Endoscopic Surgery for Lumbar Disc Disease: Our Experience in 136 Cases

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ABSTRACT

Introduction: Endoscopic spine surgery has grown exponentially worldwide in recent years and is mainly used for the treatment of disc herniation and spinal stenosis. Few studies addressing this technique have been published in our country; therefore, we considered it relevant to report our experience. **Materials and Methods:** A retrospective evaluation was conducted of patients who underwent endoscopic discectomy between December 2022 and December 2024, with a minimum follow-up of four months. The following variables were analyzed: sex, age, affected level and side, surgical approach, pre- and postoperative Visual Analog Scale (VAS) scores, presence or absence of neurological deficit, use of a surgical drill, operative time, complications, and disc recurrence. **Results:** A total of 136 patients were evaluated (mean age: 47 years), with a mean follow-up of 11.8 months. Radicular and lumbar VAS scores showed significant improvement at 30 days after surgery ($p < 0.001$). Seven cases of disc recurrence were recorded, along with one dural tear, two transient neurological deficits, and one postoperative hematoma. **Conclusions:** Endoscopic discectomy is a safe technique that achieves clinical outcomes comparable to those of traditional surgical approaches, with less tissue aggression and a low complication rate. Our results are consistent with those reported in the literature.

Keywords: Endoscopy; disc herniation; discectomy.
Level of Evidence: IV

Cirugía endoscópica para la enfermedad discal de la columna lumbar. Nuestra experiencia en 136 casos

RESUMEN

Introducción: La cirugía endoscópica de columna ha crecido exponencialmente durante los últimos años, en el mundo, y se emplea principalmente para el tratamiento de hernias de disco y estenosis. Se han publicado pocos estudios sobre esta técnica en nuestro país, por lo que consideramos interesante comunicar nuestra experiencia. **Materiales y Métodos:** Se evaluó retrospectivamente a pacientes sometidos a una discectomía endoscópica entre diciembre de 2022 y diciembre de 2024, y con un seguimiento mínimo de 4 meses. Se analizaron las siguientes variables: sexo, edad, nivel y lado afectado, vía de acceso, puntajes pre y posoperatorios de la escala analógica visual, presencia o no de déficit neurológico, empleo de taladro quirúrgico, duración del procedimiento, complicaciones y recidiva discal. **Resultados:** Se evaluó a 136 pacientes (edad promedio 47 años) con un seguimiento promedio de 11.8 meses. Los puntajes radicular y lumbar de la escala analógica visual mejoraron significativamente a los 30 días de la cirugía ($p <0,001$). Se registraron 7 recidivas discales, una rotura del saco dural, 2 déficits neurológicos transitorios y un hematoma posoperatorio. **Conclusiones:** La discectomía endoscópica es una técnica segura, y logra resultados clínicos similares a los de otras técnicas tradicionales, pero con un menor nivel de agresión y una baja tasa de complicaciones. Nuestros resultados son similares a los reportados en otros estudios.

Palabras clave: Endoscopia; hernia; discectomía.
Nivel de Evidencia: IV

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How to cite this article: Yeregui S, De Zavalía M, Ziraldo M, Lanari Zubaiur F, Barbieri P, Chavez A, Gobbi E. Endoscopic Surgery for Lumbar Disc Disease: Our Experience in 136 Cases. *Rev Asoc Argent Ortop Traumatol* 2026;91(1):23-32. https://doi.org/10.15417/issn.1852-7434.2026.91.1.2184

INTRODUCTION

The history of percutaneous endoscopic spine surgery dates back to 1989, when Schreiber, Suezawa, and Leu[1] added discoscopy to the percutaneous discectomy first described by Hijikata in 1975 and later popularized by Kambin, who introduced the description of the safety triangle that bears his name for accessing the intervertebral disc in 1986.[2] Subsequently, Mayer and Brock adopted this technique and were the first to compare endoscopic discectomy with microdiscectomy in 1993. Overall results were similar; however, patients who underwent the endoscopic procedure returned to work earlier. They also concluded that endoscopy was an appropriate procedure for patients with contained disc disease and small subligamentous disc herniations.[3] In 1999, Yeung popularized Kambin's approach by describing a surgical technique in which discectomy begins inside the disc and progresses outward in search of the herniation. This inside-out technique is associated with a higher risk of recurrence due to indirect visualization and annular damage.[4] For this reason, in 2005, Ruetten et al. refined the surgical technique and described the transforaminal and extraforaminal approach, which avoids entering the disc and directly targets the herniated fragment, thereby reducing residual pathology and recurrence.[5] Ruetten et al. also described the interlaminar approach, which is currently one of the most widely used techniques in endoscopic spine surgery.[6]

At present, endoscopic spine surgery is indicated for a wide range of spinal disorders, including intervertebral disc herniation, whether central, paracentral, foraminal, extraforaminal, or migrated, spinal stenosis, infectious spondylodiscitis such as pyogenic or epidural abscess, and revision surgeries such as recurrent disc herniation, interbody cage displacement, or bone cement leakage into the spinal canal.[7]

These indications are gradually expanding to include more complex procedures, such as interbody fusion and the treatment of spinal tumors.[7]

A large number of international studies have been published analyzing and reporting outcomes in patients undergoing endoscopic spine surgery, particularly for disc pathology. Many of these studies include comparisons with traditional surgical techniques. In Argentina, however, reports on this technique remain scarce.

