









ENDOSCOPIC DECOMPRESSION IN PATIENTS WITH ADJACENT SEGMENT STENOSIS AFTER LUMBAR ARTHRODESIS

DESCOMPRESSÃO ENDOSCÓPICA EM PACIENTES COM ESTENOSE DO SEGMENTO ADJACENTE APÓS ARTRODESE LOMBAR

DESCOMPRESIÓN ENDOSCÓPICA EN PACIENTES CON ESTENOSIS DEL SEGMENTO ADYACENTE DESPUÉS DE ARTRODESIS LUMBAR

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ABSTRACT

Introduction and objective: Endoscopic decompression has emerged as an effective and minimally invasive therapeutic alternative for the management of adjacent-level stenosis in patients previously undergoing lumbar fusion. This condition, known as Adjacent Segment Disease (ASD), often manifests years after the surgical procedure, with clinical symptoms such as sciatica, neurogenic claudication, and progressive functional impairment. This study presents a series of clinical cases investigating the results of the endoscopic approach in patients diagnosed with foraminal and central stenosis at a single level adjacent to fusion. **Methods:** The fully endoscopic technique used allows direct access to the stenosed area with minimal aggression to surrounding tissues, promoting effective neural decompression, reduced perioperative morbidity, and accelerated recovery. **Results and conclusion:** Preliminary results suggest that endoscopic decompression may represent a viable and advantageous strategy compared to conventional approaches, especially in patients at high surgical risk or seeking less invasive options. **Level of Evidence IV; Case Series.**

Keywords: Constriction, Pathologic; Minimally Invasive Surgical Procedures; Endoscopy; Spine; Spinal Fusion.

RESUMO

Introdução e objetivo: A descompressão endoscópica tem emergido como uma alternativa terapêutica eficaz e minimamente invasiva para o manejo da estenose do nível adjacente em pacientes previamente submetidos à artrodeose lombar. Essa condição, conhecida como Doença do Segmento Adjacente (DSA), frequentemente se manifesta anos após o procedimento cirúrgico, com sintomas clínicos como dor ciática, claudicação neurogênica, e comprometimento funcional progressivo. Este estudo apresenta uma série de casos clínicos que investigam os resultados da abordagem endoscópica em pacientes com diagnóstico de estenose foraminal e central em nível único adjacente à artrodeose. **Métodos:** A técnica utilizada, totalmente endoscópica, permite acesso direto à área estenosada com mínima agressão aos tecidos circundantes, promovendo descompressão neural eficaz, menor morbidade perioperatória e recuperação acelerada. **Resultados e conclusão:** Os resultados preliminares sugerem que a descompressão endoscópica pode representar uma estratégia viável e vantajosa frente às abordagens convencionais, especialmente em pacientes com alto risco cirúrgico ou que buscam opções menos invasivas. **Nível de Evidência IV; Série de Casos.**

Descritores: Constricção Patológica; Procedimentos Cirúrgicos Minimamente Invasivos; Endoscopia; Coluna Vertebral; Fusão Vertebral.

RESUMEN

Introducción y objetivo: La descompresión endoscópica se ha convertido en una alternativa terapéutica eficaz y mínimamente invasiva para el tratamiento de la estenosis del nivel adyacente en pacientes sometidos previamente a una fusión lumbar. Esta afección, conocida como Síndrome del Nivel Adyacente (SNA) o del Segmento Adyacente (SSA), suele manifestarse años después del procedimiento quirúrgico, con síntomas clínicos como ciática, claudicación neurogénica y deterioro funcional progresivo. Este estudio presenta una serie de casos clínicos que investigan los resultados del abordaje endoscópico en pacientes diagnosticados con estenosis foraminal y central en un solo nivel adyacente a la fusión. **Métodos:** La técnica totalmente endoscópica utilizada permite el acceso directo al área estenosada con mínima agresión a los tejidos circundantes, lo que promueve una descompresión neural efectiva, reduce la morbilidad perioperatoria y acelera la recuperación. **Resultados y conclusión:** Los resultados preliminares sugieren que la descompresión endoscópica puede representar una estrategia viable y ventajosa en comparación con los abordajes convencionales, especialmente en pacientes con alto riesgo quirúrgico o que buscan opciones menos invasivas. **Nivel de Evidencia IV; Serie de Casos.**

Descriptorios: Constricción Patológica; Procedimientos Quirúrgicos Mínimamente Invasivos; Endoscopia; Columna Vertebral; Fusión Vertebral.

