Radiographic Analysis of the Spinopelvic Parameters Obtained With an Anterior TLIF Device. Multicenter Study

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ABSTRACT

Objective: To report the results obtained according to the position of an anterior TLIF device. **Materials and Methods:** Multicenter, observational, analytical, cross-sectional, retrospective recovery study. We evaluated the pre and post-operative spinopelvic parameters of the spinograms of 20 patients who underwent surgery between September 2019 and August 2021. Patients who had undergone lumbar arthrodesis with an anterior TLIF implant were included, whereas patients without a pre or post-surgical spinogram and more than one device were excluded. **Results:** The mean monosegmental lordosis was 13.33º preoperatively and 18.81º postoperatively (p <0.001). The mean monosegmental lordosis was 7.32º, 2.95º, and 6.24º for positions I, II, and III, respectively. The mean disc height was 6.22 mm for the preoperative period and 11.06 mm for the postoperative period (p> 0.001). **Conclusion:** We found encouraging results on the placement of this type of device and its relationship with segmental lordosis, understanding the importance of its placement at the anterior end of the disc space.

Keywords: TLIF; anterior TLIF; interbody fusion; posterior approach; lordosis.
Level of Evidence: IV

Análisis radiográfico de los parámetros espinopélvicos obtenidos con el dispositivo de TLIF anterior. Estudio multicéntrico

RESUMEN

Objetivo: Comunicar los resultados obtenidos según la posición del dispositivo de TLIF anterior. **Materiales y Métodos:** Estudio multicéntrico, observacional, analítico, transversal, de recuperación retrospectiva. Se evaluaron los parámetros espinopélvicos pre y posoperatorios de espinogramas de 20 pacientes que fueron operados entre septiembre de 2019 y agosto de 2021. Se incluyó a pacientes sometidos a artrodesis lumbar con implante de tipo TLIF anterior. Se excluyó a pacientes sin espinograma pre o posquirúrgico y más de un dispositivo. **Resultados:** La media de la lordosis monosegmentaria fue de 13,33º antes de la cirugía y de 18,81º después (p <0,001). La media de la lordosis monosegmentaria fue de 7,32º; 2,95º y 6,24º para las posiciones I, II y III, respectivamente. La media de la altura discal fue de 6,22 mm en el preoperatorio y 11,06 mm en el posoperatorio (p >0,001). **Conclusiones:** Los resultados de la colocación de este tipo de dispositivos y su relación con la lordosis segmentaria fueron alentadores, se comprendió la importancia de la disposición de estos en el extremo anterior del espacio discal.

Palabras clave: Fusión intersomática lumbar transforaminal anterior; dispositivo intersomático; abordaje posterior; lordosis.
Nivel de Evidencia: IV

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INTRODUCTION

Since Briggs and Milligan[1] first described interbody fusion in 1944, different types of devices have been launched on the market whose main objective is to achieve fusion, decompress nerve structures and restore lumbar lordosis. These devices can be introduced through different approaches: anterior (*anterior lumbar interbody fusion*, ALIF), anterior or lateral oblique (*oblique lateral interbody fusion*, OLIF), lateral lumbar (*lateral lumbar interbody fusion*, LLIF), posterior transforaminal (*transforaminal interbody fusion*, TLIF) or medial posterior (*posterior lumbar interbody fusion*, PLIF). Depending on what is sought and the anatomy of each patient, one method or another is chosen.[2]

At present, by the posterior approach, two techniques are widely used: TLIF and PLIF, which differ by the site of access to the intervertebral disc. PLIF was first described by Cloward in 1952,[3] while Harms and Jeszenszky published the use of TLIF in 1998.[4] Both techniques have achieved good results according to the visual analogue scale and the Oswestry disability index.[5]

