



Spinopelvic Parameters in Anterior Lumbar Interbody Fusion, the First Follow-Up Study of Three Years in Mexican Population

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Abstract

Objective: The objective of this work is to identify the modifications of the spinopelvic balance posterior to the ALIF and therefore its clinical repercussion.

Methods: A retrospective study of 20 patients were included, patients treated with ALIF was performed by 2 neurosurgeons and 1 vascular surgeon in 1 medical center in 2015, clinical data and radiographic measurements pre and postoperative at 3 years follow-up were studied.

Results: The number of patients was 20; 16 females (80%) and 4 males (20%), with a follow-up 36 months, the mean age of the studied group was 50.1 ± 8.5 years (range 35-67 years), body mass index (BMI) was 29 ± 3.5 , two of the 20 patients (10%) had undergone prior spine surgery, a total of 26 ALIF levels were treated in 20 patients, fourteen patients (70%) underwent 1 level L5-S1 and six patients (6%) underwent 2 level L4-L5, L5-S1. All ALIF cages were supplemented with anterior integrated fixation, eight (40%) of 20 patients were treated with posterior spinal fixation in addition to their ALIF procedure, Twelve (60%) of 20 patients were standalone ALIF. The mean hospital stay after ALIF procedure were 4.05 ± 1.87 days (range 2-9 days).

PI, SS, PT and LL were measures pre and the postoperative was the last reported during the 3 years follow up, PI and SS has statistically significant ($p = 0.008$ and 0.012) correspondingly. Visual analog scale (VAS) was the measure preoperative and the postoperative was the last reported getting statistically significant ($p = 0.001$) and the complications obtained in 4 cases were persistent pain, bleeding, intestinal pseudocclusion and retrograde ejaculation.

Conclusions: The interaction between the anatomy of the pelvis and the paravertebral muscles have a direct influence on the stress of the intervertebral discs, improving the posture of the spine and minimizing energy expenditure.

In this work performed the changes in the spinopelvic parameters that are described in the literature were obtained; we know that the ALIF improves the pelvic incidence and therefore the lumbar lordosis postoperative. Here we could verify that the modification of spinopelvic balances is related to the clinical improvement of the patient in the follow-up after his surgery, however is necessary to demonstrate quantitatively the modification of these parameters in our population to justify that the surgery is a satisfactory result for the patient.

Keywords: spinopelvic parameters; anterior lumbar interbody fusion; pelvic incidence; lumbar lordosis.

Introduction

Historically anterior lumbar interbody fusion (ALIF) was described by Capener in 1932^[1,2,3,4] as a technique to treat spondylolisthesis having the landmark intervertebral disc space implanting bone graft to create fusion between two vertebrae for an anterior access through the abdominal cavity. Several advances was development by 1980's to improved the procedure^[5,6,7,8,9].

The techniques of minimal invasive spine surgery are currently carried out more frequently. Multiple biomechanical and intersomatic fusion advantages have been documented in multiple studies, ranging from improving the height of the intersomatic space, indirect decompression, lumbar lordosis, reduction of listhesis and improving the coronal and sagittal balance^[10,11,12].

The advantages of anterior approach to the lumbar spine compared to other techniques as posterior lumbar interbody fusion (PLIF), Transforaminal interbody fusion (TLIF), lateral lumbar interbody

fusion (LLIF)^[13,14], avoid perineural and epidural fibrosis, paraspinal muscles injury and their respective complications^[15,16,17].

The importance of the restoration of sagittal spinal balance demonstrated clinical outcomes in the pain relief and function of the patient^[18], the relation of the pelvis to the spine described as spinopelvic balance and the parameters are considered like pelvic tilt (PT), sacral slope (SS), pelvic incidence (PI) and lumbar lordosis (LL) have been the alignment targets to corrected sagittal deformity^[19-31].

The pelvic incidence is determined by pelvic tilt and sacral slope which are highly correlated with lumbar lordosis^[32-38].