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INTRODUCTION

Adjacent segment disease (ASD) is a recognized complication of lumbar arthrodesis, characterized by progressive degenerative changes in levels immediately above or below the previously fused segment. Traditionally, especially among more traditional spine surgeons, the view that ASD was invariably associated with segmental instability prevailed, demanding, as a logical consequence, a new arthrodesis for definitive correction.

However, in recent years, the advance of biomechanical knowledge, coupled with the development of new minimally invasive technologies, has challenged this classical approach. Recent studies show that many cases of ASD develop predominantly with mechanical neural compression, with no clear signs of structural instability. In these scenarios, isolated decompression, including the process carried out through endoscopic technique, emerges as a safe, effective and less invasive alternative, capable of promoting symptomatic relief with lower morbidity and shorter recovery time.

Faced with this paradigm change, the present study aims to report a number of cases of patients with ASD post-arthrosis, treated with isolated decompression, analyzing the clinical outcomes observed, and contributing to the refinement of surgical decision making in the face of this increasingly prevalent condition.

Clinical cases

This study was approved by the Research Ethics Committee of the Samaritan Hospital under protocol no. 3540420.5.0000.5487.

231 records of patients undergoing endoscopic spine surgery between August 2023 and November 2024 were analyzed. Of these, four patients were included in this study because they presented a clinical picture compatible with ASD, characterized by lumbar pain, radiculopathy and neurogenic claudication after asymptomatic period and radiological confirmation of central stenosis at the level immediately above previous arthrodesis.

All patients were subjected to dynamic flexion and extension x-rays to rule out segmental instability. Cases with translation greater than 3.5 mm or intervertebral angulation greater than 11° were considered unstable according to biomechanics criteria described in the literature. Patients with signs of instability were excluded from the study.

The sample consisted of two men and two women, with an average age of 73.5 years (67–77 years), previously undergoing lumbar arthrodesis at levels L3–L5, L2–S1, L3–S1 and L4–L5. The mean interval between fusion surgery and endoscopic procedure was 61.75 months (Table 1).

The intensity of pain was evaluated using the Visual Analog Scale (VAS), differentiating back pain (lumbar-VAS) and lower limb pain (LL-VAS), in six distinct moments: preoperative (Pr), immediate postoperative (POi), 1 month (PO1m), 3 months (PO3m), 6 months (PO6m) and 12 months (PO12m) after surgery.

Figures 1 to 4 illustrate the pre- and post-operative imaging findings. The clinical evolution of pain is represented in Tables 2 and 3, showing sustained improvement in VAS scores throughout follow-up.

Surgical Technique

The central decompression was carried out through the interlaminar endoscopic technique “over the top”, with unilateral approach and bilateral decompression. After positioning the patient prone on bolsters with the abdomen free, under general anesthesia

Table 1. Demographic data of the clinical cases described.

Cases	Age (Years)	Sex	Arthrodesis levels	Approached level	Time from arthrodesis to endoscopic approach (months)
1	67	M	L3-L5	L2-L3	29
2	76	F	L2-S1	L1-L2	96
3	77	M	L3-S1	L2-L3	98
4	74	F	L4-L5	L3-L4	24

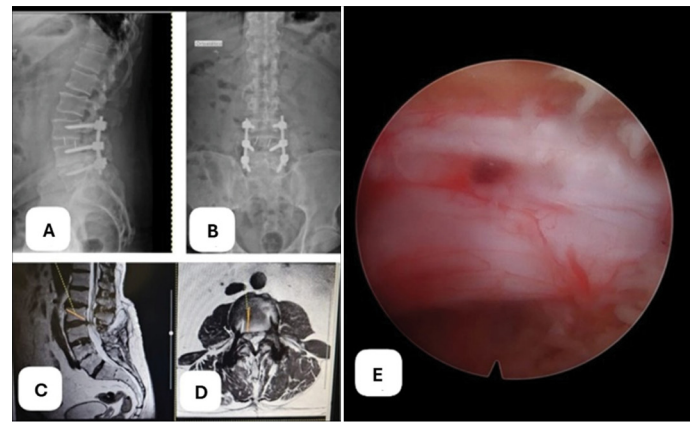


Figure 1. Case 1. Simple radiography of the lumbar spine showing arthrodesis at levels L3–L5 (A, B). Sagittal magnetic resonance cutting showing adjacent segment disease (ASD) in L2–L3 (C). Axial magnetic resonance cutting showing central lumbar canal stenosis in L2–L3 (D). Intraoperative image demonstrating the final aspect of endoscopic decompression (E).