Restoration of lordosis is recognized as one of the most important factors for a successful fusion surgery.[6,7] ALIF and LLIF type devices are excellent segmental lordosis restorers, although they are not exempt from complications which are typical of the anterior (retrograde ejaculation, incisional hernia, risk of pulmonary embolism and thrombosis) and lateral procedures (femoral neuropraxia, incisional hernia, and ipsilateral psoas weakness), and have contraindications based on the patient's anatomy. Hsieh et al. published that ALIF is superior to TLIF when it comes to gaining segmental lordosis, with segment lordosis of 8.3º for ALIF and 0.1º for TLIF.[8] Kim et al. reported similar results to those described by Hsieh.[9]

Landham et al. described the importance of the position of the PLIF devices and the generation of segmental lordosis. They found a significant difference when the device was in front of the center of the disk.[10]

The objective of this study was to report the results obtained in spinopelvic parameters, according to the position of the TLIF device (Coroent Anterior TLIF, Nuvasive®, CA, USA).

MATERIALS AND METHODS

Study design

A multicenter, observational, analytical, cross-sectional, retrospective recovery study was performed. It adhered to the STROBE statement. The spinopelvic parameters measured in spinograms before surgery and in the postoperative period of patients operated on between September 2019 and August 2021 were analyzed.

Population and sample

The inclusion criteria were: patients who had undergone pedicle instrumentation associated with an anterior TLIF type implant (Coroent Anterior TLIF, Nuvasive®, CA, USA), regardless of gender, age, and weight. The exclusion criteria were: not having pre- and post-surgical spinograms or inappropriate study technique, and patients with more than one previous TLIF device.

Procedure and technique

Surgical technique

The patient is under general anesthesia, in the prone position. Once the pedicle screws have been inserted, we proceed to work on the segment in which the interbody device will be inserted. Distraction of the segment is performed by placing a distraction forceps in the interspinous space or by placing a rod and distracting the contralateral segment to which the disc is to be worked. A complete facet osteotomy (Smith-Petersen) is performed ipsilateral to the segment and a partial facet osteotomy (grade 1, Schwab classification) is performed on the contralateral side. Next, the protruding root is identified and carefully separated in order to gain access to the disc via the transforaminal route, and an annulotomy and subsequent discectomy are performed. Then, the vertebral plates are prepared with rasps. Using direct fluoroscopy, the interbody device is introduced up to the anterior limit (anterior longitudinal ligament), then the introducer is unblocked and device introduction is continued. If the device does not lie as anteriorly as desired, it is recommended to remove it and complete the discectomy, thereby creating space for more anterior placement (Figures 1 and 2).

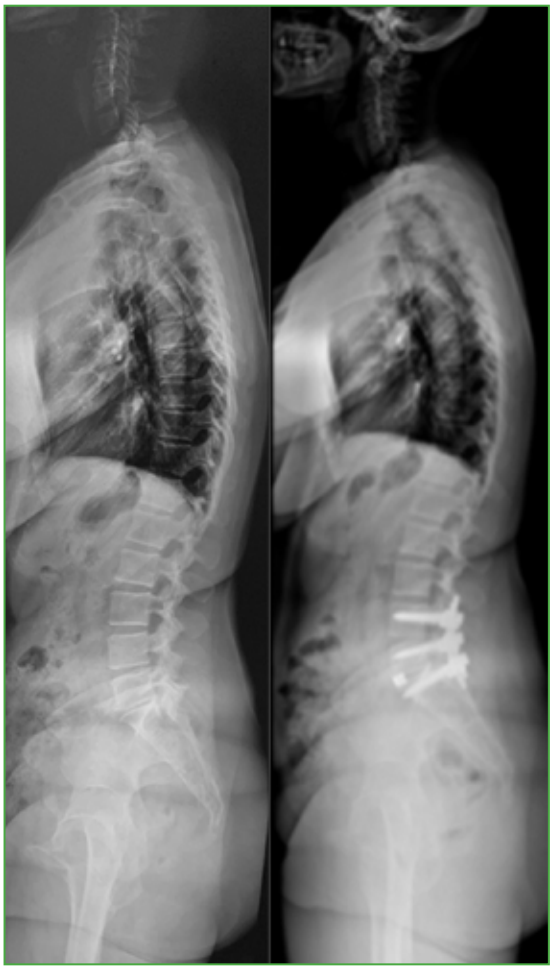

Figure 1. Pre and post-surgical spinograms. Anterior placement of the anterior TLIF interbody device is visualized.

