

Full Endoscopic Transforaminal Lumbar Interbody Fusion Approach with Percutaneous Posterior Transpedicular Screw Fixation in a Case of Spondylolisthesis Grade I with L4-5 Central Stenosis

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A case of a 79-year-old male patient complaining of low back pain for 1 year is reported. His symptoms were aggravated in the last 3 months. The magnetic resonance imaging showed a grade I spondylolisthesis at L4-5 level with severe central stenosis. In order to achieve maximal posterior opening of the L4-5 level we chose to fuse the L4-5 level with posterior stabilization in prone position with four percutaneous intrapedicular screws, bolt fixation for active distraction and anteroposterior reduction of the listhesis. The percutaneous posterolateral endoscopic approach with foraminoplasty and progressive tissue dilatation allowed a less aggressive surgery (with a small skin incision of 15 mm of length) for the transforaminal lumbar interbody fusion (TLIF) avoiding the excision of the superior facet, which would have otherwise been necessary in a posterolateral minimally invasive techniques approach. The patient was discharged after 24 hours of the intervention and three days after surgery the patient was pain-free (visual analogue scale= 0 and oswestry disability index=2). To our knowledge this is the first time that an endoscopic approach is used for a TLIF cage fusion instead of a minimally invasive techniques approach.

Key Words: Endoscopy · Foraminoplasty · Percutaneous approach · Percutaneous transforaminal lumbar interbody fusion · Transpedicular screws.

INTRODUCTION

Transforaminal lumbar interbody fusion (TLIF) is an unilateral posterior approach for achieving an interbody arthrodesis and an effective method for the management of degenerative lumbar spondylolisthesis.

Several studies have already extensively described the advantages of minimally invasive techniques (MIS) in comparison to the traditional open surgery for instrumented TLIF.¹ The purpose of this paper is to show the feasibility of an endoscopic approach for an instrumented TLIF less invasive than the mentioned MIS TLIF.

For this purpose, a case of L4-5 grade I spondylolisthesis is presented that was treated successfully using this new endoscopic approach for TLIF.

Patient introduction

A 79-year-old male patient complained of low back pain

for 1 year and his symptoms were aggravated in the last 3 months. He is a former mechanic car worker (retired). He was not able to walk more than 3 minutes in upright position without rest and then only in forward flexion. The patient complained of weakness in the lower extremities and of night pain in both legs. The patient indicated relief of pain in forward flexion.

On physical examination he could not perform heel gait and he was not able to stand in upright position. No other neurological deficit was observed.

The magnetic resonance imaging (MRI) showed a grade I spondylolisthesis at L4-5 level with severe central stenosis (Fig. 1).

Diagnosis

The lumbar lateral X-ray images in forward flexion and extension showed an anterior displacement of 10 mm in extension and of 6 mm in flexion measured with the meth-

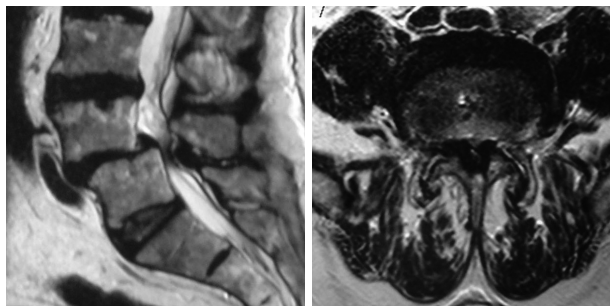


Fig. 1. Sagittal and axial MRI showing a spondylolisthesis L4-5 grade I with severe central stenosis.