The aim of this study was to analyze the outcomes achieved by our surgical team in patients who underwent endoscopic discectomy over a period exceeding two years.

MATERIALS AND METHODS

A descriptive and observational study was conducted with retrospective analysis of 136 patients who underwent endoscopic spine surgery between December 2022 and December 2024. All procedures were performed by the same surgical team at five surgical centers in the Autonomous City of Buenos Aires, Argentina.

Inclusion criteria were patients with no prior history of spine surgery who underwent lumbar endoscopic discectomy and had a minimum follow-up of four months. Exclusion criteria included patients with a history of spine surgery or those who underwent endoscopic procedures for other conditions, such as spondylodiscitis, recurrent disc herniation, or spinal stenosis.

Three transforaminal endoscopes were used: Elliquence® (Boca Raton, FL, USA), Joimax® (Irvine, CA, USA), and Hanover® (Whippany, NJ, USA), as well as an iLESSYS PRO® interlaminar endoscope (Joimax, Irvine, CA, USA). The selection of the endoscope was based solely on insurance coverage and availability, as all systems have similar technical characteristics. When bone resection was required to access the disc herniation, a Primado2® surgical drill (NSK, Shinagawa-ku, Tokyo, Japan) with a head compatible with the aforementioned endoscopes was used.

The following variables were recorded: sex, age, affected level and side, preoperative and postoperative visual analog scale scores, presence or absence of neurological deficit, surgical approach, use of a surgical drill, duration of the procedure, complications, and disc recurrence.

Surgical Technique

Transforaminal Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position, reducing lumbar lordosis to increase the cephalocaudal diameter of the foramen to be addressed. A posterolateral or lateral approach is selected according to the surgical objective. The height of the iliac crests and the position of the kidneys are considered as relevant anatomical landmarks. Using fluoroscopy, a strict anteroposterior view of the target level is obtained, ensuring that both endplates are parallel, the pedicles are equidistant, and the spinous process is centered. The midline is marked, as well as a lateral projection line over the disc with a 30-degree cephalocaudal angulation. A lateral fluo-

roscopic view is then obtained, and the entry point is marked, which may be located between the tip of the spinous process and the inferior articular facet. An 18-gauge spinal needle is introduced under anteroposterior fluoroscopic guidance and advanced to the pedicular midline, where resistance is typically felt, indicating disc entry. Position is confirmed with a lateral view. A guidewire is then inserted, followed by sequential dilators, placement of the working cannula, and insertion of the endoscope. The extruded disc fragment is identified and removed according to its location (Figure 1).