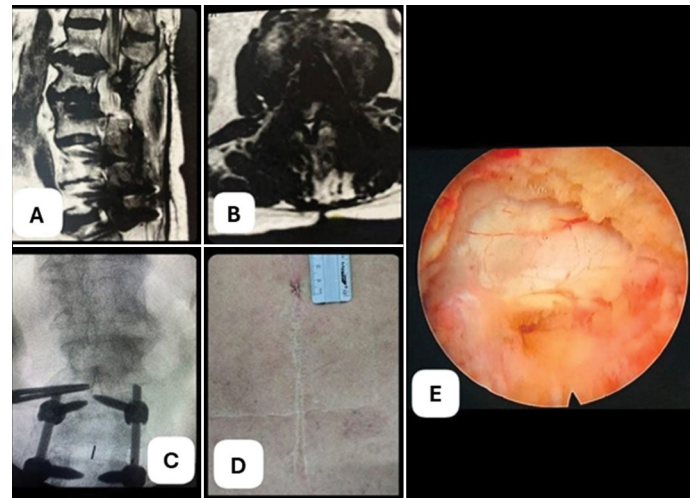


Figure 2. Case 2. Magnetic resonance cutting showing arthrodesis from L2 to S1 and adjacent segment disease (ASD) in L1-L2 (A). Axial magnetic resonance cutting showing central lumbar canal stenosis in L1-L2 (B). Intraoperative image of radioscopy evidencing the entry point of interlaminar endoscopic access (C). Comparison of previous surgery incision and current approach (D). Interoperative image showing final decompression (E).

and intraoperative neuromonitoring, antisepsis was performed and the surgical field was prepared. Fluoroscopy in anteroposterior and lateral projections was used to identify the surgical level. A cutaneous incision of approximately 7 mm was performed, about 1 cm from the middle line, on the side of the predominant symptomatology. The dilatator was introduced to the lamina of the cranial vertebra, followed by the working canula, positioned on the bottom edge of the lamina.

With the help of an endoscope with a working channel of 4.3 mm and an angle of 30 degrees, partial resection of the ipsilateral cranial blade with a high rotational drill was performed, until the yellow ligament was disinserted. Subsequently, a partial resection of the base of the thinning process and the contralateral cranial laminar ceiling was performed, allowing access to the opposite side (“over the top”), without the need for a new incision. The bone resection was then repeated in the blade of the caudal vertebra.

Subsequently, bone decompression of the lateral rejection was performed, with identification of the facet joint bilaterally and resection of the lower joint process of the cranial vertebra and the upper joint process of the caudal vertebra. After the complete release of