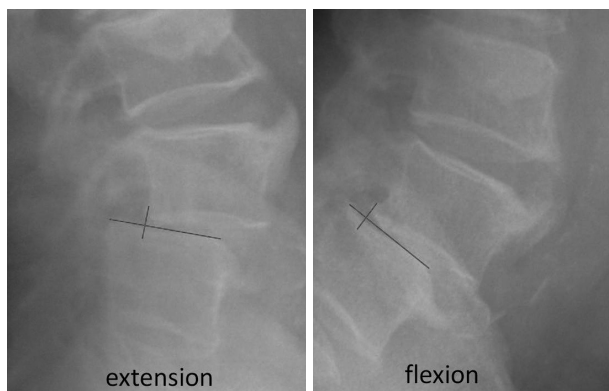


Fig. 2. Lateral X-ray in extension and in forward flexion with measurement of the vertebral slip at level L4-5.

od described by Bourassa-Moreau et al (Fig. 2).²

A pre-op Oswestry disability index (ODI) final score of 38 (in a scale of 50) and a visual analogue scale (VAS) for pain back score of 9 and VAS leg score of 6 (in a scale of 10) was registered. The evolution of the clinical symptoms in the last 3 months had been severe enough to suggest, in our opinion, a posterior fixation with interbody fusion of the L4-5 disc level.

Surgical plan

Taking in consideration the advanced age of the patient, a new full endoscopic percutaneous transforaminal approach was chosen to fuse the level L4-5 instead of a MIS transforaminal approach.

In order to achieve maximal posterior opening of the L4-5 level under fluoroscopic view the patient should be set in prone position and forward flexion. A posterior stabilization with four percutaneous intrapedicular screws with bolt fixation should permit achieving an active distraction and anteroposterior reduction of the listhesis.

To perform the insertion of a polyetheretherketone (PEEK) cage (Vertiflex Inc., San Clemente, CA, USA) filled with β TCP an endoscopic transforaminal approach with previous foraminoplasty was planned.

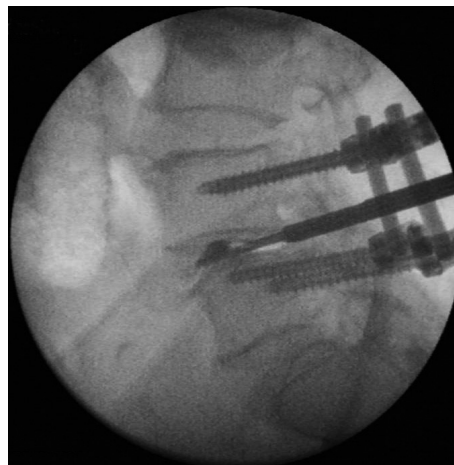


Fig. 3. Fluoroscopic image showing progressive dilatation with penetration at the L4-5 disc and the posterior fixation with transpedicular screws and bolts.

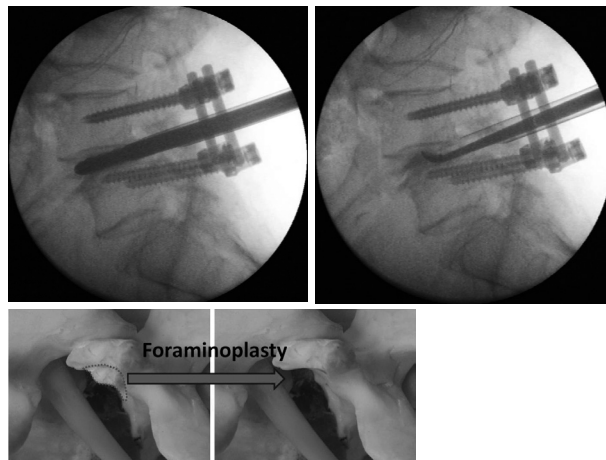


Fig. 4. Disc drilling and endplate grasping through the endoscopic beveled cannula.

Procedure

Surgery was performed under general anesthesia. The patient was operated in prone position and in forward flexion. Four small percutaneous skin incisions (15 mm each) parallel to the midline were performed. Four percutaneous cannulated titanium screws were inserted transpedicularly at L4 and L5 levels using the modified "Magerl" technique³ under fluoroscopic control. With the aid of four percutaneous towers, two titanium bolts were inserted and fixed after a previous active distraction and anteroposterior (AP) listhesis reduction.