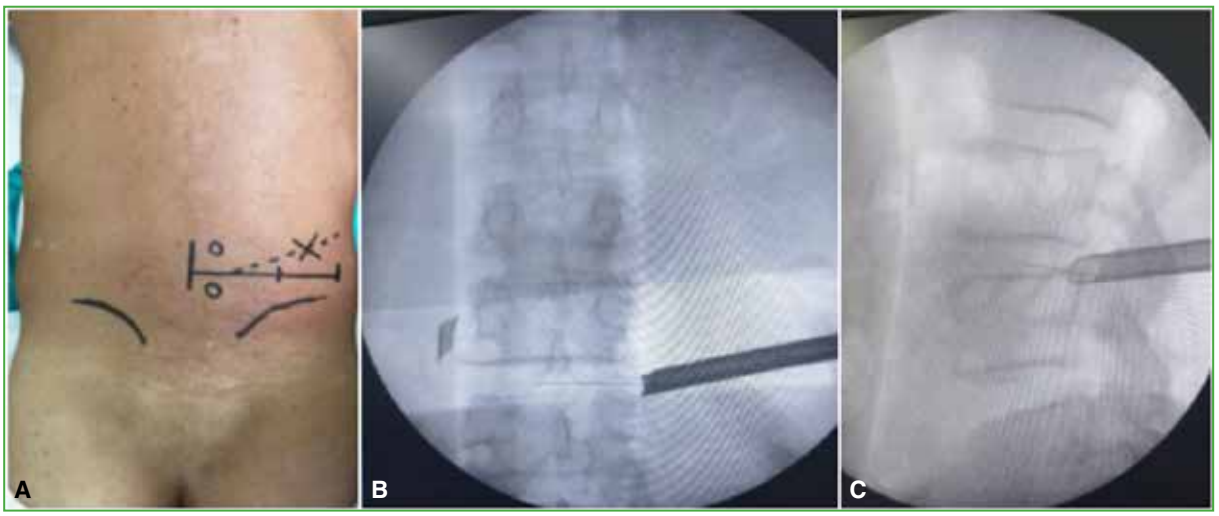

Figure 1. A. Marking of the midline and the lateral projection line on the disc at a 30° angle in the cephalocaudal direction. **B and C.** Anteroposterior and lateral fluoroscopic views showing the correct position of the guide pin.

Extraforaminal Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Unlike the transforaminal technique, a posterolateral approach is used and planned based on preoperative imaging (Figure 2), as extraforaminal disc herniations do not require a highly lateral entry point. This technique is technically challenging at the L5 S1 level due to interference from the iliac crests, making it more suitable for levels L4 L5 and above.

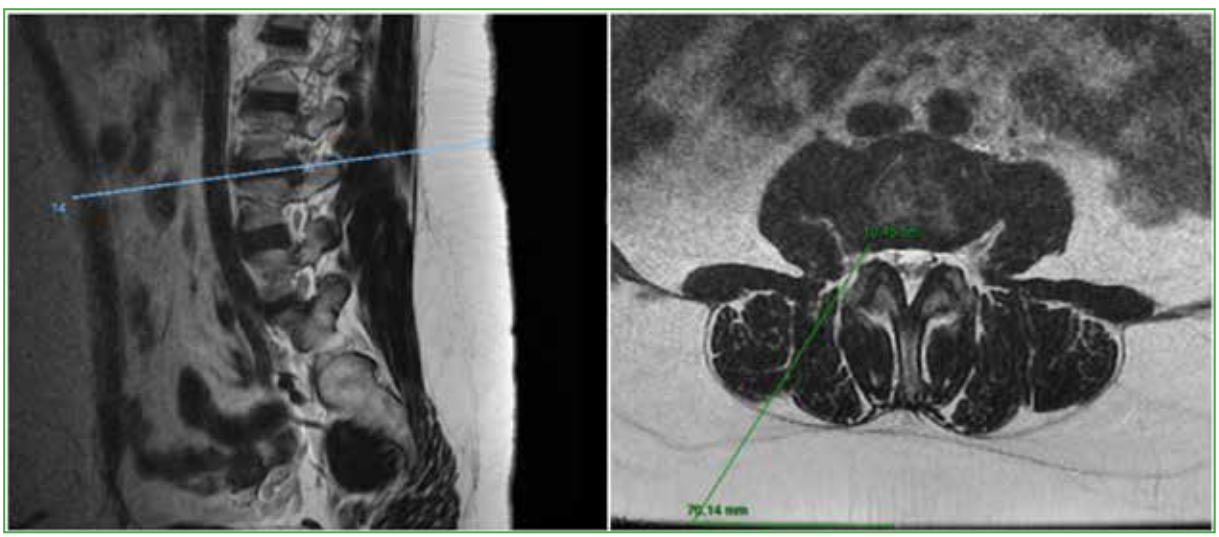

Figure 2. Preoperative planning of the extraforaminal approach on magnetic resonance imaging (sagittal and axial views).

A strict anteroposterior fluoroscopic view is obtained to visualize endplates parallel to the target disc. The midline is marked, followed by lateral marking according to the preoperative plan. The dilator is inserted and the endoscope is advanced. Fluoroscopic confirmation of correct positioning is performed. When planning is accurate, the extraforaminal disc herniation is usually the first structure visualized (Figure 3).

