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Effect of PLIF and TLIF on sagittal spinopelvic balance of patients with degenerative spondylolisthesis

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ABSTRACT

Objective: The aim of this study was to evaluate the effects of PLIF and TLIF on sagittal spinopelvic balance and to compare radiological results of two surgical procedures with regard to spinopelvic parameters.

Methods: Thirty-five patients (34 female and 1 male; mean age: 52.29 ± 13.08 (range: 35–75)) with degenerative spondylolisthesis cases were included in the study. Patients were divided into two groups according to surgical technique: PLIF and TLIF. The level and the severity of listhesis according to Meyerding classification were assessed and spinopelvic parameters including sacral slope, pelvic tilt, pelvic incidence (PI), lumbar lordosis, and segmental lumbar lordosis were measured on digital X-rays. All preoperative and postoperative parameters and the results were compared between two groups.

Results: The age distribution was similar in both groups ($p = 0.825$) and there was no difference between the mean PI of the groups ($p = 0.616$). In 15 patients, spondylolisthesis level were at the L5-S1 level (PLIF: 8, TLIF: 7), in 16 patients at the L4-L5 level (PLIF: 6, TLIF: 10) and in 4 patients at the L3-L4 level (PLIF: 2, TLIF: 2). According to Meyerding classification, before the operation, the sliding grades were 0 in 4 patients, 1 in 21 patients, 2 in 7 patients, and 3 in 3 patients. The grades changed into 0 in 28 patients, 1 in 5 patients, and 2 in 2 patients after surgery. There were no differences in the grade of listhesis between PLIF and TLIF groups preoperatively ($p = 0.190$) and postoperatively ($p = 0.208$). In both groups, the spondylolisthesis-related deformities of patients were significantly corrected after surgery ($p < 0.001$).

Conclusion: PLIF and TLIF techniques have similar radiological results in restoring the sagittal spinopelvic balance in patients with degenerative spondylolisthesis. Both techniques are good options to achieve reduction and fusion in patients with degenerative spondylolisthesis, but have no advantage over each other for restoring spinopelvic balance.

Level of evidence: Level III, Therapeutic study.

Introduction

Degenerative spondylolisthesis is defined as slipping of one lumbar vertebral body onto a subjacent vertebral body due to degenerative deformation of articular and ligamentous structures in the elderly population.[1] Compensatory mechanisms such as facet and ligament hypertrophy and displacement may lead to compression neural elements, which further potentiate pain and disability.

Spondylolisthesis changes sagittal spinal alignment, which is one of the reasons for back pain.[2,3] Sagittal spinal balance refers to optimal configuration between the pelvis and spinal column in standing position.[4]

Sagittal spinal alignment is greatly influenced by spinopelvic parameters such as sacral slope (SS), lumbar lordosis (LL), pelvic tilt (PT), and pelvic incidence (PI).[2,5–7] In standing position, the morphology and position of the pelvis influence lumbar lordosis,

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which is important for sagittal spinal alignment.[6] In most studies PI for pelvic morphology and PT and SS for pelvic position over the femoral heads are used as pelvic parameters. Changes in LL resulted in compensation with pelvic retroversion.[8]

Posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) are two different interbody fusion techniques, which promise better fusion rate than standard posterolateral fusion.[9] The PLIF technique was first described by Cloward in 1940.[10] The TLIF technique was a modification of PLIF and described by Harms in 1998.[11] The main difference is that TLIF is performed with unilateral approach, preserving contralateral facet and laminar surface. PLIF and TLIF provide good outcomes in patients with degenerative spondylolisthesis, especially when the slip is accompanied by severe stenosis and major segmental instability (generally classified Meyerding grade II or higher).[12] Both techniques simultaneously offer the option of disc height restoration, which is crucial for LL.[13]

Biomechanical loads on intervertebral discs increase parallel to the decrease in the normal sagittal inclination of the lumbosacral vertebral column; it also shows that, in addition to other parameters analyzed in sagittal morphology, the sacral table and sacral kyphosis angles are important predisposing anatomical factors for the development of intervertebral disc degeneration and herniation.[14]

Sagittal imbalance has negative effect on patient's clinic. One of the main interest of these surgical techniques is to restore the balance and normalize patient daily life. As we know in literature correction of spinopelvic parameters improves patient clinic [7,8]. Both TLIF and PLIF have different mechanism on correction of lumbar lordosis. The purpose of this study was to evaluate the effects of PLIF and TLIF on sagittal spinopelvic balance and to compare radiological results of two surgical procedures with regard to spinopelvic parameters.

