Trans-Sacral Epiduroscopic Laser Decompression (SELD) for Low back pain secondary to Herniated Lumbar Disc in the Philippines: A Case Report and Review of Literature

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ABSTRACT

LBP has a lifetime prevalence ranging from 54% to 80%, an annual prevalence of 15-45%, and a point prevalence of 30%. Lumbar radicular pain often results from a Lumbar disc herniation. With recent advances in technique and access in instrumentation, minimally invasive spine surgery has ushered in a renaissance of spine care. SELD has promising positive effects in controlling LBP following HLD.

This is a case of a 26 year old with radicular LBP of 2 years duration secondary to HLD, underwent conservative management of LBP but offered no relief and improvement, hence he became the case for the pioneering procedure of SELD in the Philippines. Immediate and significant improvement in the patient was noted. SELD was proven to be an effective therapeutic modality for patients with LBP secondary to HLD.

Keywords: *Herniated Lumbar Disc (HLD), Trans-Sacral Epiduroscopic Laser Decompression (SELD), Minimally Invasive Spine Surgery (MISS), Low back pain (LBP), Epiduroscopy*

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INTRODUCTION

Trans-sacral epiduroscopic laser decompression (SELD) is reported to have strong positive effects in controlling low back pain (LBP) or radicular pain following Herniated Lumbar Disc (HLD). This is one of the advances in practice of Minimally Invasive Spine Surgery (MISS), a less invasive surgical alternative to traditional open surgery.[1]

The endoscope was first invented by Adolf Kussmaul in 1868.[2] In 2003, Ruetten used epiduroscopy to guide intervention in 93 participants with chronic back pain syndrome.[3]

Epiduroscopy, also known as epidural spinal endoscopy, requires the insertion of a fiberoptic endoscope into the epidural space through the sacral hiatus to treat a symptomatic herniated disc that has failed to respond to conservative treatment. In recent years, considerable progress has been made in the area of epiduroscopic diagnosis and treatment of spinal lesions using a laser as a less invasive surgical alternative to traditional open surgery for lumbar disc herniation. The remarkable mechanical and technical advances of these medical optical devices have allowed more detailed imaging during procedures, which allows surgeons to see things in new ways and leads to better and more successful results. Epiduroscopy accesses through the body's natural opening, namely the sacral hiatus, to permit direct visualization of lumbar epidural lesions and surrounding structures with minimal impact on patient's musculoskeletal structures, using a flexible catheter and epiduroscopy. This steerable flexible epiduroscopic laser system is used to confirm epidural pathologic findings, and provide precise and directed therapy at the same time.[4]

In this case report, we attempt to elucidate the mechanism and use of a minimally invasive procedure for the management of HLD specifically the SELD in the Philippine setting, to provide surgeons with ocular and MRI proof of the value of SELD as one of the effective treatment modalities for HLD, and understand the mechanism of pain relief in SELD ***(Table 1)*** and the indications and contraindications ***(Table*** 2).

Table 1. Mechanism of Pain Relief [8]

Decrease size of herniated lumbar disc
Fragmentectomy (neural Decompression)
Mechanical Adhesiolysis of epidural space
Burn away the Sinu-vertebral nerve, ingrowth nerve
Reduce the inflammatory mediators by irrigation

Table 2. Indications and Contraindications of SELD [8]

Indications	Contraindications
Lumbar disc herniation, up migrated and down migrated	Central Stenosis.
Annular tear Syndrome.	Foramina Stenosis
Adhesiolysis for postoperative syndrome	Calcified lesion
Discal Cyst	Extraforaminal HNP
Biopsy, Diagnosis	Instability, listhesis

