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Original Article

# Spontaneous Spinal Arthrodesis in Stand-Alone Percutaneous Pedicle Screw Fixation Without in Situ Fusion in Patients With Lumbar Segmental Instability: Long-Term Clinical, Radiologic, and Functional Outcomes

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## Background

No study to date has established how commonly spontaneous fusion occurs after stand-alone percutaneous pedicle screw fixation in adult population. In this retrospective single-center study, we investigated the effectiveness, long-term solidity and safety of stand-alone percutaneous pedicle screw fixation without in situ fusion and the influence of presence or absence of fusion on the clinical outcome of patients with low-grade lumbar segmental instability.

## Methods

Eighty-eight patients with symptomatic low-grade spondylolisthesis were treated with posterior stand-alone percutaneous pedicle screw fixation without bone graft. Radiographic evaluation was used to determine if spontaneous fusion or absence of fusion was present. The solid fusion and absence of fusion groups were analyzed clinically (visual analog scale and Oswestry Disability Index) and with a validated self-administered questionnaire.

## Results

The average duration of follow-up was 70.5 months (range, 48–120 months). Radiologic signs of spontaneous fusion were present in 45.5% of the cohort and absent in 54.5%. Clinical outcome was excellent to good in 73.8% of the cohort (in 70.9% of cases with spontaneous fusion and in 67.5% of cases with absence of fusion). No significant differences in visual analog scale scores for residual back and lower limb pain between the 2 groups were seen at the final follow-up. At the final follow-up, 5 of 88 patients (5.6%) underwent revision surgery.

## Conclusions

Percutaneous pedicle screw fixation offers several advantages that help minimize approach-related morbidity, while achieving similar clinical outcome as seen with more traditional invasive procedures. A solid fixation without bone graft provides long-term clinical benefits. In our patients, the appearance of a spontaneous solid fusion and the absence of fusion after stand-alone pedicle screw fixation were correlated with similar improved clinical outcomes at long-term follow-up.

## Introduction

The optimal surgical approach for the management of adult lumbar degenerative instability has not yet been resolved. The mainstay principle of the treatment is to decompress and stabilize the involved spinal segment; the association of fusion in situ may obtain good long-term results.<sup>1, 2</sup> Spinal fusion is usually achieved by applying an autogenous or allogeneous bone graft over the decorticated bone surfaces; fusion, associated or not with instrumentation, can stabilize the unstable lumbar segments and also eliminate the source of pain originating from the affected intervertebral disc and facet joints.<sup>3</sup>

Standard techniques for pedicle screw stabilization with bone graft involve open exposure, which requires extensive tissue dissection. Independent of the technique and materials used for a rigid osteosynthesis, fusion has been always considered the goal. However, the solidity of the hardware is also considered critical to a definitive good outcome. If left untreated, most degenerative spinal conditions may lead to spontaneous fusion with the natural joining of 2 or more vertebrae. Moreover, spinal fixation without bone graft can speed up the natural process of fusion.<sup>4</sup>

The aims of pedicle screw instrumentation are generally to eliminate instability, indirectly allowing for decompression of the nerve roots by widening the neural foramina, and to correct theolisthesis, restoring the physiological sagittal alignment of the lumbar vertebral segment. The use of stand-alone percutaneous pedicle screw fixation offers several advantages over open approaches: it allows blunt separation of the muscles with reduction of soft tissue dissection and no bone decompression, with less risk of nerve/dural sac injuries, all factors associated with less blood loss and postoperative pain.<sup>3, 5</sup>

The solidity of the hardware is the key point of the osteosynthesis with percutaneous pedicle screw fixation, and in long-term follow-up it can be appreciated in 2 different scenarios: osteosynthesis with spontaneous fusion and osteosynthesis without fusion.

No study to date has established how commonly spontaneous fusion occurs after stand-alone percutaneous pedicle screw fixation in adult population. In the present study, we evaluated the clinical and radiologic outcomes, fusion rate, and long-term solidity of the hardware in patients who underwent stand-alone percutaneous pedicle screw fixation without posterolateral arthrodesis.

## Section snippets

### Patients

This was a retrospective, single-cohort, single-center, observational study of 88 consecutive patients with lumbosacral low-grade spondylolisthesis and advanced intervertebral disc degeneration who underwent surgery between 2006 and 2011. A clinical and radiologic review of spinal fixation was carried out in all patients, with a minimum follow-up of 48 months.

Patient demographic data and information on surgical indication, treatment level, operative details, and complications were collected ...

### Results

A total of 88 patients with lumbar minor instability who were surgically treated with percutaneous stand-alone fixation between 2006 and 2011 were enrolled in this single-center study. The subjects included 63 women and 25 men, with mean age at surgery of 59.1 ± 16.8 years (range, 31–81 years). Eighteen patients were active smokers, 5 patients had diabetes, and 4 patients had peripheral vascular disease. All 88 patients had clinically follow-up, with duration ranging from 48 to 120 months ...

### Discussion

The incidence of degenerative lumbar listhesis in the general population is approximately 4.1%, and it rarely occurs before age 50 years.<sup>7, 8, 9, 10</sup> Segmental instability has been defined by Bridwell et al.<sup>11</sup> as a sagittal translation difference of >3 mm between flexion/extension X-ray and a segmental angulation difference of >10 grades<sup>11</sup>; however, this definition lacks supporting evidence, and there remains no generally accepted definition of instability.

Degenerative lumbar instability can ...

### Conclusions

Surgical treatment of adult low-grade spondylolisthesis with advanced disc degeneration can be challenging. Standard goals of decompression, reduction, and fusion may require technically demanding and lengthy procedures that can lead to various surgical complications. Percutaneous pedicle screw fixation without in situ posterolateral and/or interbody fusion is an effective and safe surgical procedure, regardless of whether fusion is achieved. A better radiologic outcome does not always mean a ...

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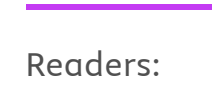
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