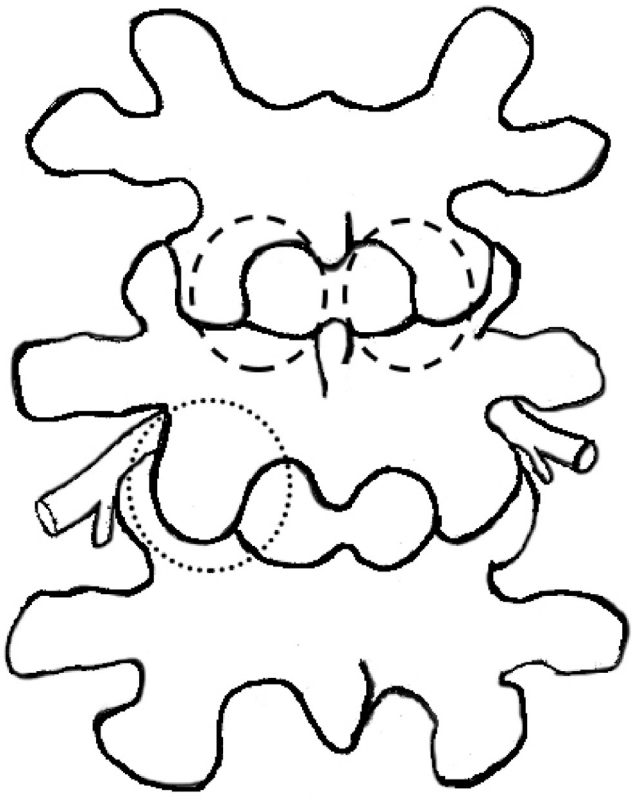

Fig. 1. Illustration demonstrating the approach of bony removal in lamina. The two-dashed circle above represents the PLIF approach and the one-dotted circle below represents the TLIF approach.

Materials and methods

Ninety-eight patients with spondylolisthesis were retrospectively evaluated from January 2008 to December 2014. Only adult degenerative spondylolisthesis cases operated with either PLIF or TLIF were included in the study. Exclusion criteria were spondylolisthesis caused by pathologic conditions such as infection, tumor, iatrogenic and congenital reasons. Five patients were lost to follow-up. We enrolled 35 patients with spondylolisthesis who were operated on with either PLIF or TLIF. All patients were female except one. The mean age of patients was 52.29 ± 13.08 (range: 35–75). Patients were evaluated in two groups, PLIF and TLIF. There were 16 patients (female: 15 and male: 1) in the PLIF group and 19 patients (female: 19) in the TLIF group. The mean of the patients was 52.87 ± 13.64 in the PLIF group and 51.84 ± 12.98 in the TLIF group.

Surgical technique

The same surgical team performed all procedures. Surgeons randomly selected PLIF or TLIF. Both procedures were performed in similar fashion as in the literature.[11,13] Patients were placed in prone position on the surgical table. Two vertebras in the spondylolisthesis level were exposed. Pedicular screws were implanted in the upper and lower levels of spondylolisthesis (Xia spinal system, Stryker). Posterior elements were removed, but facet joints were left intact bilaterally in PLIF. Unilateral laminectomy and partial facetectomy was performed in TLIF (Fig. 1). Dura and nerve root were exposed bilaterally in PLIF and unilaterally in TLIF. Segmental distraction was performed over the rod between two pedicular screws to facilitate decompression and reduction. The thecal sac and nerve root were protected by retracting to the midline. After resection of disc material and denuding the cartilaginous endplates, disc space was prepared for the interbody fusion device. Double cylindrical titanium mesh (Pyramesh surgical titanium mesh, Medtronic) or rectangular peek cages (Capstone PTC spinal system, Medtronic) for PLIF (the average hight of cages was 10.12 mm) and a single banana-shaped peek cage (AVS TL peek, Styker) for TLIF were used for interbody fusion (the average hight of cages was 9.84 mm). Autographs harvested from lamina and spinous process were filled into cages and the impacted anterior disc space. Cages were inserted into the disc space close to the midline anteriorly as far as possible. Compression was applied between pedicular screws after C-arm control.

Main differences between PLIF and TLIF are the approach to access disc and the interbody devices used for fusion. Nerve root retraction is less because the disc approach is more lateral in TLIF compared to PLIF (Fig. 1).

Radiological evaluation

Lateral radiographs of the whole spine were taken for all patients before and 6 months after surgery. Patients were standing in lateral position, elbows fully flexed with fingers on clavicle, knees and hips fully extended.[15]

All measurements were made in preoperative and postoperative digital X-rays by using Surgimap program (Surgimap Spine, Newyork, Nemaris Inc.) (Fig. 2 and Fig. 3). Spondylolisthesis levels were recorded. The severity of lysthesis was assessed by using Meyerding classification.[16] Spinopelvic parameters including sacral slope (SS), pelvic tilt (PT), and pelvic incidence (PI) were measured as reported by Duval et al[7] Lumbar lordosis (LL) was measured to define the whole lumber curve between L1 and L5

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