European Review for Medical and Pharmacological Sciences 2019; 23: 2340-2344

Isthmic spondylolisthesis and interspinous process device. Hype, hope, or contraindication?

V. PIPOLA, A. GASBARRINI, M. GIROLAMI, C. GRIFFONI, R. ZACCARO, G. BARBANTI BRÒDANO

Department of Oncologic and Degenerative Spine Surgery. IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy

Abstract. – OBJECTIVE: The aim of this study is to investigate, through the analysis of a case report and the literature review, indications and contraindications of Interspinous Process Device (IPD) in the surgical treatment of Lumbar Isthmic Spondylolisthesis (LIS).

PATIENTS AND METHODS: A 37-years-old male with L5-S1 grade 2 LIS, treated with IPD at another center, referred to us eight months later with a worsening of back and leg pain. A revision surgery was performed with IPD removal and a L5-S1 TLIF.

RESULTS: Clinical evaluation highlighted an improvement of pain, functionality, and quality of life scores at six months (VAS 4; ODI 30; EQ-5D 70) and twelve months follow-up (VAS 1; ODI 20; EQ-5D 90). CT scan was performed at six months and one-year follow-up to evaluate the fusion rate and stability of the implant.

CONCLUSIONS: Given the pathologic anatomy and the biomechanics of LIS, IPD is ineffective in preventing further vertebral body slippage resulting in segmental kyphosis, because of the lack of connection between the posterior arch and the vertebral body due to the isthmic lesion.

Key Words:
Lumbar isthmic spondylolisthesis, Interspinous process device, TLIF.

Introduction

Interspinous Process Devices (IPDs) have been developed to provide a dynamic spinal stabilization in order to avoid or improve decompression in Lumbar Spinal Stenosis (LSS)[1]. IPDs placement reduces sagittal extension, intra-discal pressure, unloads facet joints, restores foraminal height and provides spinal stability being minimally invasive[2-4].

The use of IPDs has been investigated in the treatment of LSS due to Degenerative Spondylolisthesis with controversial results.

The aim of this paper is to investigate, through the analysis of a case report and the review of literature indications and contraindications, the use of IPDs in the treatment of Isthmic Spondylolisthesis.

Case Report

A 37-years-old male suffered since several years of back pain because of L5-S1 grade 2 isthmic spondylolisthesis. In June 2016 he underwent a L5-S1 interspinous fixation at another hospital with no relief of symptoms. He was referred to our center eight months later, complaining a worsening of back pain and legs pain and bilateral paresthesia in L5. X-ray, MRI, and CT scan analysis revealed L5-S1 instability due to spondylolisthesis and L5 nerve root impingement due to bilateral foraminal stenosis (Figure 1). Clinical evaluation was performed by auto-administered questionnaires for pain (VAS, Visual Analog Scale), functionality (ODI, Oswestry Disability Index) and quality of life (EQ-5D, EuroQoL-5D): VAS score was 8, ODI score 42 and EQ-5D score 50.

The Authors decided to perform a revision surgery consisting in interspinous device removal and L5-S1 transforaminal interbody fusion by insertion of a carbon fiber cage, posterior fixation with titanium screws and bone graft for spinal fusion[5] (Figure 2).

The clinical evaluation highlighted an improvement of pain, functionality, and quality of life scores at six months (VAS 4; ODI 30; EQ-5D 70) and twelve months follow-up (VAS 1; ODI 20; EQ-5D 90). CT scan was performed at six months and one-year follow-up to evaluate the fusion rate and stability of the implant[6] (Figure 3).

