Standalone Anterior Interbody Fusion Procedure for the Treatment of Low-Grade Spondylolisthesis: A Case Series

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ABSTRACT

OBJECTIVE: Spondylolisthesis may cause local instability, facet distraction, and central and foraminal stenosis. A common surgical approach is to reduce and to stabilize the olisthesis posteriorly with pedicle screws and rods. In this work we propose an anterior one-stage approach for the treatment of spondylolisthesis, without direct decompression of neural structures nor posterior supplementation.

AIM: This article reports an innovative way to reduce and stabilize low grade isthmic or degenerative lumbar spondylolisthesis by a minimal invasive anterior approach in a standalone construction.

MATERIALS and METHOD: Eight patients and nine lumbar levels were treated through the mini-ALIF procedure. It was used an unique interbody cage, which has screws and a hollowed screw that pass through the device and reach at the upper lower vertebral body. Radiological and clinical data were collected at pre, intra and postoperative (one and six weeks, three, six and twelve months) follow-up visits.

RESULTS: The average surgical time was 108 minutes and no intraoperative complications occurred. One postoperative complication was observed: post-surgical seroma, which was solved after intervention. Successful clinical results were testified in VAS an ODI scores. VAS and ODI scores decreased at postoperative visits.

We can say that in all cases were achieved the surgical objectives: disc height gain, olisthesis correction, spine level stabilization, axial and/or radicular pain reduction.

CONCLUSION: Low grade spondylolistheses was treated using stand alone anterior interbody fusion device without posterior decompression and supplementation. Good clinical and radiological results were achieved, providing the efficacy of the procedure in the treatment of different spondylolisthesis etiologies.

KEY WORDS: ALIF, Arthrodesis, Lumbar, Spine, Spondylolisthesis

INTRODUCTION

Lumbar spondylolisthesis is often identified on clinical evaluations of patients with low back pain (5). It is defined as the forward slippage of one vertebra on its lower and has been classified into five major types based on both etiological and anatomical factors (15). The most common etiologies are degenerative and isthmic spondylolisthesis. The degeneration of the facet joints and intervertebral disc, and spondylolysis are responsible for the emergence of these respective pathologies (5). Although these two disease groups have a different pathogenesis, they represent unstable conditions of spine, and the treatment principles are the same. A good fusion is mandatory for good outcomes in isthmic and degenerative spondylolisthesis (8, 10).
The surgical goals in spondylolisthesis include stabilization of the affected level, decompression of neural elements, and restoration of the disc height and sagittal plane alignment. The stabilization is accomplished by arthrodesis from a posterior, anterior, or combined approach (7,11). The reconstruction of the anterior column is extremely important because 80% of the compressive, torsion, and shear forces are transmitted over the anterior column (4,15,16), and an interbody fusion enhances the opportunity for arthrodesis, generating biomechanical stabilization of the spinal segment (5,12,13). Minimally invasive anterior lumbar interbody fusion (mini-ALIF) is one of the surgical options for the treatment of spondylolisthesis, indirect decompressing the neural structures, overcoming the technical limitations of the different posterior approaches and providing segmental stabilization of the affected level (6, 9).

In this present study, we propose a new one-stage option using an interbody fusion device by mini-ALIF without the need of posterior decompression and supplementation for the treatment of low-grade spondylolisthesis.

METHODS

It is prospective non-randomized single-center evaluation of patients with low grade lumbar spondylolisthesis treated by standalone mini-ALIF. Clinical and radiographic data were analyzed to access safe and effectiveness of the proposed treatment.

There were eight enrolled patients from August 2009 through April 2010. Inclusion criteria were low grade (I or II) lumbar spondylolisthesis (degenerative or isthmic) on L5S1 and/or L4L5, central and foraminal clinical relevant stenosis, and at least 6 months of conservative care. Exclusion criteria were without previous surgical intervention (fusion or decompression) at the affected or adjacent spine levels, autoimmune disease, malignancy and pregnancy.

