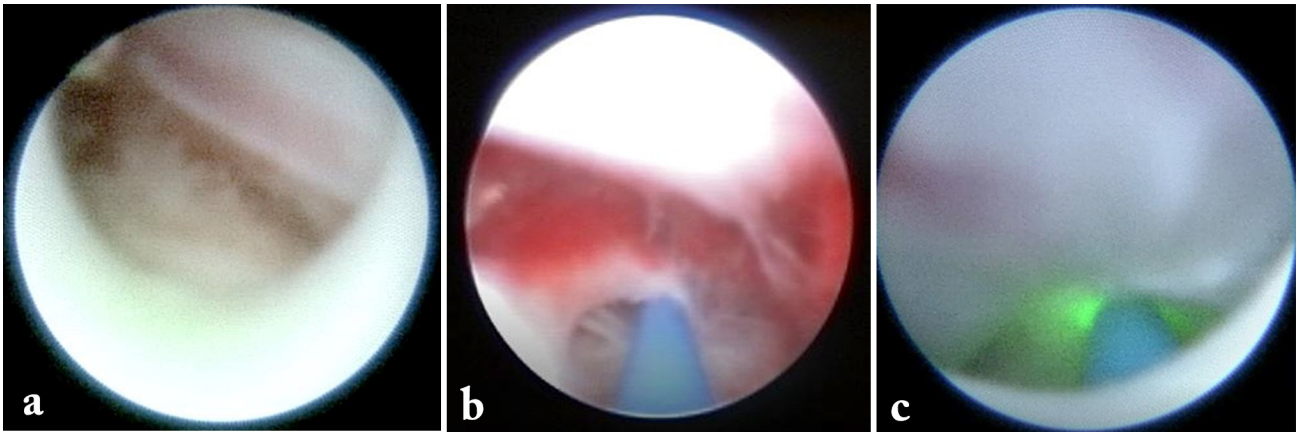

Figure-3. Epiduroscopic View **a:** Identification of herniated disc by epiduroscope **b:** Shrinkage of herniated disc by the use of Ho:YAG **c:** Decompressed root after the procedure

Student t test was used in comparison of variants of normal distribution between the groups. Variants, which do not show normal distribution, were analyzed with Mann Whitney U test in comparing the groups while Wilcoxon Signed Ranks test was used to evaluate the variants of same group. Yates Continuity Correction and Fisher Freeman Halton test were used in comparison of qualitative data. P value <0.05 was considered statistically significant.