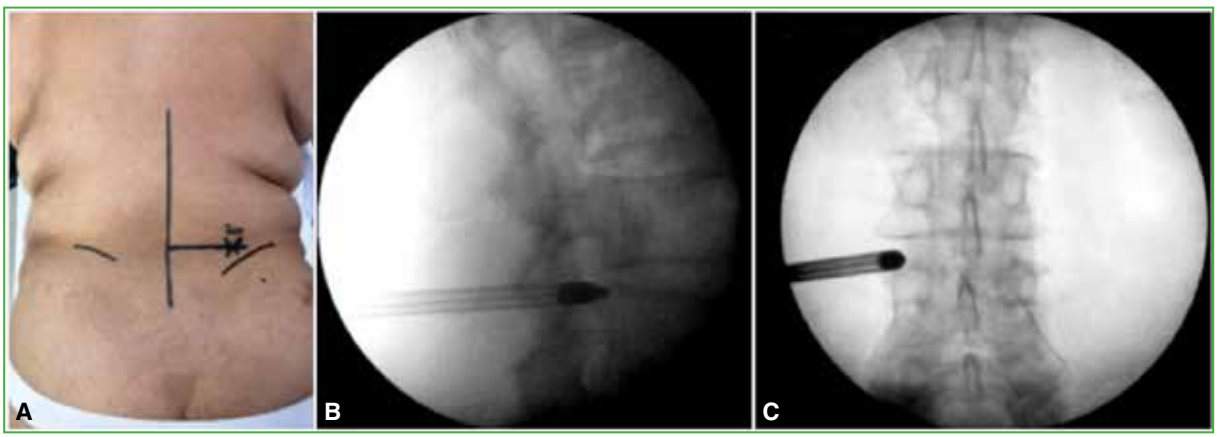

Figure 3. A. Marking of the midline and subsequent lateral marking according to preoperative planning.
B and C. Anteroposterior and lateral fluoroscopic control to verify the correct position of the dilator.

Interlaminar Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Using direct anteroposterior fluoroscopic guidance, the interlaminar window to be addressed is identified. A skin and fascial incision is performed, and the dilator is advanced. A lateral fluoroscopic view is obtained to confirm the working trajectory and to ensure adequate depth beyond the fascia. This step is particularly important in obese patients. The endoscope is inserted and the ligamentum flavum is identified. The ligament is opened in a medial to lateral direction until the epidural space is reached and neural structures are visualized. The nerve root is then gently mobilized medially, and the working cannula is advanced to allow disc fragment removal (Figure 4).

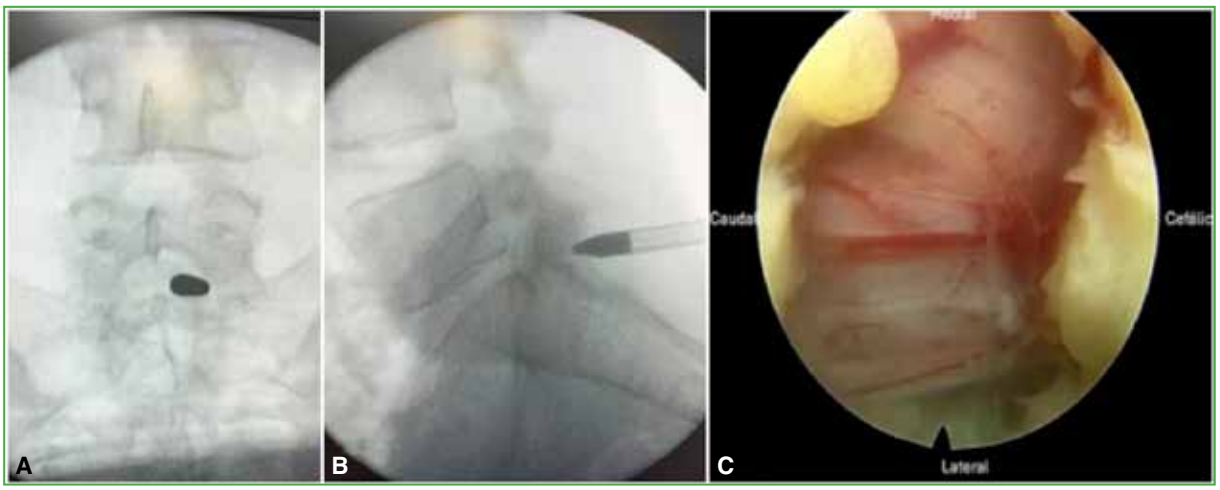

Figure 4. A and B. Anteroposterior and lateral fluoroscopic control confirming the correct position of the dilator.
C. Endoscopic view of the exiting nerve root and the dural sac.

L5-S1 Transfacet Endoscopic Discectomy

Under general anesthesia, the patient is placed in the prone position. Using direct anteroposterior fluoroscopy, the tip of the superior articular facet of S1 is identified and marked with a 16-gauge needle. An 8 mm skin incision is made and the lumbar fascia is opened. The working cannula and endoscope are advanced together. Lateral drilling of the inferior vertebral facet is performed using a diamond burr. As space is progressively created in the medial and ventral directions, the cannula is advanced. Once the anterior cortical bone of the facet is identified, it is resected using a 3 mm Kerrison rongeur. Fluoroscopic confirmation of the correct working direction is then performed (Figures 5-7).