The following implant elements were used for this operation: 2 screws (6.5×50 mm) for the L4 level, 2 screws (6.5×50 mm) for the L5 level and 2 bolts (40 mm length), all part of the Silverbolt® system (Vertiflex Inc., San Clemente, CA, USA).

Using the transforaminal posterolateral approach de-

scribed by Yeung and Tsou⁴ a 18G needle was inserted at the L4-5 disc. A contrast discography with indigo carmine (Taylor Pharmaceuticals, Decatur, IL, USA) diluted with iopamidol 300 1 : 10 was performed to confirm the segmental level of degeneration. Progressive tissue dilatation was achieved by placing a bevelled cannula of 7.5 mm of outer diameter through a 15 mm skin incision. The cannula was inserted until reaching contact with the foraminal border of the annulus (Fig. 3). Reamed foraminoplasty⁵ was then performed under endoscopic vision using a 30° endoscope with an outer diameter of 6.3 mm and a working channel of 3.7 mm (Joimax GmbH, Karlsruhe, Germany) to undercut the superior facet and to enlarge the foramen without touching or harming the neural structures. The foraminoplasty is mandatory to enlarge the foramen allowing later the cage insertion without harming the exiting root (Fig. 4). Degenerated nuclear material was also removed.

Disc and endplate drilling with a Ø 9 mm drill (Hoogland Spine Systems GmbH, München, Germany) and endplate grasping was carried out, through the endoscopic cannula (Fig. 4) using an eroder (Vertiflex Inc., San Clemente, CA, USA). A progressive cannula dilatation up to Ø 12.9 mm was performed. Then, a cage probe was placed into the

disc through the Ø 12.9 mm straight cannula. The placement of the probe was controlled fluoroscopically until an optimal location inside the disc was reached. After retrieving the probe, an 8×25 mm PEEK cage filled with 1 mL of β -tricalciumphosphate paste (Ostim 35® by Vertiflex Inc., San Clemente, CA, USA) was introduced through the percutaneous Ø 12.9 mm straight cannula under C-arm fluoroscopic lateral control (Fig. 5, 6) in order to promote a regular fusion at the L4-5 disc level.

Finally the skin and fascia were sutured with resorbable Vicryl 00.

RESULTS

Result of operation

The overall operation time was of 2 hours and the patient remained for 1 hour in the recovery room under I.V. analgesia. Postoperative computed tomography (CT) scan pictures were taken (Fig. 7, 8) in order to control the location of the fusion cage and the positioning of the transpedicular screws.

The same day of the intervention the patient was able to walk in upright position and without forward flexion. The

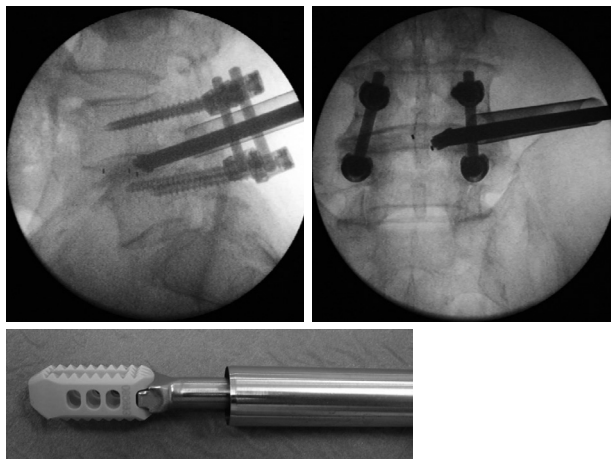


Fig. 5. Lateral and AP fluoroscopic view of the PEEK cage delivery system through the 12.9 mm Ø straight cannula.