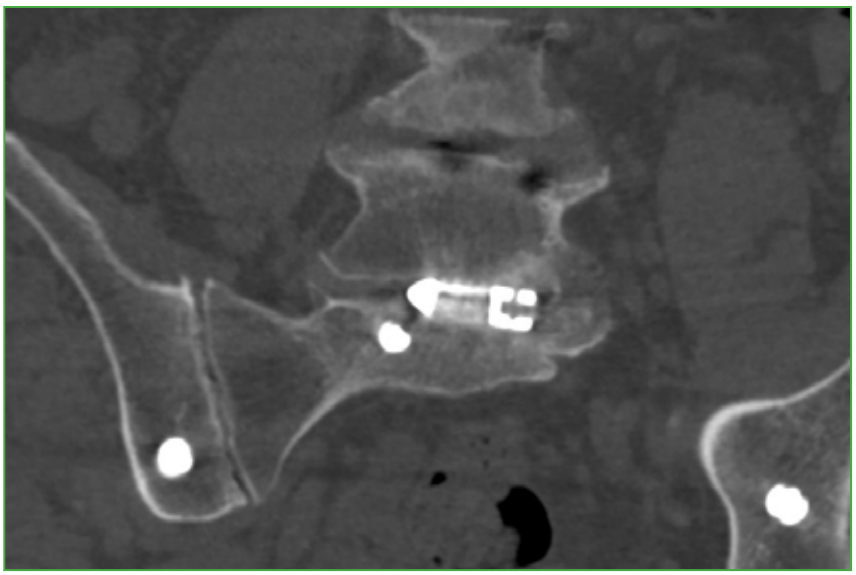

Figure 2. Axial, sagittal and coronal tomographic slices. Anterior placement of the anterior TLIF interbody device is observed.

Image evaluation

The images were analyzed by two spinal surgery specialists and the values of the pre-surgical radiographs were compared with those of the post-surgical ones using the Surgimap® program version 2.3.2.1.

Statistical Analysis

The following spinopelvic parameters were evaluated in the pre- and post-surgical spinograms: lumbar lordosis (L1-S1), monosegmental lordosis in the segment in which the interbody device was placed, L4-S1 lordosis, pelvic tilt, T1-pelvis angle, disc height. and the position where the interbody device was placed (Figure 3). Statistical tests were performed to compare the preoperative and postoperative variables with the IBM SPSS 23.0 Statistics® program. The stipulated significance levels were 95%, that is, it is concluded that there are statistically significant differences with a p-value <0.05.

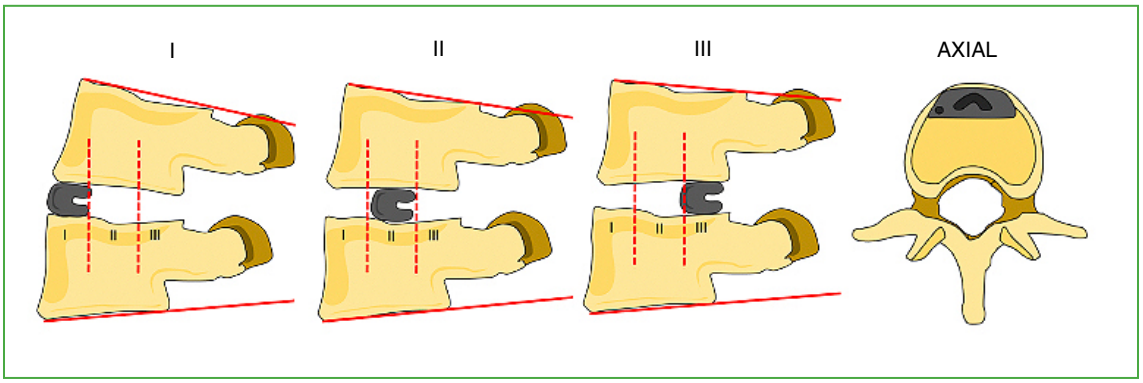

Figure 3. The disc space was divided into three segments: I, the most anterior; II, the medial and III, the most posterior. Axial view of the device layout.