The lumbosacral morphology and the global sagittal balance are the main factors of the biomechanical pathogenesis of the sagittal balance disorders, consequently the mechanical tension of the lumbosacral junction translated into pain and future deformation^[39,40,41].

The objective of this work is to identify the modifications of the spinopelvic balance posterior to the ALIF and therefore its clinical repercussion.

Methods

A retrospective study of 30 patients treated with ALIF was performed by 2 neurosurgeons and 1 vascular surgeon in 1 center in 2015. The criteria inclusion were 1) patients treated with ALIF, 2) had radiographic preoperative and postoperative follow-up at an average of 3 year register. In this manner, 20 patients were included, and 10 patients were excluded due to missing radiographic data. An independent observer studied the patients, clinical data and radiographic measurements pre and postoperative.

Demographic data included age at the time of surgery, sex, body mass index, diagnosis and length of follow-up.

Operative details included a history of prior spine surgery, prior spine fusion, number of ALIF levels, anterior cage fix, posterior spinal fixation and length of hospital stay.

The comparison of the radiographic spinopelvic parameters pre and postoperative of interest were pelvic tilt (PT), sacral slope (SS), pelvic incidence (PI) and lumbar lordosis (LL) and the outcomes measures pre and postoperative included assessing visual analog scale (VAS).

Statistical analyses included frequency testing for demographic and treatment variables, paired t-tests comparing spinopelvic parameters and clinical outcomes from preoperative and postoperative. Statal analysis was carried out using SPSS v. 19.0.

Surgical technique

Under general anesthesia, the patient in supine upon operating table, we planning the abdominal approach with assistance of vascular surgeon, infraumbilical middle line 4-5cm skin incision done using retroperitoneal route which is mobilized from the inner abdominal wall medially the contents of the abdominal cavity and is exposed the iliac vessels. The target area is exposed, it opens the disc space, removal of disc material and prepare the endplates for optimal placement of a cage with human bone morphogenetic protein to improve the interbody fusion, during this process we use the x ray control to carry out the procedure, we chose the implant

and secure into the vertebral body with 4 screws through stand-alone mechanism. In some cases tanspedicular posterior percutaneous screws they were required for the end of the procedure (Figure 1.)

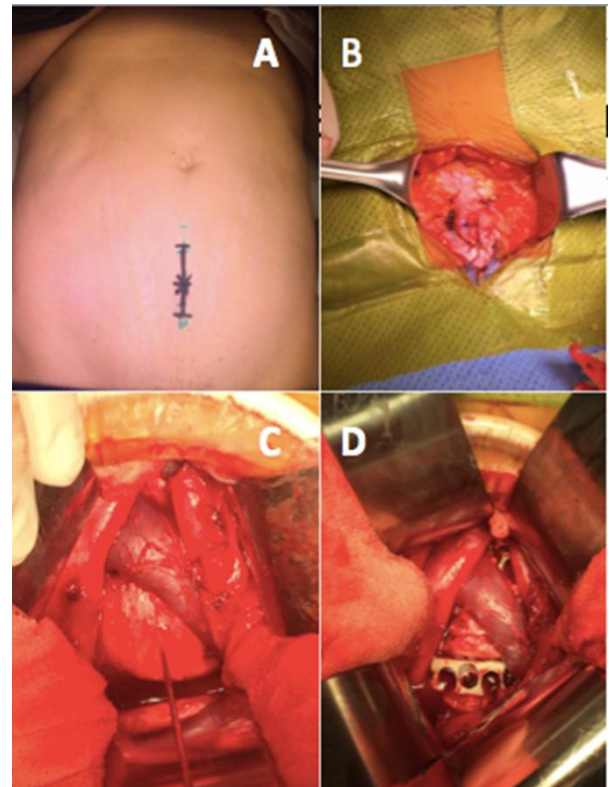


Figure 1: Anterior Lumbar interbody fusion (ALIF) steps: **A.** infraumbilical middle line 4-5cm skin incision is marked, **B.** Locate anterior aponeurosis, rectus abdominis, mobilized the contents of the abdominal cavity and exposed the lateral landmark the psoas muscle. **C.** The next lateral landmark to identify of the level L5-S1 is the iliac vessels, the discectomy is later performed. **D.** Finally the stand alone lordotic cage is placed in the worked space.