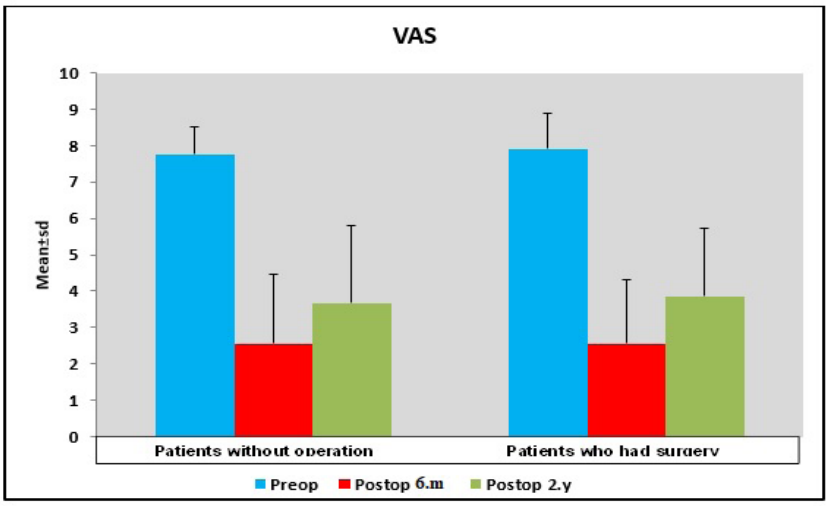

Figure-4. VAS Scores of patients in Group A and Group B

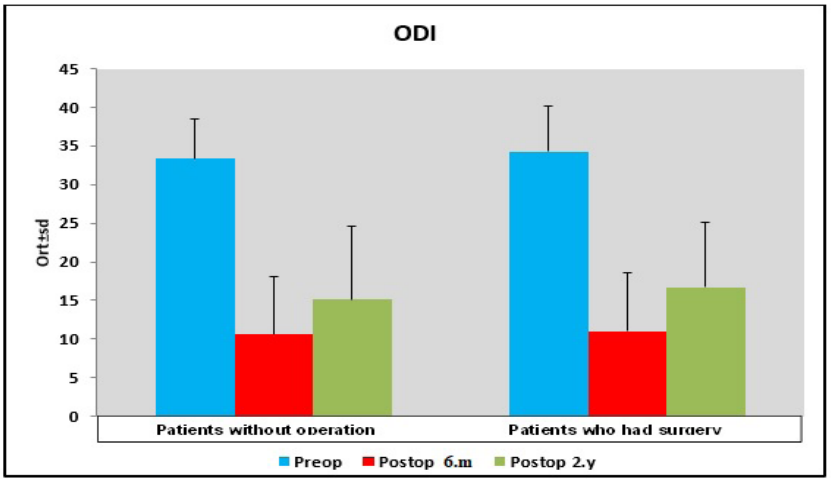

Figure-5. ODI Scores of patients in Group A and Group B

RESULTS

Patients were kept in bed for at least 4 hours after the intervention. For a postoperative observation period of 24 hours, all patients were admitted to the hospital. Significant improvement in low back and lower limb pain was observed on the first day after the procedure and all patients were discharged on the 1st day postoperatively.

Considering both groups, preoperative VAS scores ranged from 6 to 10 while postoperative VAS scores ranged from 0 to 9 on 6th month and 1 to 9 on 2nd year. During follow up, on 6th month after the procedure, there were significant decreases in both groups with regard to the VAS scores. The mean VAS score for Group A decreased to 2.55 ± 1.89 from 7.76 ± 0.76 (p<0.01), and for Group B, it has decreased from 7.92 ± 0.96 to 2.56 ± 1.75 (p<0.01) On the 2nd year, the mean VAS score was detected as 3.67 ± 2.13 for Group-A and 3.85 ± 1.86 for Group-B. The decreases after 2 years were also evaluated as significant (p<0.01) (Table-3, Fig.-4).

Median decrease in VAS scores for Group A and Group B were 5.21 ± 1.96 and 5.35 ± 1.77 on 6th month and 4.09 ± 1.68 and 4.07 ± 1.55 on 2nd year respectively and these data revealed statistical significance (p=0,001; p<0,01). VAS scores were not statistically different when compared between Group-A and Group-B (p>0,05).

Decreases in the average ODI scores were detected for both groups as well; from 33.33 ± 5.13 to 10.56 ± 7.47 on 6th month and 15.08 ± 9.51 on 2nd year in Group-A and from 34.23 ± 5.99 to 11.02 ± 7.65 on 6th month and 16.71 ± 8.39 on 2nd year in Group B. Mean decrease in ODI scores for Group A and Group B were 22.77 ± 8.69 and 23.21 ± 9.53 on 6th month and 18.25 ± 10.71 and 17.52 ± 9.53 on 2nd year respectively. The difference between the preoperative and postoperative ODI scores were also statistically significant on 6th month and 2nd year after the procedure (p=0,001; p<0,01). There was no statistical difference in ODI scores between two groups (p>0,05) (Table-4, Fig.-5).

Between two groups, there were also no statistical differences in composition of sex, age, mean duration of illness and levels of lesions (p>0,05).

Decompression of nerve root and decrease in mass effect of herniated disc were demonstrated with postoperative MRI (Fig.-6 and 7).

Eleven of the patients showed deterioration of motor or sensory deficits requiring surgery during the follow-up period. One patient presented urinary incontinence temporarily that recovered totally within 3 months. Three of them had headache and neck pain after the operation. We experienced dural puncture in 3 patients during procedure. It was relatively easy to introduce the epiduroscope via sacral hiatus in all patients except for 4 of them.

Table-3. Evaluation of VAS Scores according to Groups

VAS		Group A (n=96)	Group B (n=48)	[c]p
Preop	*Mean±sd*	7.76±0.76	7.92±0.96	**0.419**
	Median (min, max)	8 (6, 10)	8 (6, 10)	
Postop 6.m	*Mean±sd*	2.55±1.89	2.56±1.75	**0.758**
	Median (min, max)	2 (0, 8)	2.5 (0, 9)	
Postop 2.y	*Mean±sd*	3.67±2.13	3.85±1.86	**0.355**
	Median (min, max)	3 (1, 9)	4 (1, 9)	
	[e]p	**<0.001****	**<0.001****	
Preop-Postop 6.m	**Difference**	-6 (-9, 1)	-6 (-9, 2)	**0.694**
	[f]p	**<0.001****	**<0.001****	
Preop-Postop 2.y	**Difference**	-5 (-8, 2)	-4 (-9, 2)	**0.655**
	[f]p	**<0.001****	**<0.001****	
Postop 6.m-Postop 2.y	**Difference**	1 (-1, 4)	1 (-2, 3)	**0.107**
	[f]p	**<0.001****	**<0.001****	