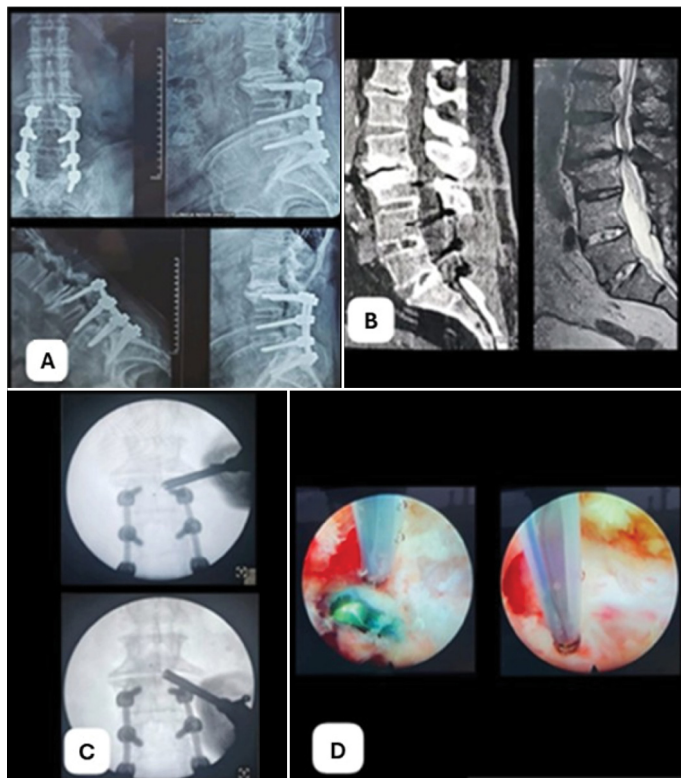


Figure 3. Case 3. Simple and dynamic radiographs of the lumbar spine showing arthrodesis from L3 to S1 and absence of frank instability (A). Sagittal cutting of computed tomography and MRI, evidencing adjacent segment disease (ASD) in L2-L3 (B). Intraoperative image of radioscopy with endoscope positioning (C). Intraoperative image showing final decompression and the presence of synthesis material in the visual field of endoscopy (D).

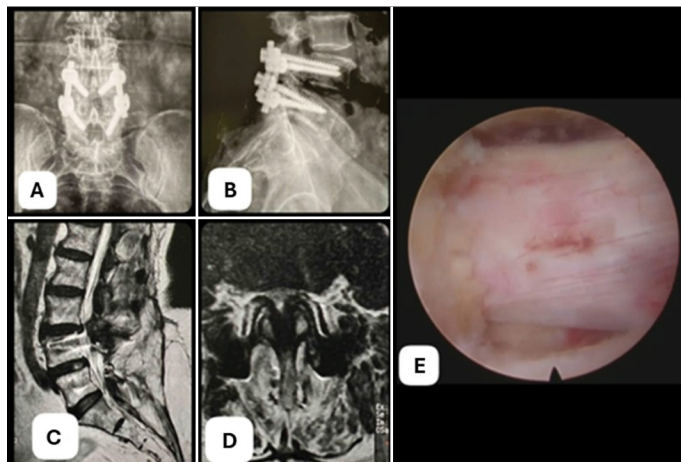


Figure 4. Case 4. Simple X-rays showing arthrodesis on L4-L5 with pedicular screws (A, B). Sagittal magnetic resonance cutting showing adjacent segment disease (ASD) in L3-L3 (C). Axial cutting of the magnetic resonance imaging showing central lumbar canal stenosis in L3-L4 (D). Intraoperative image showing final decompression (E).

the yellow ligament, its complete removal was carried out, aiming at exposure of the hard matter and the compressed nerve roots. The decompression was confirmed under direct visualization, with free pulse of the hard and bilateral inspection of the neural structures.

The hemostatic control was carried out by bipolar coagulation under continuous gravitational irrigation with saline solution, positioned about 1.5 m above the patient's plane. At the end, the instrumental was removed and the cutaneous incision closed with

Table 2. Evolution of the intensity of lumbar pain by EVA. PR: preoperative; POi: immediate postoperative; PO1m: postoperative of 1 month; PO3m: postoperative of 3 months; PO6m: postoperative of 6 months; PO12m: postoperative of 12 months.

Lumbar-VAS	Pr	POi	PO1m	PO3m	PO6m	PO12m
Case 1	8/10	5/10	1/10	2/10	1/10	2/10
Case 2	10/10	4/10	0/10	2/10	0/10	0/10
Case 3	8/10	6/10	2/10	0/10	1/10	1/10
Case 4	8/10	6/10	2/10	0/10	1/10	1/10

Table 3. Evolution of the intensity of pain in the lower limbs by VAS. PR: preoperative; POi: immediate postoperative; PO1m: postoperative of 1 month; PO3m: postoperative of 3 months; PO6m: postoperative of 6 months; PO12m: postoperative of 12 months.

LL-VAS	Pr	POi	PO1m	PO3m	PO6m	PO12m
Case 1	9/10	3/10	2/10	2/10	1/10	2/10
Case 2	10/10	2/10	0/10	1/10	0/10	1/10
Case 3	7/10	3/10	0/10	0/10	0/10	0/10
Case 4	8/10	2/10	0/10	0/10	0/10	0/10

a simple dot. There was no need for drainage. The average surgical duration was 87.5 minutes (varied from 80 to 95 minutes), and hospital discharge occurred between 6 and 8 hours after the procedure. No intraoperative or postoperative complications were observed during 12-month follow-up.