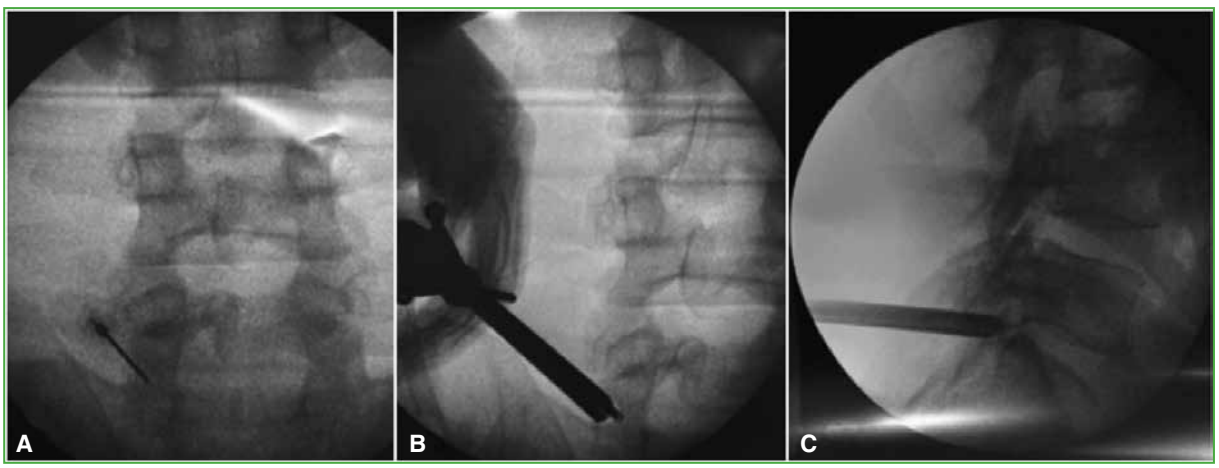

Figure 5. A. Fluoroscopic control to identify the left superior articular facet of S1 using a 16 G needle**.**
B and C. Anteroposterior and lateral fluoroscopic views showing the correct working trajectory.

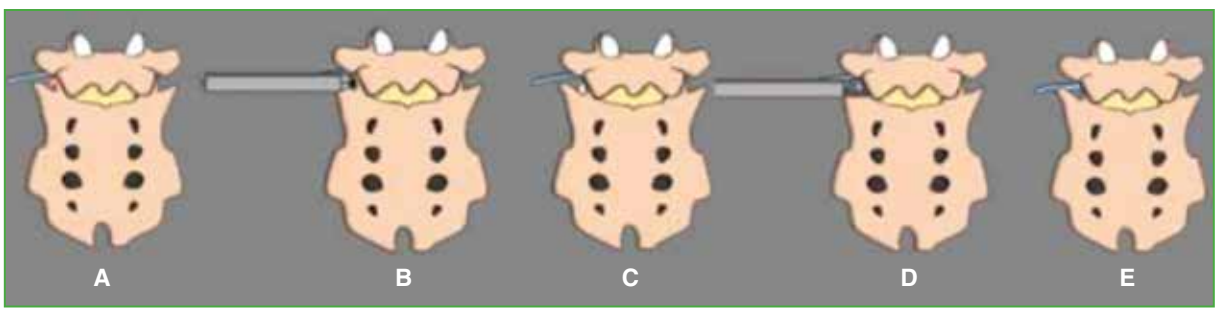

Figure 6. A. Lateral identification of the superior articular facet of S1. **B.** Drilling of the facet from lateral to medial and in a ventral direction. **C.** Visualization of the extruded disc fragment. **D.** Excision of the disc fragment. **E.** Free L5 nerve root.