[c]Mann-Whitney U Test *[e]Friedman test* *[f]Wilcoxon signed-ranks test* ***p<0.01*

Table-4. Evaluation of ODI Scores according to Groups

ODI		Group A (n=96)	Group B (n=48)	[c]p
Preop	*Mean±sd*	33.33±5.13	34.23±5.99	**0.468**
	Median (min, max)	34 (20, 46)	34 (24, 49)	
Postop 6.m	*Mean±sd*	10.56±7.47	11.02±7.65	**0.575**
	Median (min, max)	8 (0, 36)	10 (0, 40)	
Postop 2.y	*Mean±sd*	15.08±9.51	16.71±8.39	**0.146**
	Median (min, max)	11 (4, 42)	16 (4, 42)	
	[e]p	**<0.001****	**<0.001****	
Preop-Postop 6.m	**Difference**	-24 (-42, 3)	-24.5 (-38, 16)	**0.606**
	[f]p	**<0.001****	**<0.001****	
Preop-Postop 2.y	**Difference**	-21 (-38, 15)	-20 (-45, 18)	**0.368**
	[f]p	**<0.001****	**<0.001****	
Postop 6.m-Postop 2.y	**Difference**	4 (-7, 17)	6 (-8, 18)	**0.013***
	[f]p	**<0.001****	**<0.001****	

[c]Mann-Whitney U Test *[e]Friedman test* *[f]Wilcoxon signed-ranks test*
**p<0.05* ***p<0.01*

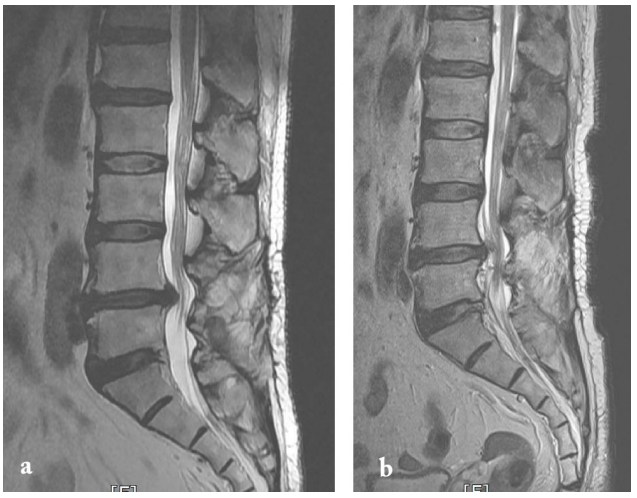

Figure-6. a, b. Sagittal MRI demonstrating the herniation before and after the procedure respectively

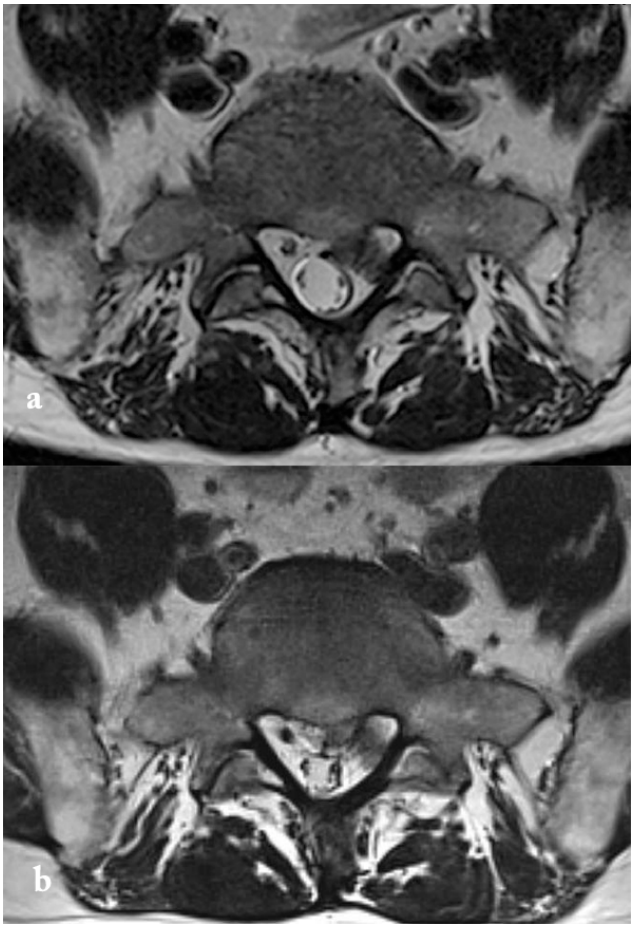

Figure-7.a, b. Axial MRI demonstrating the herniation before and after the procedure respectively