Discussion

IPDs have gained popularity as a surgical treatment for lumbar spinal stenosis showing

Corresponding Author: Valerio Pipola, MD; e-mail: valeriopipola@gmail.com

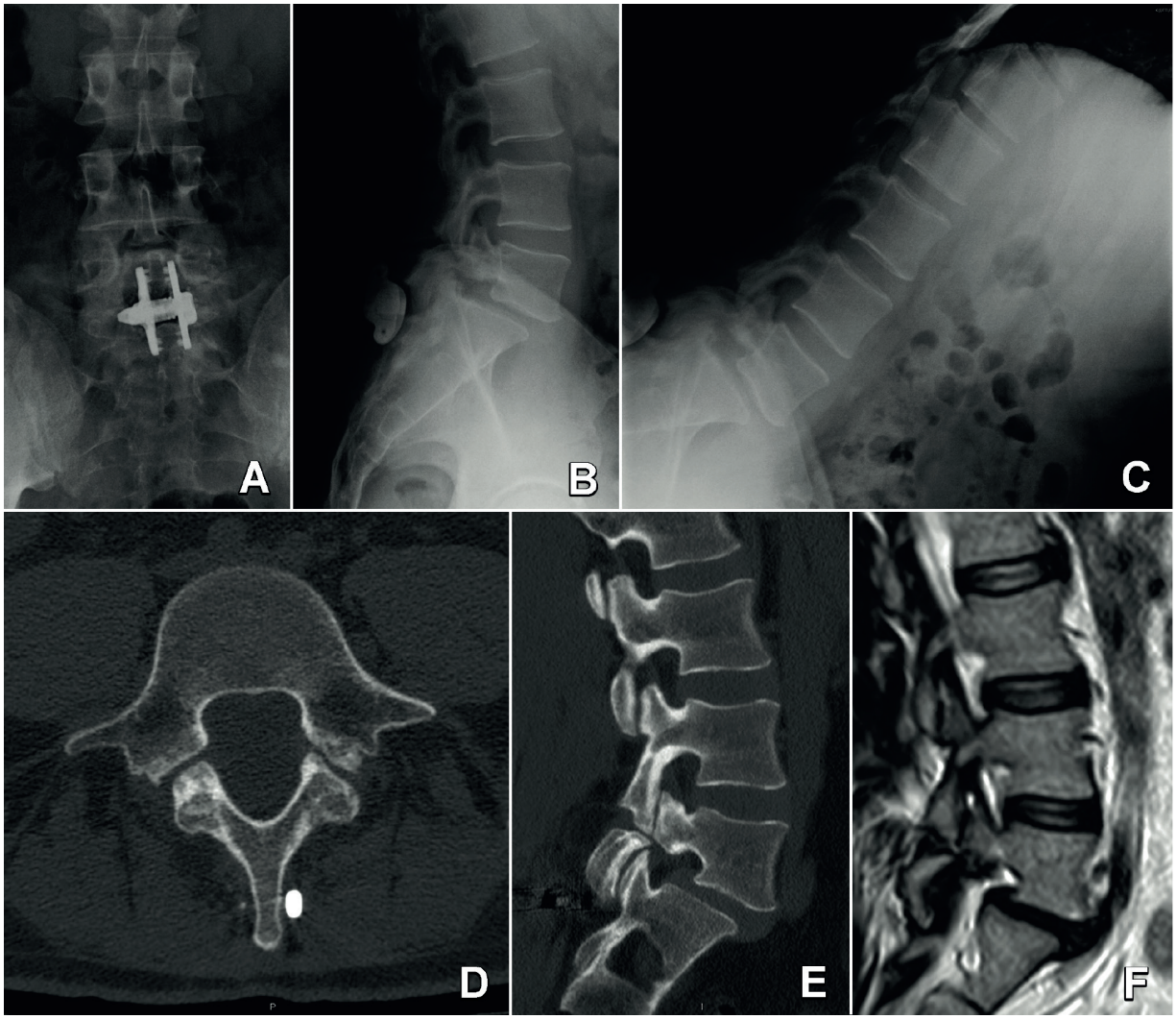

Figure 1. Radiological assessment performed after the treatment of IPD placement, showing that isthmic spondylolisthesis is still present. Anteroposterior ***(A)***, lateral ***(B)*** and flexion standing ***(C)*** radiographs; axial ***(D)*** and sagittal ***(E)*** CT scan; sagittal MRI ***(F)***, showing the degeneration of the L5-S1 intervertebral disc.