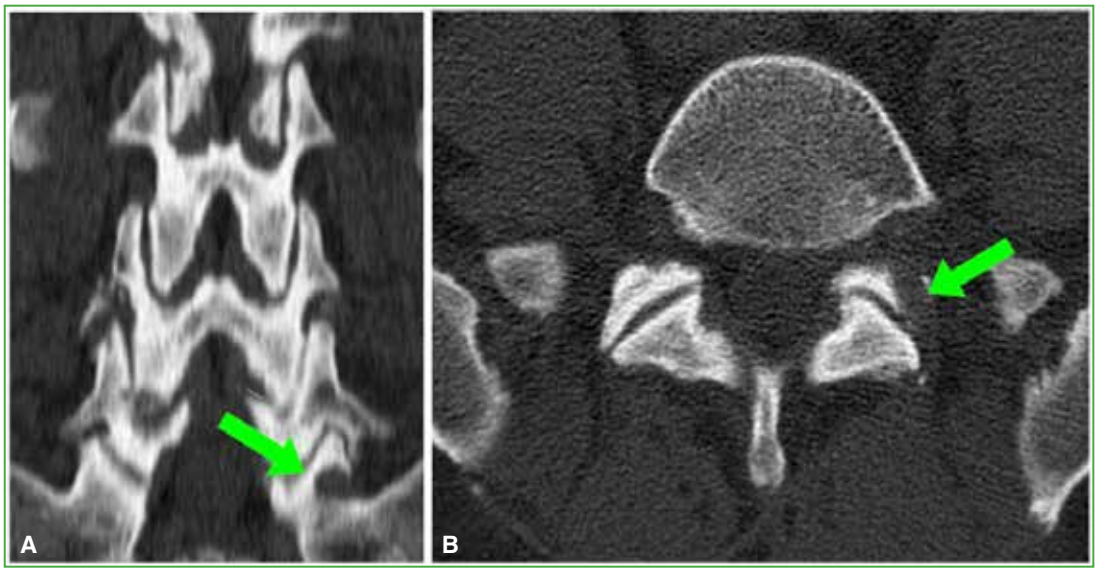

Figure 7. A and **B.** Postoperative computed tomography scan. Green arrows indicate the trajectory of the surgical drill through the facet.

Neuromonitoring

Seventy-two percent of the patients underwent intraoperative neuromonitoring, including motor and somatosensory evoked potentials of the lower limbs, as well as free-run and stimulated electromyography.

Rehabilitation

All patients were encouraged to begin standing and ambulation with the assistance of a physical therapist upon recovery from general anesthesia, which occurred between 90 and 180 minutes after surgery. Rehabilitation was delayed in patients who underwent surgery during evening or nighttime hours.

RESULTS

A total of 154 endoscopic spine surgeries were performed between December 2022 and December 2024. Eighteen patients were excluded for the following reasons: recurrent disc herniation in six cases, spondylodiscitis in two cases, lumbar spinal stenosis in six cases, loss to follow-up in three cases, and one patient in whom the endoscopic procedure was initiated but conversion to conventional discectomy was required due to technical difficulty with the approach. This last patient had a disc herniation initially treated endoscopically but required intraoperative conversion (Figure 8).

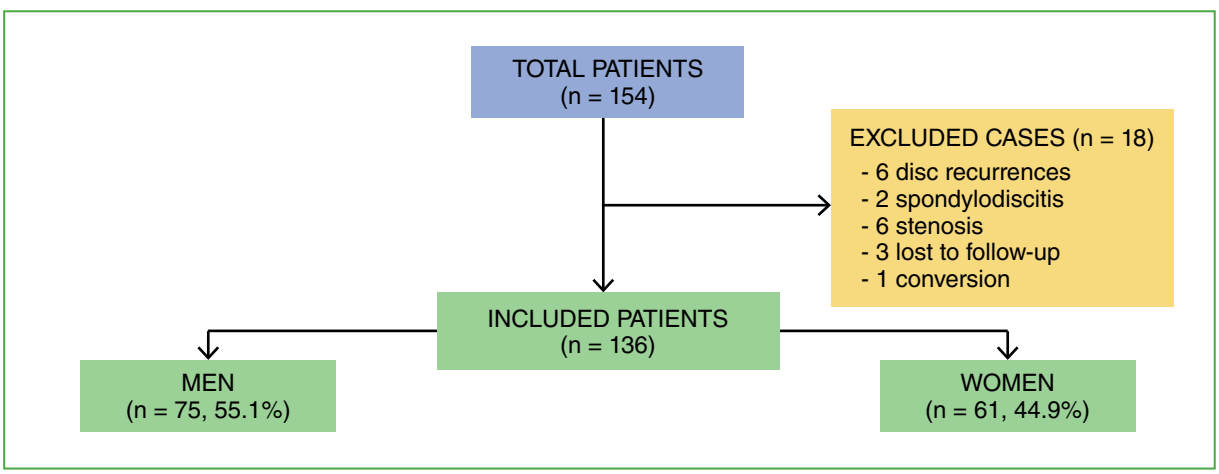

Figure 8. Flowchart of the study sample.

The final sample consisted of 136 patients who underwent surgery for lumbar disc herniation, all with a single affected level. Seventy-five patients (55.1%) were male and 61 (44.9%) were female. The mean age was 47.2 years, with a range from 18 to 83 years. The mean follow-up period was 11.8 months, ranging from 4 to 25 months. The left side was more frequently affected in 71 cases (52.2%), and the most commonly involved level was L5 S1 in 71 cases (52.2%), followed by L4 L5 in 42 cases (30.8%). Before surgery, 78.6% of patients presented with isolated radiculopathy, while the remaining 29 patients (21.4%) also exhibited some degree of motor deficit.