DISCUSSION

In recent years, several minimal invasive procedures have been developed and reported with varying success [7]. With each passing day, new instruments and techniques provide more alternatives for conservative procedures.

Spine surgery presents as a complicated system overlaps with anatomy, physiology, statics, mechanics etc. Many disciplines work together in an area. When we deal with the spine, it is important to imagine new relationships between anatomical structures.

Anatomy does not examine only the tissues just lined up in order to make up different layers; it studies on what they do with each other and which combinations they form. Trans-Sacral Epiduroscopic Laser Decompression originates from different ways of thinking anatomy and mechanics of the spine. It offers a totally different way to cure lumbar disc herniation. Its main goal is to use anatomy for searching "natural pathways" to reach the disease.

Sacral hiatus provides an extraordinary way to reach disc pathologies through epidural space allowing longitudinal approach [12]. Since discal pathologies typically occur within epidural space, epiduroscopy seems to be a preferable approach in this manner.

Several studies have demonstrated the results of epiduroscopic disc decompression in recent years. There are two important clinical series of epiduroscopic procedure using laser. One of them is a report of 154 cases reviewed at 8 participating centers [11]. The other one is a recent prospective case series study that reviews the clinical outcomes of 250 patients [10]. Both of these reports have revealed the technical details of epiduroscopic laser decompression for herniated discs. Generally, we have followed the same methodology in our cases. We have observed significant improvement in low back pain and lower limb pain in our patients with regard to the VAS and ODI scores after the procedure.

Previously, epiduroscopic procedures have been considered to be indicated generally for peridural fibrosis following spinal procedures and not a primary alternative for disc herniation [16]. As time passed by and experience enlarged, epiduroscopic laser disc decompression have become a relatively popular method for most cases. It was reported that epiduroscopic laser neural decompression provided satisfaction (more than 85 %) for patients with chronic low back pain and/or leg pain regardless of previous back surgery history [8]. In our study, there were no statistically significant differences between two groups as well.

However, it is obvious that this method has some limitations. It is not possible to remove herniated disc totally, as we do

via microdiscectomy. Postoperative MRI usually reveals residual disc herniation (Figure-7.d). Despite the favorable statistical results, during the follow-up period, we had to do microdiscectomy for 11 patients who showed deterioration of motor or sensory deficits. It is well known that patients may require surgery again even after open procedures. Nevertheless, 11 patients of 144 seems to be significantly higher when compared with microdiscectomy. We hope that there will always be such cases and some other advancing instruments in near future could resolve the problem of residual or recurrent disc herniation.

Lee et al. have reported that have removed sequestrated herniated nucleus pulposus using 1 mm forceps [10]. It seems to be a novel method which could be a part of SELD application after particular experience.

Avellanal et al. have systematically reviewed the complications and side effects of epiduroscopy [1]. They have reported that dural puncture and overpressure due to fluid injection were the main causes of complications. Complications related to epiduroscopy were usually minor and mostly transient neurological symptoms like headache, neck pain, dizziness, etc. Also some rare complications such as iatrojenic intradural lumbosacral cyst were reported following epiduroscopy [14].

In our cases, we have performed epiduroscopy under light sedation to detect these symptoms immediately. However, we had patients with headache and dural puncture who had uneventful recovery with conventional analgesics. Moreover, one patient had urinary incontinence because of neurogenic bladder and he recovered within 3 months. We have experienced that anatomical orientation through epiduroscope and confirmation of the tissues is not always easy. One of the main goals of SELD is the combination of epiduroscopy and fluoroscopy. The images provided by these two techniques lead to a much more comprehensive evaluation of spinal pathologies. However, it was suggested that there could be marked discrepancies between imaging and intraoperative findings of epiduroscopy [13]. Magnetic resonance imaging of this patient with urinary incontinence revealed no newly developed lesions, such as residual/aggravated disc herniation, hematoma or infection. After investigating all factors, based on the results of the clinical evaluation, we have concluded that the patient had probably micro injury in the sacral nerve roots during laser firing. In a report of cadaver study, it was suggested that laser usage during epiduroscopy might increase the potential for unwanted complications because of the ablative effect on nerve tissue even at the lowest laser power [9]. Another possibility for this patient was thought to be the mechanical injury by steerable catheter in the epidural space [3].