to be effective in reducing symptoms of lumbar spinal stenosis thanks to a constant distraction of spinous processes[7,8]. The indications seem to be rather narrow, and the clinical efficacy of IPDs has to be still verified. However, IPDs are being extensively used beyond their classical indications with the inevitable risk of a clinical failure.

In the last decade, research focused on degenerative spondylolisthesis (DS) producing (or worsening) lumbar spinal stenosis, highlighting it as a contraindication to the use of these devices[9-14]. Bohm et al[14] reported about six patients treated by IPD because a grade I spondylolisthesis; all patients reported improvement in symptoms since two weeks to two months, but all patients reported recurrence of symptoms, including back and leg pain and weakness or numbness in one or both legs; in some cases, these symptoms progressively worsened; all patients need revision surgery and fusion. The study published by Verhoof et al[12] in 2008 is the most frequently cited study recommending that any degree of spondylolisthesis should be considered a contraindication for IPD placement. The authors reviewed the medical charts of nine patients affected by grade 1 spondylolisthesis and treated by IPD placement. They found that re-intervention was required in 67% of these patients. Bowers et al[13] and Puzzilli et al[14] endorsed

the recommendation that even grade 1 spondylolisthesis should be considered a contraindication for IPD placement. Puzzilli et al[14] reported that in five cases of spondylolisthesis at three years follow-up, IPD removal was required and followed by decompression with instrumented fusion. The authors concurred that IPD should not be used in patients with spondylolisthesis suitable for instrumentation with pedicle screws.

To the authors' best knowledge, there are no reports available in the literature on the effectiveness of IPDs in treating symptoms and preventing further slippage in lumbar isthmic spondylolisthesis.

Pathoanatomy and biomechanics of LIS are completely different from that of DS in the presence of a lysis in the pars interarticularis that constitute a break in continuity in the posterior arch[15,16]. As a consequence, it becomes less effective in opposing to shear-stress forces so that anterior slippage might occur (Figure 4). Signs and symptoms are related to nerve roots compression and to mechanical instability associated to the slippage of the vertebral body. In this biomechanical environment, there is no rationale to endorse the use of IPDs to prevent further vertebral body slippage, because of the lack of connection between the posterior arch and the vertebral body.