Radiographic evaluation included x-ray, magnetic resonance (MRI) and computed tomography (CT) images. Olisthesis values were represented by the percentage of slippage one vertebra over the lower one. Values from 0 to 25% were considered to represent a grade I spondylolisthesis, while values from 25% to 50% were classified as grade II.

Clinical self reported outcomes were assessed on Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) questionnaires.

Follow-up included preoperative and postoperative visits, on one and six weeks, three, six and 12 months.

Seven cases were single level treated (L5S1) and one case was double level treated (L4L5 and L5S1). The surgeries were performed through a mini-ALIF using a retroperitoneal approach, without any posterior supplementation. Disc exposure was followed by ALL removal, partial discectomy, endplate preparation, disc space distraction and interbody device insertion, two screws (proximal) and one screw cage (distal) threading. The interbody cage was filled with silicate substituted synthetic calcium phosphate bone graft (Actifuse ABX®, Baxter International Inc.).

The interbody device Fusimax Cage on Cage (MDT, São Paulo, Brazil; Figure 1) is a titanium lordotic cage with two screws directed to the upper vertebra and a caudal directed hollow screw, which may act as another cage. So the primary fusion is either performed by anatomical pressures over the device and by the screws fixation, while the secondary fusion could be achieved by bone growth athwart both intravertebral and interbody cages.

Statistical analyzes were performed through t-Student tests considering 95% confidence intervals.

RESULTS

Five males and three females were enrolled. The case series was characterized by a mean age of 43.4 years old and 28.4 average BMI. Discectomy and interbody cage placement were performed on eight L5S1 levels and on one L4L5 levels. Mean surgical time was 108 minutes with 100cc average blood loss. At the point this article the mean follow-up is eight months (3 – 12, range). No intraoperative complication occurred. Average hospital discharge was 30 hours.

One access related complication occurred (12.5%), a patient evolved with abdominal seroma and solved after intervention. No other complication occurred.

Using a quantitative method for olisthesis assessment, preoperative x-rays evidenced that the studied patient group had 24% of mean slippage. X-ray analysis showed that the procedure achieved 50% correction (Figure 2). During the follow-up visits no significant subsidence or radiolucency has occurred.

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Through the outcome assessment in Visual Analogue Scale (Figure 3), we could observe consistent reduce in back pain and legs pain, data that statistically testify the value of individual radiological data and clinical reports. Also, ODI questionnaire scores testified clinical patient improvement (Figure 4).

**CASE EXAMPLES**

**Case #1**

H.J.C., male, 42 years old, back and leg pain for 2 years, worsening during the last year, unresponsive to conservative care. Spondylolisthesis L5S1 grade I (Figure
5). Preoperative VAS back and leg score, 95. Soon after surgery, radicular pain was totally solved and back pain was consistently reduced.

It was possible to observe in the preop MRI that the L5S1 intervertebral disc was dehydrated and posterior located to the L5 vertebrae (Figure 5). Posterior L5S1 intervertebral space was diminished, foraminal spaces were narrowed by L5 pedicle and by the disc.

Postoperative X-Rays show spondylolistes reduction, disc height augmentation and foraminal spaces widening (Figure 6). A good spine primary fusion result was achieved and can be observed in the dynamic X-Rays.

Case #2
E.I., male, 41 years old, with axial back pain for 20 years. During past two years feels irradiated bilateral pain, can’t stand. Degenerative Disc Disease (DDD) L4L5, spondylolistes L5S1 grade I, collapsed L5S1 disc and L5 pars fracture (Figure 7). Preoperative VAS back and both leg, 100. Pain reduced 70% one week after surgery.

In preoperative MRIs it was possible to verify bilateral stenosis with no central stenosis (Figure 7). Surgery achieved wide intervertebral space gain, which allowed L5 pedicle rise and foramen opening (Figure 8).

Case #3
E.G.S.N., male, 53 years old, axial and radicular pain for the past one year, not respondent to conservative care.

Retrolistesis L4L5, listhesis L5S1 and L4L5 facet luxation. L5 pars fracture (Figure 9). Preoperative VAS back = 100, VAS legs = 80.