Patient Information

Patient is a 26 year old Male, Filipino, Nurse from Legazpi, Albay, Philippines, came in the hospital with a complaint of low back pain of 2 years duration described to be 3-8/10 on Pain Score, limiting his movement and functionality at work, it was described to be sharp non radiating, localized at the lumbar area, noted upon prolonged sitting and standing, aggravated by flexing and lifting heavy objects, relieved by lying down. The low back pain was noted to be gradually progressing which prompted consult to a physician, radiographic xray of the lumbosacral area done revealed normal findings. Several months had passed with the persistence of symptoms, patient now notices paresthesias at the L4, L5 distribution on the R lower extremity. Rehab consult done, for which patient was advised regular session with PT for 3 months, 2-3x per week for upperback and core body exercises offered no relief of symptoms. Consult done at a Neurosurgeon, patient was advised to do an MRI which revealed Disc bulge, L3/L4 and L5/S1 with mild thecal sac indentation and mild bilateral neural foramina narrowing, patient was then scheduled to be the 1^{s} patient for SELD procedure in the Philippines at UERMMMCI. Upon General Survey, patient was awake, not in distress, ambulatory, with stable vital signs, Wt: 72 kg Ht: 167 cm BMI: 25 kg/m2. Unremarkable General Physical Examination, motor strength of 5/5 all extremities with good bulk and tone, (+) sensory level at L4 and L5 right, for light touch and pin prick. Patient had intact joint, vibration and position sense both lower extremities. Upon examination of the spine, no gross anatomic deformity, no scoliosis, and no tenderness noted. However, pain was notable upon flexion, relieved by extension (+) SLR R DRE: good sphincter tone, (+) bulbocavernosus reflex. Lumbosacral radiograph revealed: Intact Disc Spaces, straigthening of the lumbar lordosis (Figure 1 A,B), Lumbosacral MRI revealed: Disc bulge, L3/L4 and L5/

S1 with mild thecal sac indentation and mild bilateral neural foramina narrowing. An Oswestry Low Back Pain Disability Questionnaire was used to evaluate low back pain, with an ODI of 21 categorized as Moderate disability.

***Figure 1**. A. AP view,intact disc spaces (arrow); B. Lateral View, straigthening of the lumbar lordosis C. T1W Disc Bulge L3/L4 and L5/S1 (Arrow) with mild thecal sac indentation and mild bilateral neural foramina narrowing, Lumbar lordosis is maintained. No spondylolisthesis observed. There is no loss of vertebral body and intervertebral disc height, no facet joint nor ligamentum flavum hypertrophy. The rest of the visualized soft tissues are unremarkable. D. T2W Disc Bulge L3/L4 and L5/S1 (Arrow)*

Inclusion and Exclusion Criteria.[10]

Inclusion Criteria
1. Contained disc herniation, or discal or synovial cyst demonstrated on MRI or CT
2. Neurological findings referring to a single nerve root, leg pain of greater intensity than back pain, and a positive straight-leg-raising test
3. No improvement after 2 weeks of conservative treatment

Exclusion Criteria
Hemorrhagic diathesis
Infection
Spondylolisthesis
Spinal stenosis
Previous surgery at the indicated disc level
Significant psychological disorder
Significant narrowing of the disc space Pathologic findings at the sacrum epidural space

Patient Selection

Preoperative multidisciplinary measures were done including radiographic, clinical, as well as basic laboratory results. A precise medical history and the correlation of symptoms with MRI findings were done. The patient was provided with an informed consent explaining the procedure and its probable risks and complications. Preoperative evaluation was done by the anesthesia service.

The patient was selected based on the inclusion criteria mentioned above, low back pain and radicular pain of the lower extremities caused by HLD proven by MRI, with refractory pain even after medical and physical therapy for > 2 weeks, a contained disc herniation demonstrated on MRI.

Staff and Manpower

Procedure was headed by a trained MISS surgeon specifically for SELD procedure, assisted by a trained SELD nurse from Korea, second assist was a Neuro-surgery resident, 2 newly trained nurses assisted in preparing the laser and tower, Anesthesiologist for IV sedation and intraoperative anesthesia care, and a Radiology technician manning the C ARM.

Materials and Equipment

The procedure was performed using the Ho:YAG laser (Sphinx Laser Machine), the laser has a 550 nm wavelength, and 0.4 mm depth of penetration. To deliver the laser and a 15-K pixel flexible fiberoptic scope with a 1.2 mm diameter to the epidural space, a video guided catheter (VGC) with a 3.0mm outer diameter (3mm Video Guided Catheter) was used. It has a radiopaque shaft with 1.3mm dual working channels and dual infusion ports for infusing saline for irrigation. The epiduroscopic equipment consisted of an epidural endoscope, a video camera system, and a video monitor.

Procedure

The procedure was performed with the patient under local anesthesia, utilizing lidocaine with epinephrine over the sacral hiatus, and the patient was monitored by an anesthesiologist. The patient was placed in the prone position on a radiolucent operating table (Figure 2.A). All the time the patient was awake, allowing a free conversation with the anesthesiologist and surgeon throughout the procedure.