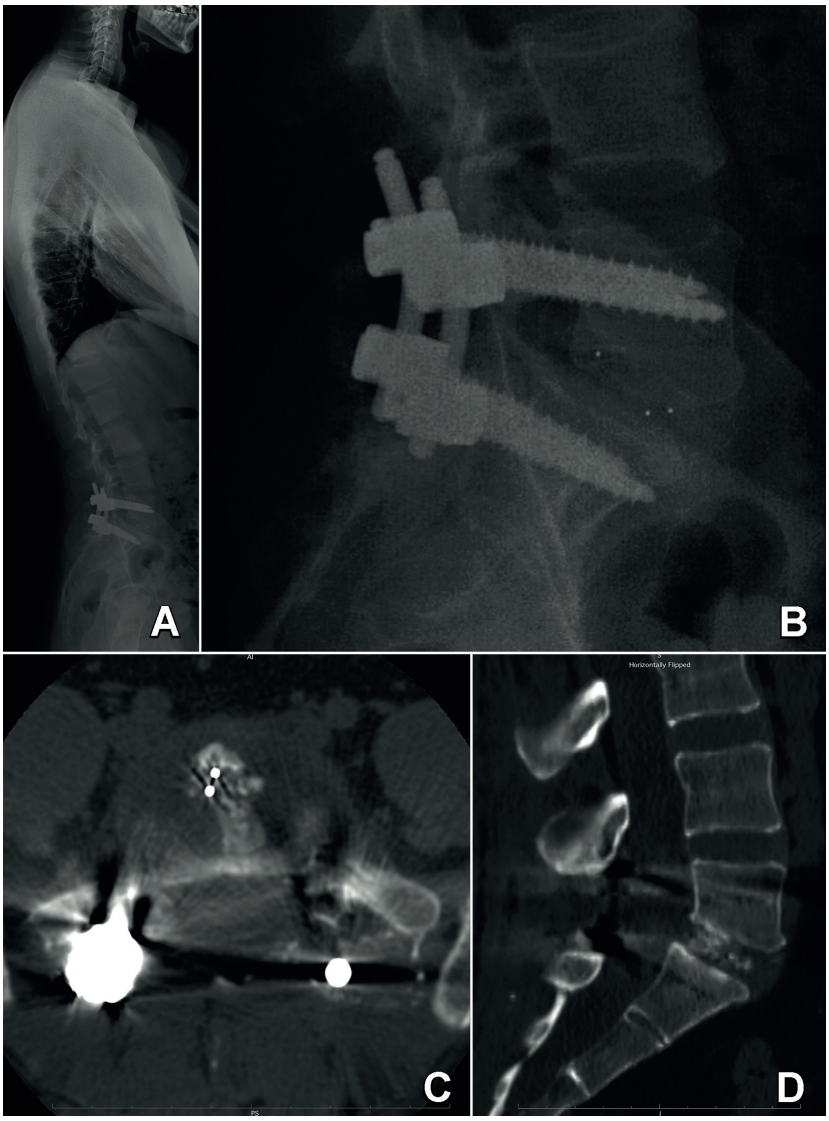

Figure 2. Radiological assessment performed six months after the revision surgery, showing TLIF fusion rate grade 2 according to Williams's Criteria. Lateral radiographs of the whole spine ***(A)*** and of the lumbar spine ***(B)***; axial ***(C)*** and sagittal ***(D)*** CT scan.