Results

Patient population

The number of patients was 20; 16 females (80%) and 4 males (20%) with a follow-up 36 months, the mean age of the studied group was 50.1 ± 8.5 years (range 35-67 years), body mass index (BMI) was 29 ± 3.5 .

Operative details

Two of the 20 patients (10%) had undergone prior spine surgery, a total of 26 ALIF levels were treated in 20 patients, fourteen patients (70%) underwent 1 level L5-S1 ALIF and six patients (6%) underwent 2 level L4-L5, L5-S1-ALIF. All ALIF cages were supplemented with anterior integrated fixation, eight (40%) of 20 patients were treated with posterior spinal fixation in addition to their ALIF procedure, Twelve (60%) of 20 patients were standalone ALIF. The mean hospital stay after ALIF procedure were 4.05 ± 1.87 days (range 2-9 days).

Radiographic parameters

PI, SS, PT and LL were measures preoperative and the postoperative was the last reported during the 3 years follow up (Table 1), (Figure 2) provide example of measures of spinopelvic balance and lumbar lordosis, only PI and SS has statistically significant ($p = 0.008$ and 0.012) correspondingly.

Table 1: Radiographic measures in all patients

Radiographic measures	Preop	Posop	Δ^*	P
PI	56.0±15.01	60.6±14.80	4.6	0.008
PT	14.0±9.47	15.3±8.45	1.3	0.339
SS	39.5±11.00	44.8±8.80	5.3	0.012
LL	58.7±11.71	61.1±11.47	2.3	0.218
VAS	8.9±1.23	3.4±2.28	5.5	0.001

Mean values are presented as the mean ± SD.

* Change from preoperative to postoperative.