RESULTS

During the study period, 20 patients were selected (Figure 4) who had received a total of 20 anterior TLIF devices: 11 (55%) in the L4-L5 segment and nine (45%) in L5-S1. Eight devices (40%) were placed in position I; seven (35%), in position II and five (25%), in position III.

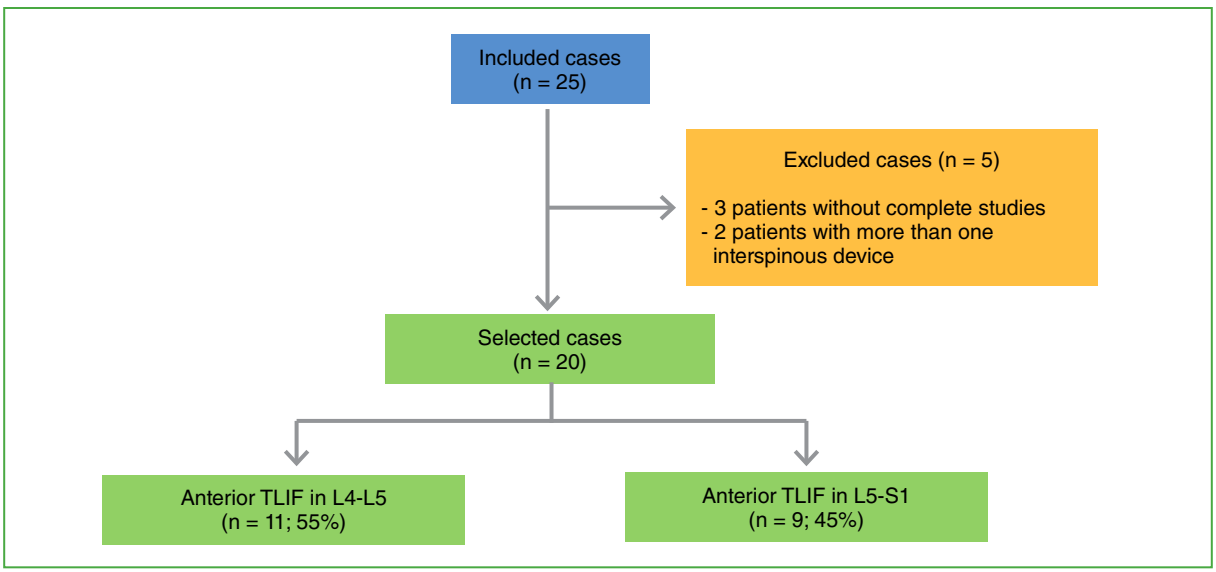

Figure 4. STROBE flowchart for case selection.

When the device was placed in position I, the mean monosegmental lordosis achieved was 7.32º, in position II, 2.95º, and in position III, 6.24º. Mean disc height was 6.22 mm (± 1.81) preoperatively and 11.06 mm (± 1.82) postoperatively, this result was statistically significant (p <0.001). The mean lordosis of L1-S1 was 39.38º (± 16.12) in the preoperative period and 44.22º (± 14.96) in the postoperative period, the result was not statistically significant (p <0.75). On the other hand, the values were statistically significant (p <0.007) for L4-S1 lordosis, with a mean of 26.26º (± 10.88) in the preoperative period and 34.71º (± 9.13) in the postoperative period.

The mean monosegmental lordosis was 13.33º (± 7.62) in the preoperative period and 18.81º (± 5.61) in the postoperative period, the result was statistically significant (p <0.001). The mean pelvic tilt was 21.96º (± 10.66) in the preoperative period and 20.74º (± 7.53) in the postoperative period, with a statistically insignificant result (p = 0.38). Lastly, the mean T1-pelvis angle was 20.03º (± 11.37) in the preoperative period and 15.64º (± 7.51) in the postoperative period, a statistically significant result (p <0.01) (Table, Figure 5).