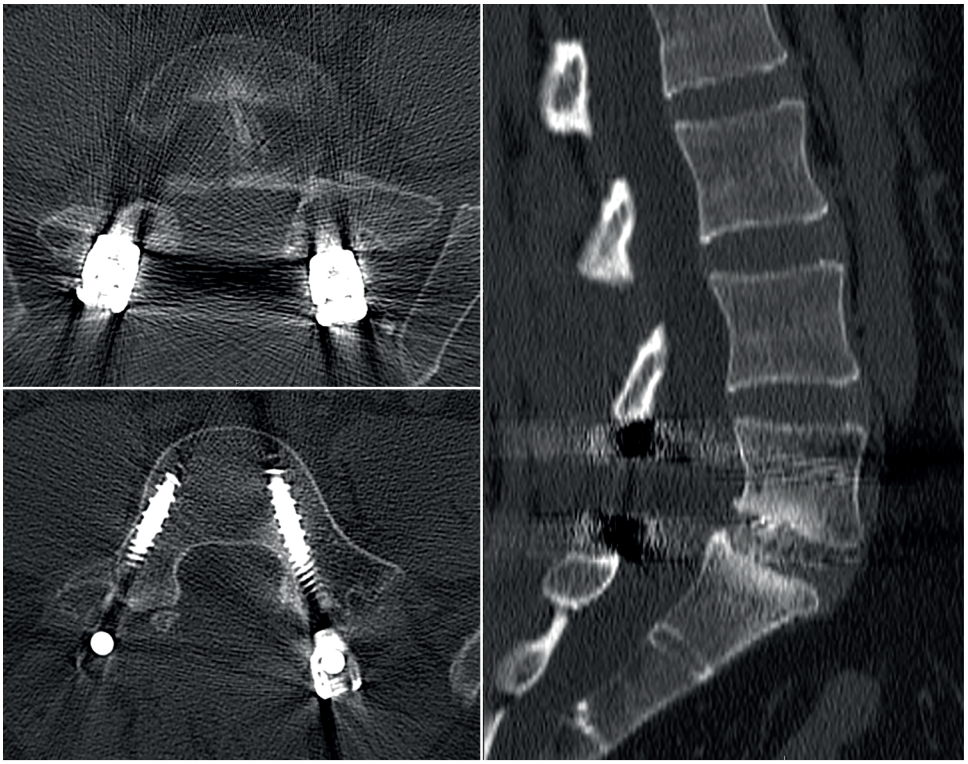

Figure 3. CT scan performed at 1-year follow-up shows the stability of the implant and TLIF fusion rate grade 1 according to Williams's criteria.

In the present report, the symptoms of the patient have been worsened by the use of IPD so that early revision procedure was deemed necessary. In particular, the choice to use it at L5-S1, which should be the most lordotic segment, produces a focal kyphotic deformity that makes long-term success even less likely to occur. The decision to revise it by circumferential fusion allowed to achieve a reduction by means of ligamentotaxis as reported by Sears[17,18].

Conclusion

The most useful approach for the surgical treatment of isthmic spondylolisthesis remains

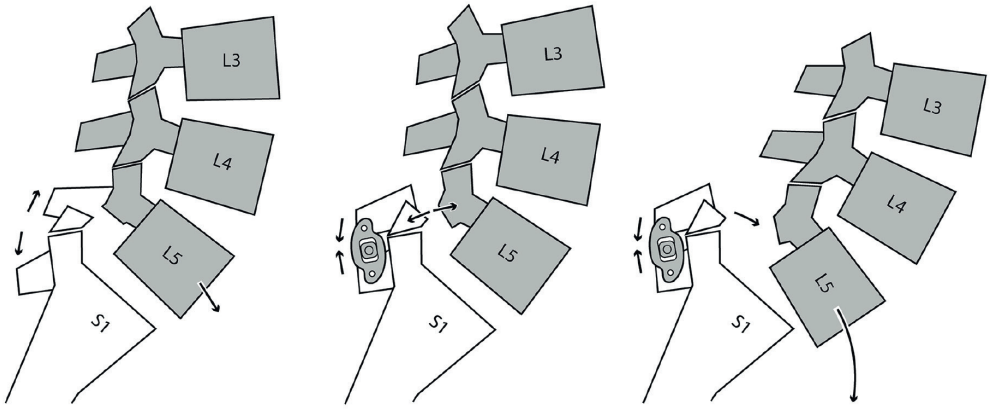

Figure 4. The interspinous device is ineffective in preventing further vertebral body slippage resulting in segmental kyphosis, because of the lack of connection between the posterior arch and the vertebral body due to the isthmic lesion.

a topic of controversy and debate. Concerning the use of IPDs in lumbar spondylolisthesis, they represent a contraindication for the treatment of LSS due to grade 1 spondylolisthesis, and it represents an absolute contraindication also in case of isthmic spondylolisthesis, although stronger evidence is required to endorse this conclusion.

Conflict of Interest

The Authors declare that they have no conflict of interest.

Statement

The Authors state that the paper was realized with the contribution of 5x1000 Grant - Healthcare Research of the Italian Ministry of Health. The Authors declare they have no conflict of interest about this work. Written informed consent for data and images publication was provided by the patient.

Acknowledgments

The authors thank Carlo Piovani for his helpful collaboration in image editing.