A 5 mm skin incision was made over the sacral hiatus using a #11 blade. The sacrococcygeal ligament was punctured with a Tuohy needle under fluoroscopic guidance followed by a guide wire and dilator, and the Myelotec spinal introduction system was inserted into the sacrococcygeal ventral epidural space. Subsequently, a 3.0mm steerable VGC was introduced (Figure 2.D). A C-arm fluoroscope was used to provide images in both the anterior/posterior and lateral views to verify the position of the catheter in the ventral epidural space (Figure 2.B,C)

Through the, epiduroscope and the Ho:YAG laser were advanced into the end of the catheter to visualize the epidural space and perform HNP ablation. After introducing the VGC, fluoroscopy and epiduroscopy were used to confirm that the tip of the catheter was located at the most inferior part of the targeted disc, covering the PLL.

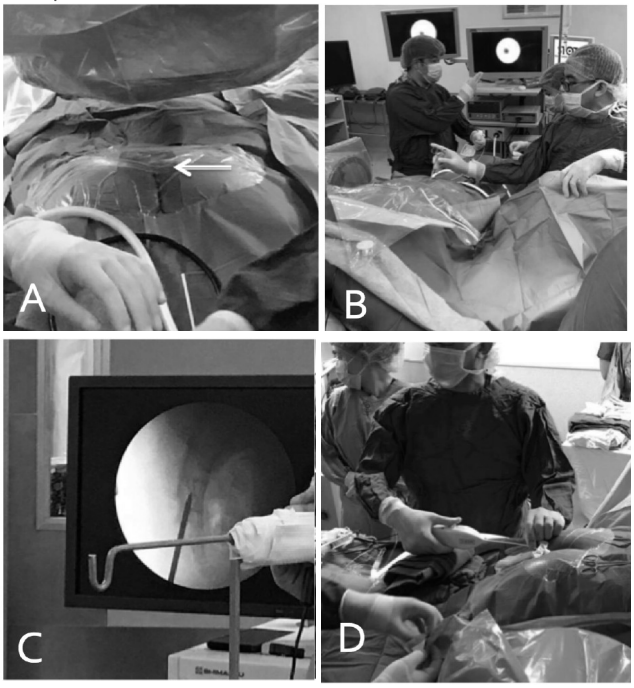

Figure 2: A. Prone Position, with Sacral Hiatus entry point (Arrow) B. Localization with C ARM guidance C. C ARM trocar insertion, D. 3.0mm steerable VGC was introduced

Under direct vision with epiduroscopy, adhesiolysis and morcellation technique was used to by the Ho:YAG laser (Figure 3. A,B,C). After the surgeon was able to sufficiently decompress the ruptured disc using the laser. The floating and sequestrated HNP was removed using 1mm forceps. The ruptured discs were decompressed until the epiduroscopic images confirmed nerve root decompression, the epidural space between the dura and bulging PLL with an underlying HNP became wider. The wound was closed by one-point skin suture. The suture was removed 1 week after SELD.

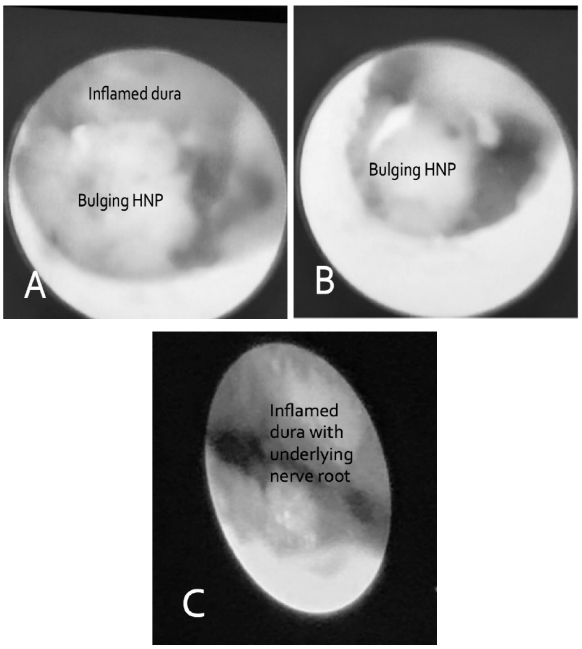

Figure 3 A. Initial epiduroscopic view (white) bulging HNP, (red) inflamed dura with nerve root B. Midpoint during Laser Application C. Exposure of Inflamed root