Both affected lumbar levels were anteriorly approached and received the “Cage on Cage” interbody prosthesis. Soon after surgery patient referred 75% reduction in legs pain and 60% in back pain. The prostheses were well aligned and disc height gain was achieved as expected (Figure 9).

DISCUSSION
In the present article we report cases of low-grade spondylolistesis treated by minimally invasive anterior lumbar interbody fusion. The procedure did not included any posterior access, what may avoid posterior access related risks: neural damage or epidural scar as a result of avoiding contact with the thecal sac, back muscle injury and significant blood loss. Clinical emerging signs were substantially reduced after surgery and radiological assessments testified that the surgical objectives were reached and maintained in a medium term follow-up.

There are several surgical options for the treatment of spondylolisthes (3). Choice is influenced by many technical factors, including anatomic variation of patient and surgeon’s experience. Although the best surgical technique has not yet been determined, most surgeons have thought that posterior decompression, the so-called

Figure 5: Case #1 preoperative exams. On the top are shown MRI slices, one axial and 4 sagittal images. In the axial one is revealed the bottom L5 endplate. In the bottom exams there are dynamic X-Rays.
Figure 6: Case #1 postoperative X-Rays. Here are shown orthostatic lateral images in diverse postoperative time, also antero-posterior and dynamic images in 3 months follow-up visit.

Figure 7: Case #2 preoperative exams. On the top are shown MRI sagittal slices, within central and left and right lateral slices. Dynamic X-Rays are at the bottom images.

Figure 8: Case #2 postoperative X-Rays. Here are shown orthostatic lateral images in diverse postoperative time, also antero-posterior and dynamic images in 6 week follow-up visit.

Figure 9: Case #3 exams. On the top are shown preoperative images and in the bottom, 3 months follow-up X-rays.
Gill operation, is necessary for isthmic spondylolisthesis (15). However, the Gill procedure can often lead to spinal instability and deformity (16). To prevent the defects of posterior laminectomy, posterolateral fusion (PLF) and posterior lumbar interbody fusion (PLIF) were developed (17, 18). But for cases presenting degenerative disc disease require wide dissection of normal tissue and excessive neural retraction, excessive blood loss, increased postoperative pain and recovery time. Most posterior approaches cannot avoid the risk of neural damage.

Isthmic and degenerative are completely different entities in pathoanatomy and symptoms as well regarding indication for stabilization (19). Usually low grade isthmic does not need surgery (20), but we restricted it only for clinically and radiological relevant cases.

With disc height diminishing and slipped vertebrae, the foramen usually are stenosed by the disc and the pedicle (21). With the disc removal and interbody spacer insertion, it was possible to provide disc height gain and slippage correction. These changes may remove the damaged disc, possible pain generator; opening the foraminal spaces, decompressing the neural roots; stabilize treated spine levels, preventing abnormal movements to overstress facets, muscles and adjacent levels elements.

Moreover, for one-stage anterior lumbar fusion procedures it may be important to use a device with supplemental elements that increases primary fixation, prevents postoperative device misalignment and ensures the correction achieved on surgery.

Unfortunately, the cage material, titanium, does not allow us to access secondary fusion (bone ingrowth) on CT images. But through x-rays it is possible to measure range of motion (ROM), and accompanied to absent radiolucency signs on CT it is possible to access primary fusion success.

In this study, the one stage surgery provided the advantages of a minimally invasive surgical technique and reduced hospital stay. In conclusion, we demonstrate that the mini-ALIF technique without posterior decompression is a safe and effective technique for the treatment of low-grade spondylolisthesis with leg pain.

Future plans include to compare anterior interbody fusion versus posterior stabilization in a prospective randomized multicenter study for the treatment of low-grade spondylolisthesis.

**CONCLUSION**

It was possible to treat isthmic or degenerative spondylolisthesis with anterior interbody fusion without direct decompression nor posterior reduction and stabilization. To this point the procedure seems to be safe, radiological efficient and clinically effective, and other clinical studies are necessary to address the surgical feasibility of this procedure for this and other indications.

**BIBLIOGRAPHY**


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