References

1) Gunzburg R, Szpalski M, Callary SA, Colloca CJ, Kosmopoulos V, Harrison D, Moore RJ. Effect of novel interspinous implant on lumbar spinal range of motion. Eur Spine J 2009; 18:696-703.
2) Dai LY, Xu YK, Zhang WM, Zhou ZH. The effect of flexion-extension motion of lumbar spine on the capacity of spinal canal. An experimental study. Spine 1989; 14:523-525.
3) Bono CM, Vaccaro AR. Interspinous process devices in the lumbar spine. J Spinal Disord Tech 2007; 20:255-261.
4) Lindsey DP, Swanson KE, Fuchs P, Hsu KY, Zuchermsn JF, Yerby SA. The effects of an interspinous implant on the kinematics of the instrumented and adjacent levels in the lumbar spine. Spine 2003; 28: 2192-2197.
5) Barbanti Bròdano G, Lolli F, Martikos K, Gasbarrini A, Bandiera S, Greggi T, Parisini P, Boriani S. Fueling the debate: are outcomes better after PLIF or after PLF in adult patients with low grade adult isthmic spondylolisthesis? Evid Based Spine Care J 2010; 1: 29-34.
6) Tan GH, Goss BG, Thorpe PJ, Williams RP. CT-based classification of long spinal allograft fusion. Eur Spine J 2007; 16:1875-1881.
7) Christie SD, Song JK, Fessler RG. Dynamic interspinous process technology. Spine 2005; 30: S73-S78.
8) Richards JC, Majumdar S, Lindsey DP, Beaupre GS, Yerby SA. The treatment mechanism of an interspinous process implant for lumbar neurogenic intermittent claudication. Spine 2005; 30: 744-749.
9) Bohm PE, Anderson KK, Friis EA, Arnold PM. Grade 1 spondylolisthesis and interspinous device placement: removal in six patients and analysis of current data. Surg Neurol Int 2015; 6:54.
10) Siewe J, Selbeck M, Koy T, Röllinghoff M, Eysel P, Zarghooni K, Oppermann J, Herren C, Sobottke R. Indications and contraindications: interspinous process decompression devices in lumbar spine surgery. J Neurol Surg A Cent Eur Neurosurg 2015; 76: 1-7.
11) Gazzeri R, Galarza M, Neroni M, Fiore C, Faiola A, Puzzilli F, Callovini G, Alfieri A. Failure rates and complications of interspinous process decompression devices: a European multicenter study. Neurosurg Focus 2015; 39: E14.
12) Verhoof OJ, Bron JL, Wapstra FH, van Royen BJ. High failure rate of the interspinous distraction device (X-¬Stop) for the treatment of lumbar spinal stenosis caused by degenerative spondylolisthesis. Eur Spine J 2008; 17: 188-192.
13) Bowers C, Amini A, Dailey AT, Schmidt MH. Dynamic interspinous process stabilization: review of complications associated with the X-¬Stop device. Neurosurg Focus 2010; 28: E8.
14) Puzzilli F, Gazzeri R, Galarza M, Neroni M, Panagiotopoulos K, Bolognini A, Callovini G, Agrillo U, Alfieri A. Interspinous spacer decompression (X¬-Stop) for lumbar spinal stenosis and degenerative disk disease: a multicenter study with a minimum 3-¬year follow-up. Clin Neurol Neurosurg 2014; 124: 166-174.
15) Richolt JA, Rauschmann MA, Schmidt S. Interspinous spacers-technique of Coflex implantation. Oper Orthop Traumatol 2010; 22: 536-544.
16) Siepe CJ, Heider F, Beisse R, Mayer HM, Korge A. Treatment of dynamic spinal canal stenosis with an interspinous spacer. Oper Orthop Traumatol 2010; 22: 524-535.
17) Sears W. Posterior lumbar interbody fusion for lytic spondylolisthesis: restoration of sagittal balance using insert-and-rotate interbody spacers. Spine J 2005; 5: 161-169.
18) Xia ZL, Wang Y, Sun QD, Du XF. MiR-203 is involved in osteoporosis by regulating DKK1 and inhibiting osteogenic differentiation of MSCs. Eur Rev Med Pharmacol Sci 2018; 22: 5098-5105.