DISCUSSION

Lumbar arthrodesis is widely used for the treatment of degenerative pathologies of the spine, such as spondylolisthesis and spinal stenosis, with the aim of stabilizing compromised vertebral segments. The number of spinal arthrodesis surgeries has increased substantially in the last decade in the United States. With population aging, an increasing indication of arthrodesis is observed in elderly patients and with multiple comorbidities, which has been associated with higher rates of postoperative complications.¹⁻¹¹ Additionally, studies indicate that the complexity of surgical instrumentation is positively correlated with the risk of complications, reinforcing the need for strict criteria in case selection.¹²

Arthrodesis can result in biomechanical overload at the levels adjacent to the fusion, leading to the development of adjacent segment disease (ASD). Clinically, ASD may manifest as low back pain, sciatica, neurogenic claudication, paresthesias, sphincter dysfunction, and functional limitation. The incidence of ASD varies between 5% and 30%, depending on factors such as age, surgical technique, number of fusion levels and previous degeneration in adjacent segments.¹⁻³

ASD is subdivided into two categories: the radiographic form, identified by structural changes in imaging exams without clinical symptoms; and the clinical form, which associates these changes with relevant neurological manifestations. In both scenarios, the presence of foraminal or central stenosis may justify therapeutic interventions.¹⁻³

With the advancement of minimally invasive techniques, endoscopic decompression emerged as an effective alternative to the traditional treatment of ASD. The endoscopic approach allows precise neural decompression through small incision, with preservation of adjacent anatomical structures and less tissue aggression. Compared to reapproaching by fusion and extension of the arthrodesis, this technique is associated with less morbidity, less surgical time and accelerated functional recovery.⁴⁻⁶

Studies indicate that up to 29% of patients undergoing lumbar arthrodesis may need new surgery, with 10% of cases involving extension of the fusion.¹ Factors such as excessive rigidity of implants and pre-existing degeneration increase the risk of ASD. Therefore, the careful evaluation of the sagittal alignment, residual mobility and condition of adjacent discs is fundamental during the initial surgical indication.¹³

Indication of endoscopic decompression should consider the absence of segmental instability, assessed by dynamic X-rays with criteria such as translation greater than 3.5 mm or angle greater than 11° between the vertebrae. The technique is especially effective in cases of foraminal stenosis, but can also be used in central stenosis, as demonstrated in this series of cases.

Current literature reinforces the role of endoscopic decompression as a viable and safe therapeutic alternative, with reduced complication rates and significant improvement in symptoms.⁷ A systematic review revealed an annual incidence of radiographic ASD of 5.9% and clinical of 1.8%, with the extent of fusion being the main risk factor.⁶ Thus, preserving adjacent levels and adopting less invasive techniques are important strategies in the prevention of late complications.

The findings of this series corroborate previous data, such as those of Telfeian et al.¹⁴, which demonstrated positive results with endoscopic decompression in patients with post-arthrodesis ASD. The standardization of the “over the top” technique and efficient decompression, with complete removal of the yellow ligament and preservation of the joint facets, was decisive for the clinical success observed. In this scenario, endoscopic decompression

is consolidated as an effective minimally invasive approach to the treatment of ASD in patients without signs of instability, offering symptomatic relief with lower surgical morbidity.

CONCLUSION

Endoscopic decompression represents a minimally invasive, effective and safe alternative for the treatment of adjacent segment disease (ASD) in patients previously undergoing lumbar arthrodesis, especially in the absence of segmental instability. This approach has been distinguished by offering lower morbidity, preservation of paravertebral structures, reduced hospitalization time and accelerated functional recovery.

Despite the limited number of cases in this series, the clinical results presented corroborate the potential of this technique in the management of ASD, reinforcing its therapeutic feasibility against traditional approaches. However, additional studies with greater sampling and prolonged follow-up are needed to validate these findings and establish more precise indication criteria, expanding the applicability of the technique in the context of modern spinal surgery.

CONFLICT OF INTEREST

All authors declare no potential conflict of interest related to this article.

CONTRIBUTIONS OF THE AUTHORS

Each author contributed individually and significantly to the development of this article. RE, APE, FSE: conceptualization, validation, writing – original draft; TDM, ADHS, MBSB: formal analysis, data curation; SEL, JPMB: formal analysis, writing – editing and review.

DATA AVAILABILITY DECLARATION

The contents underlying the research are available in the manuscript.

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