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Case Report

A Hybrid Surgical Management Approach for Adjacent Segment Disease in the Lumbar Region

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Abstract

Adjacent segment disease (ASD) is a well-recognized clinical entity associated with surgical instrumentation history. A hybrid approach to achieving an extension of the transpedicular system without altering the already stable segment is another alternative for the selective management of ASD.

Introduction

Adjacent segment disease (ASD) is a well-recognized clinical entity associated with decompression and a history of surgical instrumentation in different spinal segments and it is most frequently associated with lumbar degenerative diseases [1-3]. Inherent patient factors, surgical variables, and radiological evidence define the risk factors for its presentation and subsequent care [4-6]. Musculoskeletal biomechanics have been considered key factors in potential ASD development [7,8].

Today, there are many instrumentation systems, and the range is wide, but each system has its own particular differences. One of the limitations derived from the diverse of devices that can be scaled under "universal" technical and mechanical criteria, is that not all systems are compatible. However, it represents a challenge when requiring an extension of the bars to other levels, without altering the stable segment.

In specific cases where the same bar fixation system is unavailable in some countries, alternative solutions must be found.

Therefore, we present a representative case using another system in a hybrid technique, mounted, or ridden on bars of the previous system, to solve the listhesis of the adjacent segment in the upper level.

Case History/Examination

A 58-year-old female patient had a history of lumbar transpedicular instrumentation performed 4 years ago for lumbar spinal canal stenosis and mechanical instability, which clinically manifested as radiculopathy and neurogenic claudication in the L4-S1 segment. New evidence of mechanical low back pain and radiculopathy at the L3–L4 segment was

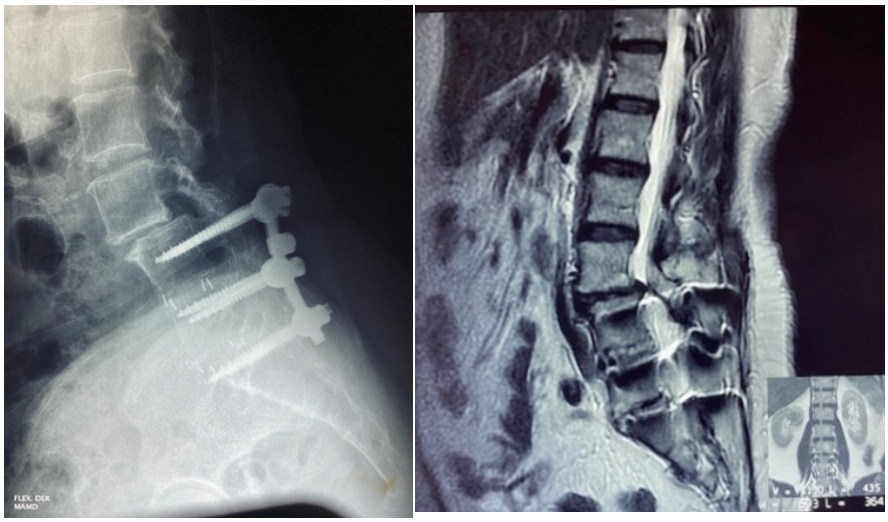

Figure 1. *Preoperative radiographs demonstrated ASD at the superior level (L3/4) [A], and MRI showed evidence of canal stenosis secondary to degenerative changes and instability [B].*

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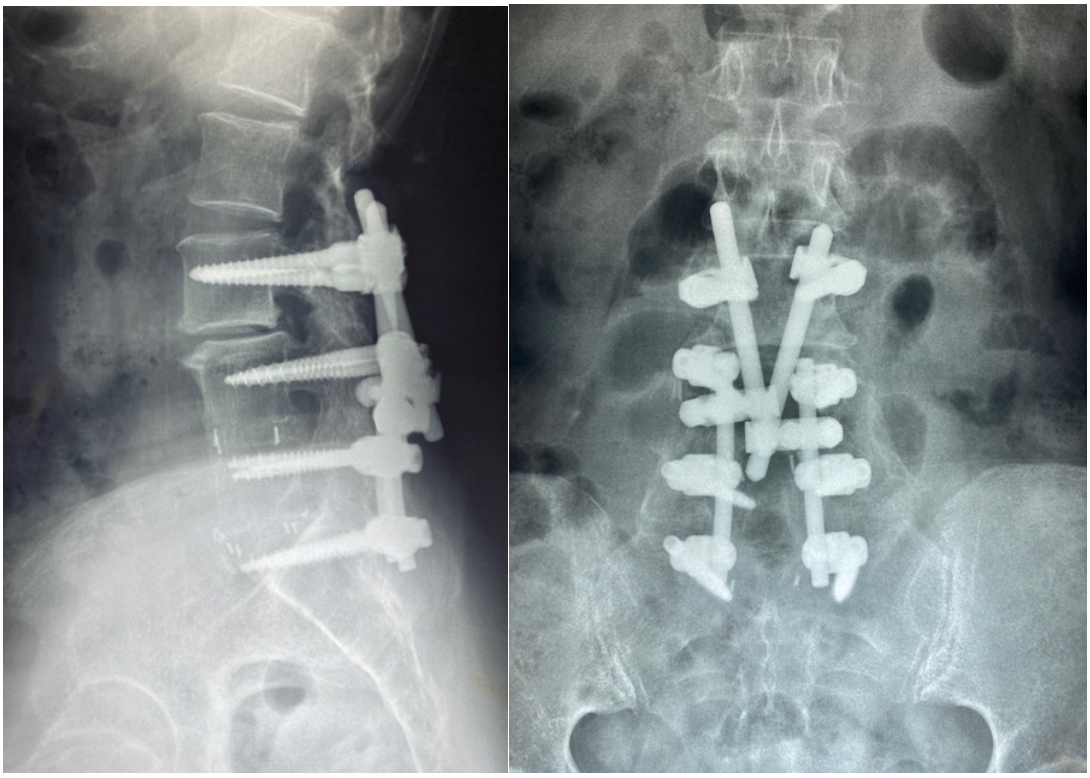

Figure 2. *Postoperative control, (2 Months) demonstrating reduction of the listhesis and stability of the superior segment without mobilization of the previous instrumentation (L4-S1) [A, B].*

attributed to secondary ASD (Figure 1). Regarding the new evidence of radiculopathy in the upper level associated with ASD, an extension of the rods was planned.