CONCLUSIONS

No description of scientific method could possibly be broad enough to encompass all the approaches and methods used by spinal surgeons. There are no useful and exception-free methodological rules governing the progress of surgery. For SELD is a relatively new procedure, we consider that further studies revealing the results of long-term follow-up are needed. We conclude that for selected cases of lumbar disc herniation, SELD appears to be a preferable treatment modality for low back pain or radicular pain.

Conflict of Interest: No potential conflict of interest relevant to this article was reported.

Informed Consent: Informed consent was obtained from all individual participants included in this study.

REFERENCES

1. Avellanal M, Diaz-Reganon G, Orts A, Gonzalez-Montero L, Ares JDA. Epiduroscopy: Complications and Troubleshooting. *Tech Reg Anesth Pain Manag* 2014; 18: 35-39.
2. Blomberg R. A method for epiduroscopy and spinaloscopy. Presentation of preliminary results. *Acta Anaesthesiol Scand* 1985; 29: 113–116.
3. Chang MC. Sacral root injury during trans-sacral epiduroscopic laser decompression: A case report. Medicine (Baltimore) 2017; 96(42): e8326.
4. Choy DS. Percutaneous laser disc decompression (PLDD): twelve years' experience with 752 procedures in 518 patients. *J Clin Laser Med Surg* 1998; 16: 325-331.
5. Hayek SM, Helm S, Benyamin RM, Singh V, Bryce DA, Smith HS. Effectiveness of spinal endoscopic adhesiolysis in post lumbar surgery syndrome: a systematic review. *Pain Physician* 2009; 12: 419-435.
6. Heavner JF, Cholkhavatia S, Kizelshteyn G. Percutaneous evaluation of the epidural and subarachnoid space with the flexible fiberscope. *Reg Anesth* 1991; 15S1: 85.
7. Hussain NS, Perez-Cruet MJ. Complication management with minimally invasive spine procedures. *Neurosurg Focus* 2011; 31: E2.
8. Jo D, Kim ED, Oh HJ. The comparison of the result of epiduroscopic laser neural decompression between FBSS or not. *Korean J Pain* 2014; 27(1): 63-67.
9. Jo D, Lee DJ. The extent of tissue damage in the epidural space by ho /yag laser during epiduroscopic laser neural decompression. *Pain Physician* 2016; 19(1): E209-214.
10. Lee SH, Lee SH, Lim KT. Trans-sacral epiduroscopic laser decompression for symptomatic lumbar disc herniation: a preliminary case series. *Photomed Laser Surg* 2016; 34(3):121-129.
11. Richter EO, Abramova MV, Cantu F, DeAndres J, Lierz P, Manchiaro PL, Van Buyten JP, Kim JD, Jang JH, Jung GH, Kim JY, Jang S, Salgado H, Salgado P, Alo KM.. Anterior epiduroscopic neural decompression: Eight-center experience in 154 patients. *Eur J Pain Supp* 2011; 5: 401–407.

12. Richter EO, Abramova MV, Mussell J. Current trends in minimally invasive spinal surgery. *J Neurosurg Rev* 2011; 1(Suppl.-1): 1–13.
13. Ruetten S, Meyer O, Godolias G. Epiduroscopic diagnosis and treatment of epidural adhesions in chronic back pain syndrome of patients with previous surgical treatment: first results of 31 interventions. *Z Orthop Ihre Grenzgeb* 2002; 140: 171-175.
14. Ryu KS, Rathi NK, Kim G, Park CK. Iatrogenic intradural lumbosacral cyst following epiduroscopy. *J Korean Neurosurg Soc* 2012; 52(5): 491-494.
15. Schütze G, Kurtze H. Percutaneous investigation of the epidural space using a flexible endoscope: a contribution to epiduroscopy. *Reg Anesth* 1993; 18(1S): 24.
16. Shim KW, Park EK, Kim DS, Choi JU. Neuroendoscopy current and future perspectives. *J Korean Neurosurg Soc* 2017; 60(3): 322-326.