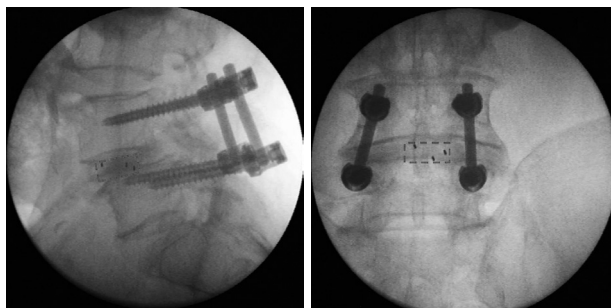


Fig. 6. Lateral and AP fluoroscopic images showing the final position of the PEEK fusion cage in place at L4-5 level with the posterior pedicular screws fixation system.

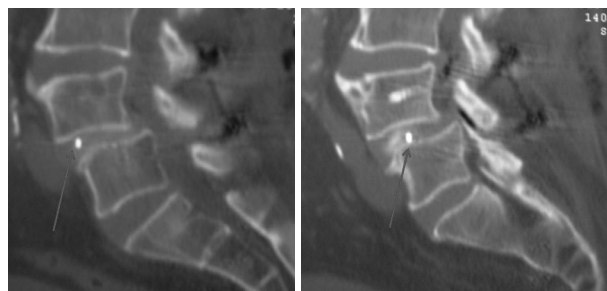


Fig. 7. CT scan post-op control in sagittal view with the fusion cage's position markers.

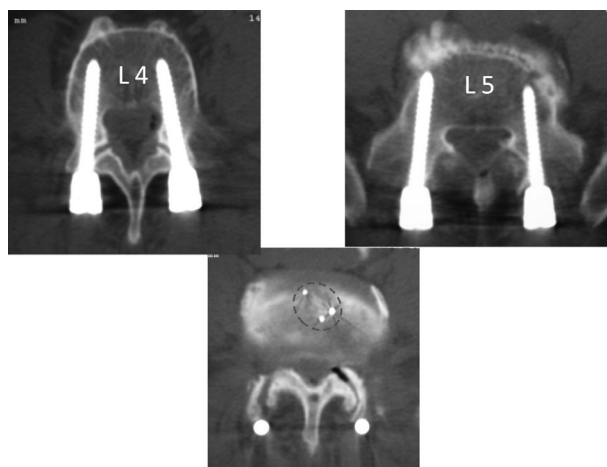


Fig. 8. CT scan post-op control: axial view with transpedicular screws at L4 and L5. Fusion cage markers can be seen at the L4-5 disc.

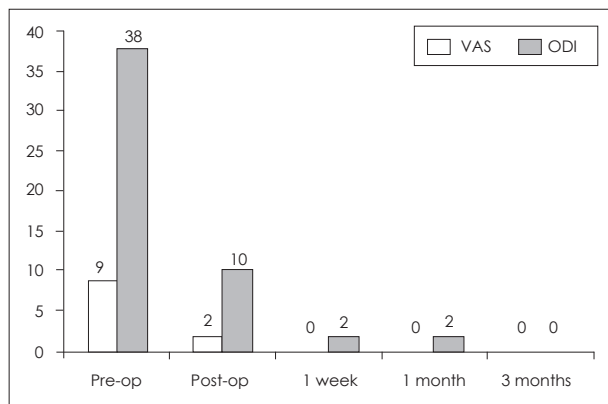


Fig. 9. VAS and ODI time evolution.

patient was discharged less than 24 hours from his admission for surgery. At that time the patient referred only light back pain (VAS=2) that was controlled with oral analgesia and anti-inflammatory drugs. Three days after the intervention the patient was pain-free (VAS=0, ODI=2).

The follow-up evolution of the patient's VAS and ODI scores can be seen in Fig. 9.

Pitfalls & complications

No pitfalls and/or complications of this operation were observed.