Although all four previously described surgical approaches were used, the interlaminar approach was the most frequently employed, accounting for 114 cases (83.2%), followed by the transforaminal approach in 10 cases (7.3%) (Figure 9). The mean operative time was 64 minutes, with a range from 15 to 195 minutes. When operative time was analyzed according to the surgical approach, extraforaminal discectomy was the fastest, with a mean duration of 47 minutes, whereas the transfacet approach had the longest mean operative time at 71 minutes.

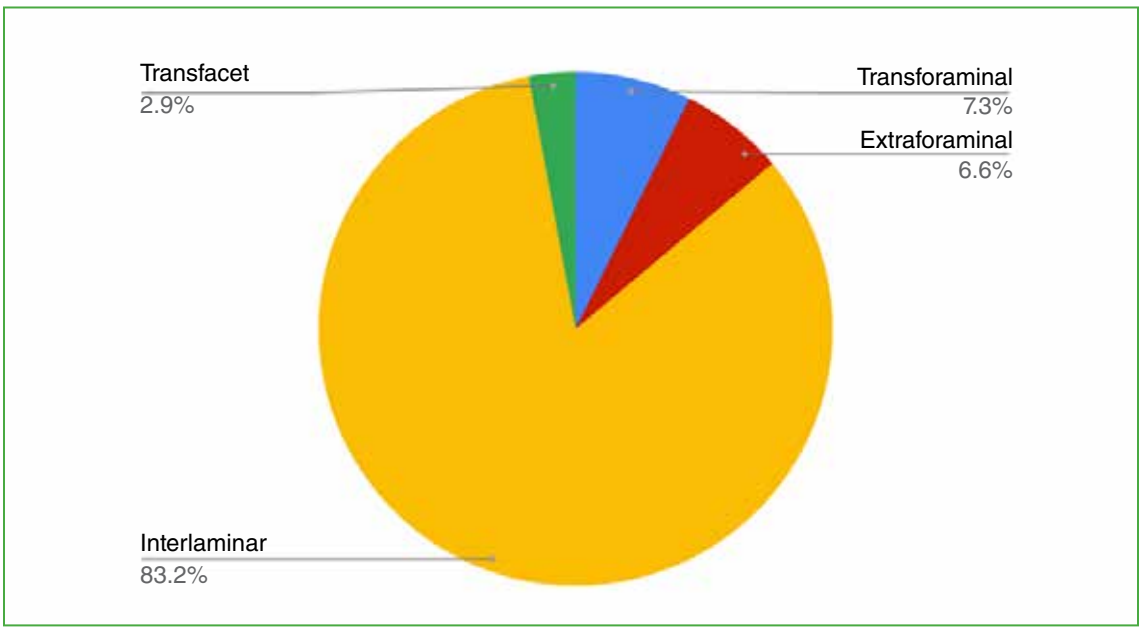

Figure 9. Distribution of surgical approaches performed.

In most patients (41.9%), the Elliquence® transforaminal endoscope was used. In 37% of cases, the use of a surgical drill was required. Patients ambulated at a mean of 3 hours after surgery, with a range from 1 to 5 hours. Hospital discharge occurred at a mean of 9 hours after completion of the procedure, ranging from 5 to 36 hours.

Regarding functional outcomes, the mean radicular visual analog scale score decreased from 8.5 preoperatively to 1.7 at 30 days ($p < 0.001$), to 0.7 at 3 months ($p < 0.001$), and to 0.2 at 6 months ($p < 0.001$). The 6-month evaluation included 97 patients with at least 6 months of follow-up. The mean lumbar visual analog scale score decreased from 1.6 preoperatively to 1.3 at 30 days ($p < 0.004$), to 0.9 at 3 months ($p < 0.001$), and to 0.5 at 6 months ($p < 0.001$), also evaluated in 97 patients with sufficient follow-up.

Four complications were recorded, representing 2.9% of the sample, including both intraoperative and postoperative events. One patient with an L4 L5 disc herniation treated via the interlaminar approach sustained a dural sac injury smaller than 2 mm. The tear was not repaired, and the patient had a favorable outcome without additional treatment. Two patients developed transient quadriceps paresis graded 3 out of 5 in the immediate postoperative period. Both had undergone a transforaminal approach, and the deficit was interpreted as neuropraxia caused by endoscope positioning and pressure on the nerve root. Both patients fully recovered muscle strength within 60 days following surgery, with rehabilitation and pregabalin at a dose of 75 mg per day. One patient presented with persistent pain and progressive loss of strength in the immediate postoperative period. Magnetic resonance imaging revealed a hematoma in the surgical field, which was drained endoscopically 36 hours after the initial procedure.

The patient showed good clinical evolution and fully recovered muscle strength within 48 hours. No surgical site infections were recorded.