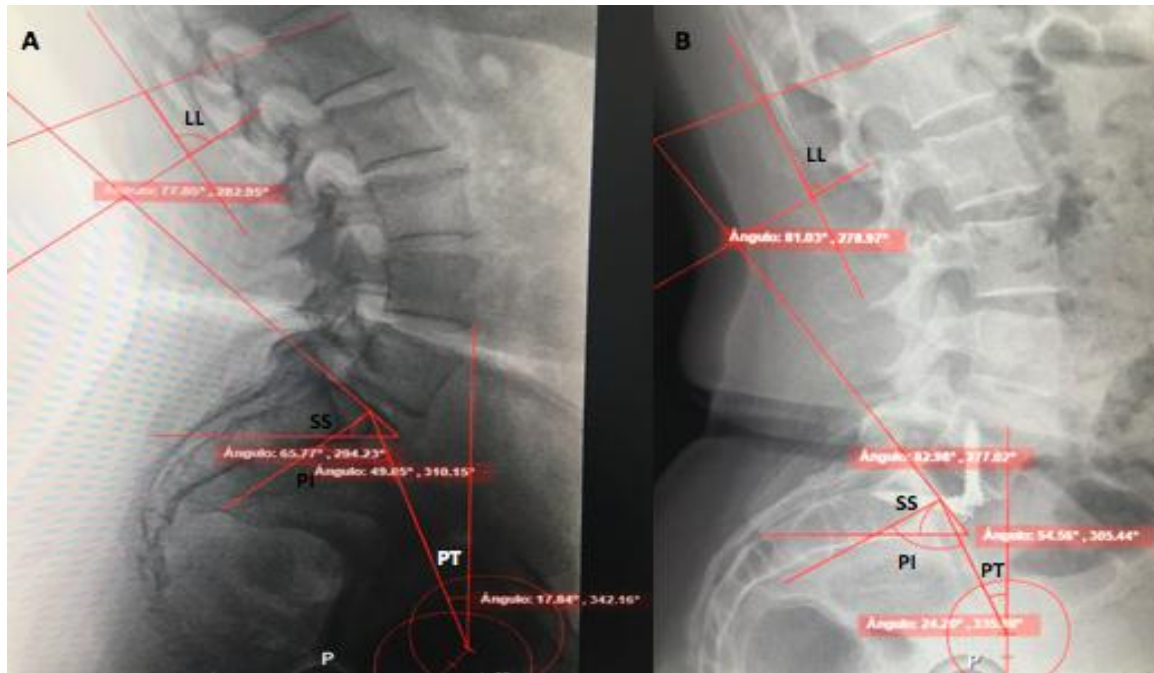


Figure 2: Radiographic measures: spinopelvic parameters, pelvic tilt (PT), sacral slope (SS), pelvic incidence (PI) and lumbar lordosis (LL) **A)** preoperative parameters in lateral X ray, **B)** postoperative parameters in X ray.

Outcomes measures

Visual analog scale (VAS) was the measure preoperative and the postoperative was the last reported during the 3 years follow up getting statistically significant (p= 0.001).

Complications

The complications obtained in 4 cases were persistent pain, bleeding, intestinal pseudoocclusion and retrograde ejaculation.

Discussion

The spine can be studied under a sagittal, coronal and axial plane. The biomechanics of the lumbar spine has been a subject of current discussion of great importance for correction of the coronal and sagittal balance. The appropriate segmental alignment required to get an adequate global balance, the progressively loss of the compensatory mechanisms lead to degenerative lumbar and disc disease, low back pain, deformity and instability that may require surgery^[21].

Spinopelvic parameters of importance such as pelvic incidence (PI) are known to vary with age and their value reflects the anatomy of the pelvis, not the values of sacral slope (SS), pelvic incidence (PI) that derive directly from the position of the pelvis. In the same way, the increase in PI after a surgical procedure for degenerative deformity leads to an increase in lumbar lordosis^[39,40,41].

It has been observed that the alterations in the PI lead to the isthmic spondylolysis and spondylolisthesis sustained in multiple

studies of abnormal spinopelvic balance. In general, the correlations of the study we conducted were based on identifying the modification of spinopelvic parameters found in our population before and after the ALIF intervention, observing similarity to those studied by other authors^[1,18,39].

Other studies in the literature reported that the normal range of the pelvic incidence is between 40 to 65, sacral slope 30 to 50, the normal range of lumbar lordosis between 31 and 70 which in our study this parameters are within the ranges of world literature^[39].

Loss of LL has been shown to be closely related to clinical symptom operative complications such as subsequent intervertebral disc degeneration and coronal and sagittal imbalance^[40,41].

In our study, there was a positive correlation between postoperative PI and postoperative lumbar lordosis that is to say that for each increasing degree of the postoperative PI it increases by 54% the postoperative LL, as it is known in the literature^[42]. Postoperative pain was also evaluated, presenting an improvement of 5 points between the start of treatment and the last medical visit. A positive clinical correlation with postoperative lumbar lordosis and postoperative pain to ALIF described in (Table 2) as scatter table. However, we observed that the greatest changes in spinopelvic parameters were seen in patients with 2 levels of ALIF L4-L5, L5-S1, whom a modification of the lumbar lordosis was actually observed. (Table 3)

Table 2: Dispersion of LL and VAS preoperative (A) and postoperative (B)