DISCUSSION

In our opinion, the central stenosis at L4-5 level had been aggravated by the progressive evolution of the spondylolisthesis. A percutaneous pedicle screw and bolt placement through four access towers was less aggressive for the patient, conditioned by his advanced age, than open surgery and allowed the convenient distraction and reduction of the spondylolisthesis (Fig. 10).

The percutaneous posterolateral endoscopic approach with foraminoplasty and progressive tissue dilatation allowed a less aggressive approach (with a small skin incision of 15 mm) for the TLIF, avoiding the excision of the superior facet that would otherwise have been necessary in a posterolateral MIS approach. To our knowledge this is the first time that an endoscopic approach is used instead of a MIS approach for a TLIF cage fusion.

Furthermore the smallest skin incision for TLIF that we have found in the literature was of 30 mm of length¹ in a MIS approach that requires a time to ambulation of 3.2 ± 1.9 days and a hospital stay of 9.3 ± 2.6 days. In this new percutaneous endoscopic TLIF approach the incision was of only 15 mm of length with a time to ambulation of 6 hours and a total hospitalization time of less than 24 hours (Fig. 11). The current follow-up is 3 months and the out-

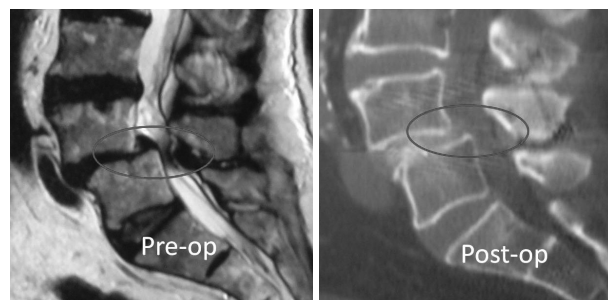


Fig. 10. Pre-op MRI with comparative CT scan post-op control: active slight reduction of the spondylolisthesis.

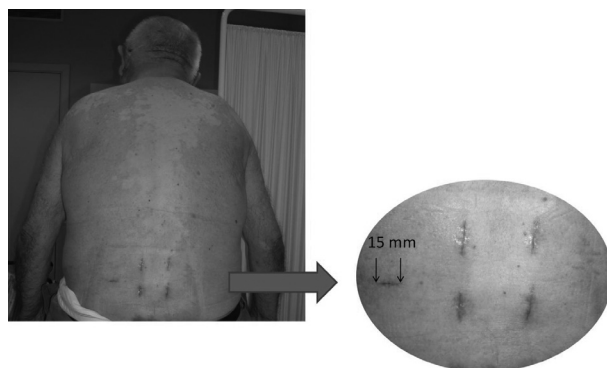


Fig. 11. Five 15 mm small skin scars resulting from the incisions of percutaneous TLIF approach.

come until now has been "excellent" according to Macnab⁶ criteria.

The fusion cage and the transpedicular screw fixation system employed here have been extensively previously described and employed in the literature.¹ The novelty of this study resides in the employed TLIF posterolateral approach with an endoscope to visualize and protect the exiting nerve root while performing a foraminoplasty. This was performed instead of cutting the inferior portion of the lamina, the superior and inferior articular processes, and ligamenta flava, as described by Shunwu et al.¹

In summary, the recuperation time of our patient within the first week was faster than MIS techniques¹ due to a minimized aggression given by the described new endoscopic TLIF cage placement, while the expected evolution of the fusion procedure should not differ from other MIS or open techniques.

CONCLUSIONS

Our patient's recovery was fast and satisfactory. Pain improved in the first week from VAS=9 to VAS=0. The endoscopic TLIF with percutaneous posterior transforaminal screw stabilization is less aggressive than open or MIS TLIF surgery and seems to be a promising technique for patients with spondylolisthesis up to grade I. Longer series

with a broader follow-up must be necessary in order to address the effectiveness of the presented endoscopic technique.

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