Seven cases of disc recurrence were diagnosed, representing 5.1% of the sample. Recurrence occurred at a mean of 86 days after surgery, with a range from 3 to 240 days. In all recurrence cases, the initial approach had been interlaminar. One patient was treated with conventional surgery, while the remaining six underwent repeat endoscopic surgery. All patients had favorable outcomes (Table).

Table. Details of the seven disc recurrences.

	Recurrence 1	Recurrence 2	Recurrence 3	Recurrence 4	Recurrence 5	Recurrence 6	Recurrence 7
Sex	M	F	M	F	F	F	M
Age (years)	44	37	60	44	42	22	49
Level	L4-L5	L5-S1	L4-L5	L5-S1	L4-L5	L5-S1	L5-S1
Approach	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar	Interlaminar
Surgical drill	No	No	Yes	No	Yes	No	No
Time to recurrence (days)	240	30	60	60	180	90	30
Endoscope system	Ellicuence®	Ellicuence®	Hanover®	Hanover®	Joimax®	Joimax®	Hanover®
Management	Endoscopic	Open	Endoscopic	Endoscopic	Endoscopic	Endoscopic	Endoscopic

F = female; M = male.

DISCUSSION

Endoscopic spine surgery is a minimally invasive procedure that represents the cutting edge of spinal surgery and is gradually gaining acceptance among spine surgeons.[8,9] This percutaneous technique is currently well established for decompression procedures. However, its use in other types of surgery, such as spinal fusion, tumor surgery, or deformity correction, remains under discussion. It has been demonstrated that this technique achieves clinical outcomes comparable to those of other minimally invasive and open techniques, as measured by the visual analog scale and the Oswestry Disability Index, while offering advantages such as reduced intraoperative blood loss, shorter operative time, and consequently, a lower complication rate.[7,8,10,11] In our study, although no direct comparison with other surgical techniques was performed, we observed not only a significant improvement in clinical scores but also early ambulation and rapid hospital discharge. Regarding discharge timing, it is important to note that this varied depending on the time of surgery. Patients operated on in the morning were discharged earlier, whereas those operated on in the afternoon or evening were usually discharged the following day.

Although endoscopic discectomy is considered a safe technique, it is not free of complications. Disc recurrence is undoubtedly the most frequent complication and has been reported to range from 4% to 12% in different studies.[7,12-14] Ren et al.[14] retrospectively evaluated 1159 patients who underwent endoscopic discectomy for disc herniation, with a mean follow-up of 38 months, and reported a disc recurrence rate of 11.2%, occurring on average 10 months after surgery. High body mass index, disc protrusions compared to extrusions, and Modic-type changes were identified as risk factors for recurrence. In contrast, a recent systematic review by Compagnone et al.[15] reported substantially lower recurrence rates, specifically 3.5% for the interlaminar approach and 3% for the transforaminal approach. In our series, the disc recurrence rate was 5.1%. When analyzing the seven patients who experienced recurrence, all shared certain characteristics, including preserved disc height and posterolateral herniations. Although this rate is relatively low compared with that reported in much of the international literature, it may increase with longer follow-up. Other complications described in the literature include dural sac injury, reported in 4% to 10% of cases, and nerve injury, reported in less than 3%.[7,12-14] Although both complications occurred in our series, the overall complication rate was low at 2.9%, and all affected patients recovered without permanent sequelae.

In Argentina, reports on endoscopic spine surgery are extremely scarce. The first was published by Dr. Antoni in 1994, describing interlaminar arthroscopic discectomy in 14 patients, with favorable outcomes.[16] In 2017, Van Isseldyk et al.[17] reported results in 42 patients, showing a significant decrease in the Oswestry Disability Index, with three reoperations due to persistent symptoms. In 2019, Frucella and Maldonado[18] evaluated 60 patients undergoing 77 endoscopic discectomies and reported significant improvement in functional scores, a 3.3% reoperation rate due to persistent symptoms in the immediate postoperative period, an 11.6% rate of persistent pain in the medium term, and one case of radicular deficit.

An important difference between our study and the aforementioned national series, as well as many international reports, is the predominant use of the interlaminar approach over the transforaminal approach. This choice was based exclusively on the surgical team's familiarity and comfort with this technique.

The main strength of this study is the large number of patients included, representing the largest national series published to date. However, several limitations must be acknowledged, including the retrospective design, the use of four different surgical approaches, and a minimum follow-up period of 4 months, which may be insufficient to fully assess long-term recurrence rates and could potentially influence the results.

CONCLUSIONS

Endoscopic discectomy is a safe surgical technique that achieves clinical outcomes comparable to those of traditional techniques, while offering the advantages of lower surgical invasiveness and a low complication rate. The results of our series are consistent with those reported in the existing literature.

Conflict of interest: The authors declare no conflicts of interest.

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