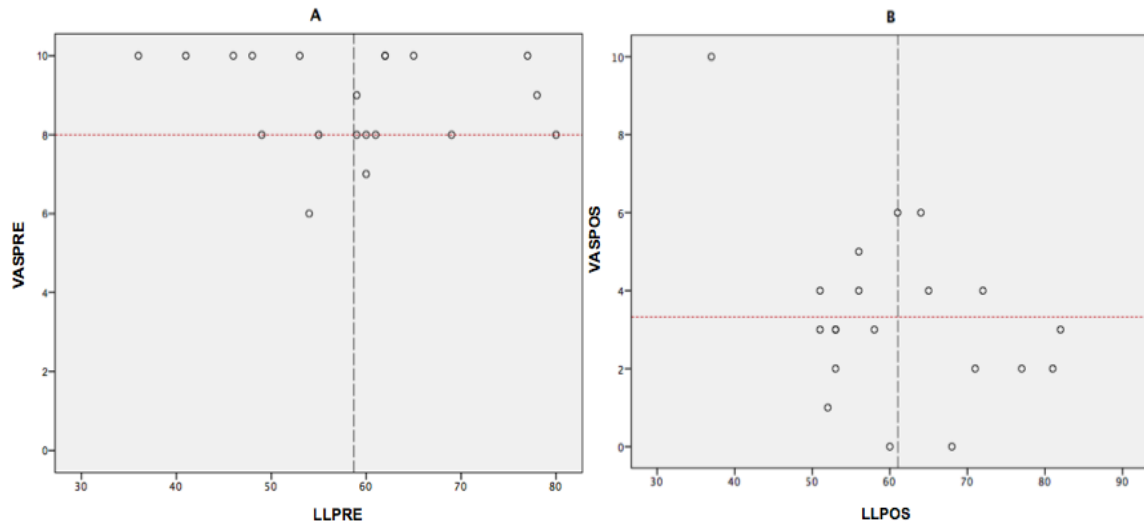


Table 2: A mean = 58.7 for LL and a mean of 8.85 for VAS was obtained in the preoperative (A), both with changes in the postoperative evaluation of the means; for the LL of 2.35 and for VAS of 5.5).

Table 3: ALIF L5-S1

Radiographic measures	Preop	Posop	Δ*	P
PI	59.2±15.46	62.1±16.90	2.9	0.160
PT	15.1±10.08	15.6±9.59	0.5	0.767
SS	40.5±12.60	45.6±9.89	5.1	0.078
LL	61.3±11.58	61.3±12.60	0.0	1.000
VAS	8.6±1.28	3.2±2.42	5.4	0.000

Mean values are presented as the mean ± SD.
* Change from preoperative to postoperative.

ALIF L4-L5, L5-S1

Radiographic measures	Preop	Posop	Δ*	P
PI	48.3±11.64	57.0±8.25	8.7	0.007
PT	11.3±8.02	14.3±5.54	3.0	0.151
SS	37.0±6.03	42.8±5.78	5.8	0.022
LL	52.7±10.48	60.5±9.31	7.8	0.051
VAS	9.3±1.03	3.7±2.07	5.7	0.002

Mean values are presented as the mean ± SD.
*Change from preoperative to postoperative.

This study had the following limitations: first this study was limited by its retrospective nature, second the study was a single center study and there were only a limited number of patients, considering that this first trial study on the country and exists a few studies correlating ALIF with spinopelvic balance we suggest making multicenter studies and large simple to get best results.

Conclusions

The interaction between the anatomy of the pelvis and the paravertebral muscles have a direct influence on the stress of the intervertebral discs, improving the posture of the spine and minimizing energy expenditure.

In this work performed the changes in the espinopelvic parameters that are described in the literature were obtained; We know that the ALIF improves the pelvic incidence and therefore the lumbar lordosis postoperative. Here we could verify that the modification of spinopelvic balances is related to the clinical improvement of the patient in the follow-up after his surgery, however is necessary to demonstrate quantitatively the modification of these parameters in our population to justify that the surgery is a satisfactory result for the patient.

Conflict of interest

The authors report no conflict of interest concerning the materials or methods used in the present study.

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