Follow up and Outcome

Immediately post op, from preoperative SLR at 250 noting significant improvement in SLR >600 post operatively (Figure 4. A,B). On the first post-operative day without any pain medications taken, the patient noted relief of back pain, patient was able to ambulate without assistance, able to flex his hips without any pain. With an ODI score of 10, and an Excellent score for MacNab, denoting no pain and restriction to activity. Post-operative site was dry, with no signs of hematoma or CSF leak. Repeat MRI done on the first postoperative day revealed decompression of the spinal canal at the level of L3/L4, L5/S1. Subsequent follow up done at 2 months and 6 months noted no recurrence of back pain or any radicular pain.

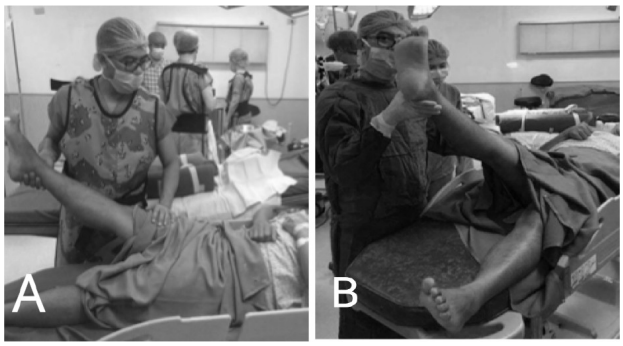

***Figure 4**: A. Preop SLR at 25 degrees B. Postop SLR no pain >60 degrees raised*

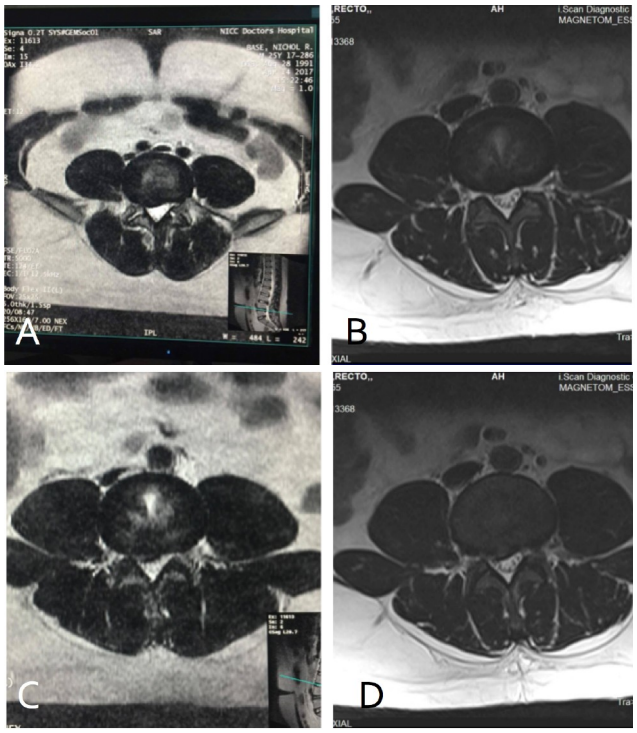

***Figure 5**: A. Preop MRI L3/L4 disc level B. Postop MRI MRI L3/L4 disc level C. Preop MRI L5/S1 disc level D. Post op MRI L5/S1 disc level*

Discussion

With recent advances in technique and access instrumentation, minimally invasive spine surgery has ushered in a renaissance in spine care. As more patients receive minimally invasive spine surgery treatments, stronger long-term outcome data are supporting this change in practice pattern. [5]

Patient outcomes are improved compared with traditional open surgery and cost are reduced, partly due to reduced hospital stays and recovery times. Approach-related morbidity is significantly reduced because normal anatomical structures are preserved to a greater extent, reducing the incidence of delayed progressive deformity and degenerative changes. Minimally invasive surgical procedures of the spine can be just as efficacious as traditional open procedures with respect to the operative pathology. Unnecessary approach dissection and ligamentous and muscular disruption are minimized, potentially leading to a reduced incidence of repeated operations and scar formation. [6]