Methods

The extension of the rods was planned using a hybrid system to avoid altering the stable portion (L4-S1) and to correct displacement and instability in the new upper segment L3-L4 with anterolisthesis, by placing only two transpedicular screws in the L3 vertebra and rods mounted on the same primary system (Sibi 3D Tlathon™). This was complemented with bilateral foramen decompression, preserving the facets and achieving distraction and alignment of the unstable segment without complications.

Conclusion and Results

The clinical evolution was satisfactory, without neurological deficits, with resolution of neuropathic and mechanical pain. The patient is independent, not requiring analgesics at present, but managing with pregabalin 75 mg per night, in addition to physiotherapy recommendations for spinal hygiene. Her radiological review in the postoperative period and at one year of clinical follow-up shows stability and segmental alignment without functional limitations (Figure 2). The hybrid approach to achieve transpedicular system extension without altering the already stable segment is an alternative for the selective management of ASD.

Discussion

In the last decade, knowledge of ASD has significantly increased. ASD refers to adjacent disc degeneration after a segmental spinal fusion surgery which can cause radiculopathy, stenosis, myelopathy, or instability [1,2] The increasing frequency of spinal fusion also heightens the need for preventive measures because approximately 25.8% of spinal fusion cases require reoperation within 5–20 years of follow-up [8]. The incidence of reoperation is 8%, particularly in male patients with longer fusion constructs involving multiple levels [9].

Several studies have described the risk factors for developing ASD; however, some categorizations are still controversial. Some of these risk factors include a body mass index of ˃25, a history of smoking, arterial hypertension, preoperative disc degeneration (Pfirrmann's classification, ˃3), and spinal fusion of ≥3 levels. Other possible risk factors include age, gender, and spinal fusion ending at the L5 level [3-5] (Table 1).

The pathophysiology lies in the modification of movement biomechanics at the adjacent segment. A study showed a correlation between paraspinal muscle injury and accelerated disc degeneration [4], due to spinal instability, which leads to an expanded range of motion in the adjacent intervertebral joint [1,10-12] Therefore, muscle activity increases to maintain balance in the upright position, intensifying forces and stress concentrations at the adjacent disc [1,5,8,11,12].

The mainstay of treatment for pain management initially involves nonsurgical methods. The surgical options involve fusion/decompression surgery, spinal cord stimulation, and adhesiolysis [13]. Spinal cord stimulation has been reported as the preferred initial approach. However, if it fails, an interspinous process device (IPD) should be implanted percutaneously [14-16]. In cases of spinal instability, spinal fusion is recommended as the best option [13].

Currently, several preventive methods are available. Current trends favor minimally invasive surgery and indirect decompression techniques such as anterior, lateral, and oblique lumbar interbody fusion, which have shown better outcomes compared to open surgery and direct decompression

Table 1. *Key facts regarding the adjacent segment disease.*

Definition of the ASD	Hilibrand [2] in 2004
Spinal cord stimulation as a better initial approach than spine fusion	North [15] in 2005 underwent a prospective randomized trial with 50 patients comparing spinal cord stimulation versus spine fusion surgery
Description of the topping off technique	Sénégas [12] in 2008
Lower incidence of ASD following minimally invasive over open surgery	Li [11] underwent a meta-analyses including 770 patients
Percutaneous implantation of an Interspinous Process Decompression (IPD).	Deer [13] Treat Symptomatic Lumbar Adjacent-Segment Degeneration.
Lower incidence of ASD following indirect over direct decompression	Chang [17] underwent a meta-analysis including 576 patients
Different surgical strategies are evaluated with respect to the risk of ADS.	Bains [21] a cohort of 5291 patients.

ASD: Adjacent segment disease, IPD: interspinous process device

like posterior and transforaminal interbody fusion [17,18]. The topping-off technique (using an IPD over a hybrid stabilization device) or other dynamic stabilization systems (such as K-rod) are also recommended [19-21]. Recently, it has been considered that dynamic systems adjacent to the fused segment may prevent the development of ASD and may be considered as an alternative in these cases [22]

This case involves a history of lumbar transpedicular instrumentation performed 4 years ago for lumbar spinal canal stenosis and mechanical instability. A hybrid system is attached on the primary system, achieving distraction and alignment of the unstable segment without complications. The clinical evolution was satisfactory, without neurological deficits.

The hybrid approach to achieve transpedicular system extension without altering the already stable segment is another alternative for the selective management of ASD in specific cases where the same bar fixation system is unavailable.

Declaration of patient consent

The authors certify that appropriate patient consent has been obtained. All case data are fully integrated into the clinical record, with informed consent obtained for the surgical procedure and authorization for scientific publication. This report adheres to institutional ethical standards and was not registered as a clinical trial due to its single-case nature. As it does not involve the patient's identity, face or personal information, no ethical observations are applicable..

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Authorship List

- Design of the manuscript: RRZ
- Technical approach of the case and preparation of manuscript: RRZ, FVG, STG, LLR, CIRB, RML.
- Manuscript review: All authors discussed the case, commented on the manuscript and gave their final approval.

Conflict of interest

The authors declare that there is no conflict of interest.

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