The epiduroscopic laser method also showed that lumbar disc decompression resulted in well-controlled pain and improved quality of life during the follow-up period after the procedure in a previous study that included eight centers.[7]

The advantages of SELD are as follows: A good view of Anatomical structures before removal of disc fragment, these includes the nerve root, disc, dura, adhesions and inflammation; for small amount of disc to be removed, there is a lower rate of subsidence; there are no additional, unnecessary annulus injury or nucleus pulposus injury leading to a lower rate of recurrence; the procedure can also be used as a multi level diagnostic and therapeutic modality; and lastly it can be used to identify adhesion and at the same time ablate of sinuvertebral nerves. [8]

In the study of Jung-Woo Hur et al, Reports the preliminary clinical and radiologic results of SELD for the treatment of LDH in a single center experience. There were twenty-one patients who underwent SELD for the treatment of single-level LDH were retrospectively evaluated for minimal 12-month follow-up. Outcome measures used were visual analog scale (VAS) scores for back and leg pain and functional status was measured with Oswestry disability index (ODI). Radiologic outcome were evaluated by comparing the changes of disc size on MRI scans, preoperatively, postoperatively and at final follow-up. They have found out that there significant improvements of VAS score and ODI after SELD for LDH with back and leg pain at minimal 12 months of follow-up. Postoperative MRI scans revealed significant decrement of the disc size and reduction of neural compression. [9]

In the Prospective case series of Sung Ho Lee et al, which intends to determine the outcomes of SELD with regard to reducing pain and improving the functional status in patients with LBP and radiculopathy caused by definitive neural compression confirmed by MRI. A total of 250 patients with LBP and simultaneous radiculopathy underwent SELD by applying a

Ho:YAG laser. Clinical outcomes were evaluated using the VAS score for LBP, and radiculopathy and functional status were measured using the ODI. Patients showed good clinical outcomes in the early period and at 3 months after the procedures, and there were no significant complications affecting the clinical outcomes, such as nerve damage caused by thermal injury, infection, or post- operative hematoma. They have concluded that the VAS score and ODI significantly improved after SELD in HNP patients with LBP and radiculopathy. Postoperative MRI showed a notable decrease in the HNP size and a reduction in neural compression. SELD is suggested to be an effective therapeutic modality for patients with symptomatic HNP. [10]

Epiduroscopy permits direct visualization of the epidural space with minimal impact on patients' musculoskeletal structures. The higher the resolution of the epiduroscope, the better the visualization of anatomical structures in the narrow epidural space and closer the monitoring of the laser, which enables securing the safety of the nerve root. [10]

The goal of the approach is to go to the ventral epidural space simply because you will find most of the pathology in the degenerative spine. The presence of the meningo vertebral ligaments will be an obstacle in navigating the spinal epidural space. [8]

Morcellation is a surgical method used for division and removal of large masses of tissues during epiduroscopic surgery. In Epiduroscopic fragmentectomy the fragment is minced up, or morcellated, into smaller pieces inside the fragment space in order to extract from the epidural space. [8]

The concept of SELD is based on the sacral hiatus introduction of epiduroscopy and the insertion of a fiberoptic laser system into the ventral lesion of the epidural disc space. This procedure enables the vaporization of discs in the herniated part, cauterization of the sinuvertebral nerve, lysis of adhesion nearby the nerve root, and irrigation of inflammation. Laser decompression of HNP was limited between the PLL and posterior annulus to avoid doing more damage to posterior annulus. A damaged posterior annulus is prone to cause herniation of the nucleus to recur. Laser application is performed with an optic fiber that is placed directly into the herniated disc, which generates heat, reduces the water content of the disc, and changes the protein structure of the disc, permanently decreasing its ability to absorb water. Slow and continuous irrigation with cool saline allowed visualization of the anatomical structures by preventing distension of the epidural space, and thermal damage to the nerves was significantly reduced by using the Ho:YAG laser and irrigating bleeding during the procedure. The most important aim of the endoscopic procedure is to avoid bleeding. We confirmed the anatomical structures by endoscope and avoided the blood vessels, especially arteries. However, during the laser decompression, venous bleeding occurred sometimes. If there was bleeding during the procedure, we secured the endoscopic view by continuous cool saline irrigation. After the procedure, expansion of thecal sac and other structures compressed bleeding points.[10]

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