Table. Results of pre and postoperative spinopelvic parameters

	Preoperative	Postoperative	p
L1-S1 (°)	39.38 ± 16.12	44.22 ± 14.96	0.075
L4-S1 (°)	26.26 ± 10.88	34.71 ± 9.13	0.007
Monosegmental lordosis (°)	13.33 ± 7.62	18.81 ± 5.61	0.010
Disc height (mm)	6.22 ± 1.88	11.06 ± 1.82	0.001
T1-pelvis angle (°)	20.03 ± 11.37	15.64 ± 7.51	0.011
Pelvic tilt (°)	21.96 ± 10.66	20.74 ± 7.53	0.389

The stipulated significance levels were 95%, that is, it is concluded that there are statistically significant differences with a p-value <0.05.

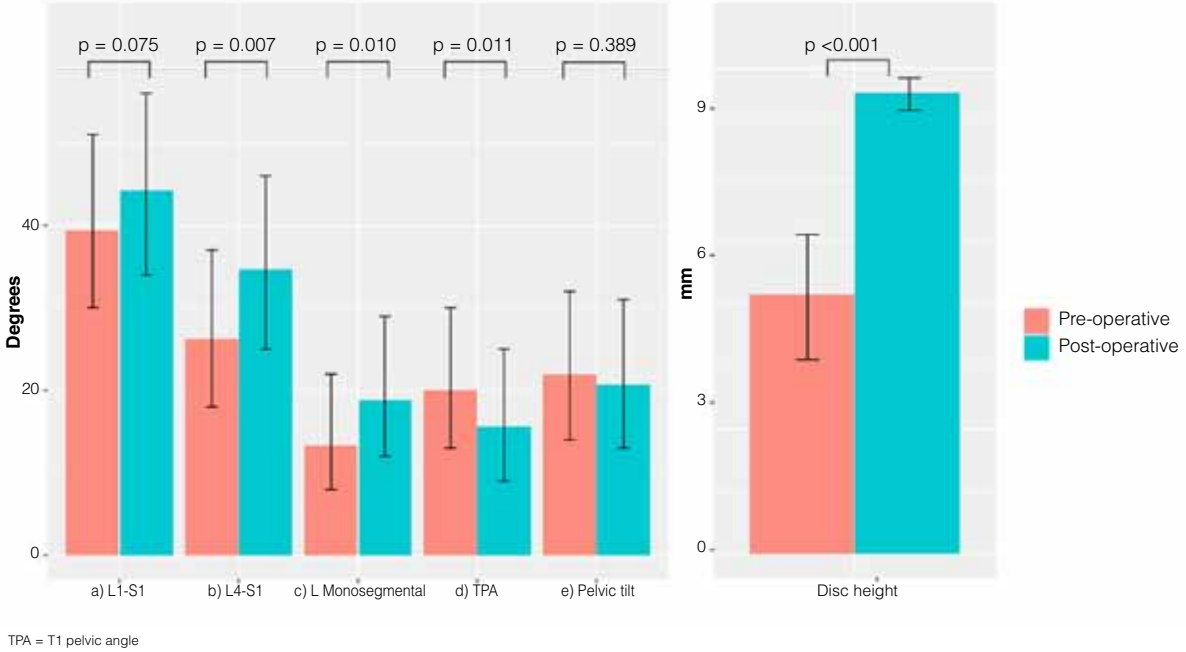

Figure 5. Analysis of pre and postoperative spinopelvic parameters. Statistically significant differences, p <0.05.

Regarding the postoperative L1-S1 lordosis and the position of the anterior TLIF device, it is concluded that there is no linear relationship between the variables, since Tk = 0.127 (p = 0.518) and rho = 0.149 (p = 0.532) values were obtained (Kendall's Tau b and Spearman's Rho correlation coefficient, respectively). When evaluating the relationship between the postoperative monosegmental lordosis and the position of the anterior TLIF device (Figure 6), a statistically significant, weak and indirectly proportional relationship was found between the variables, because an rk = -0.384 (p = 0.055) and an rs = -0.454 (p = 0.045) were obtained.

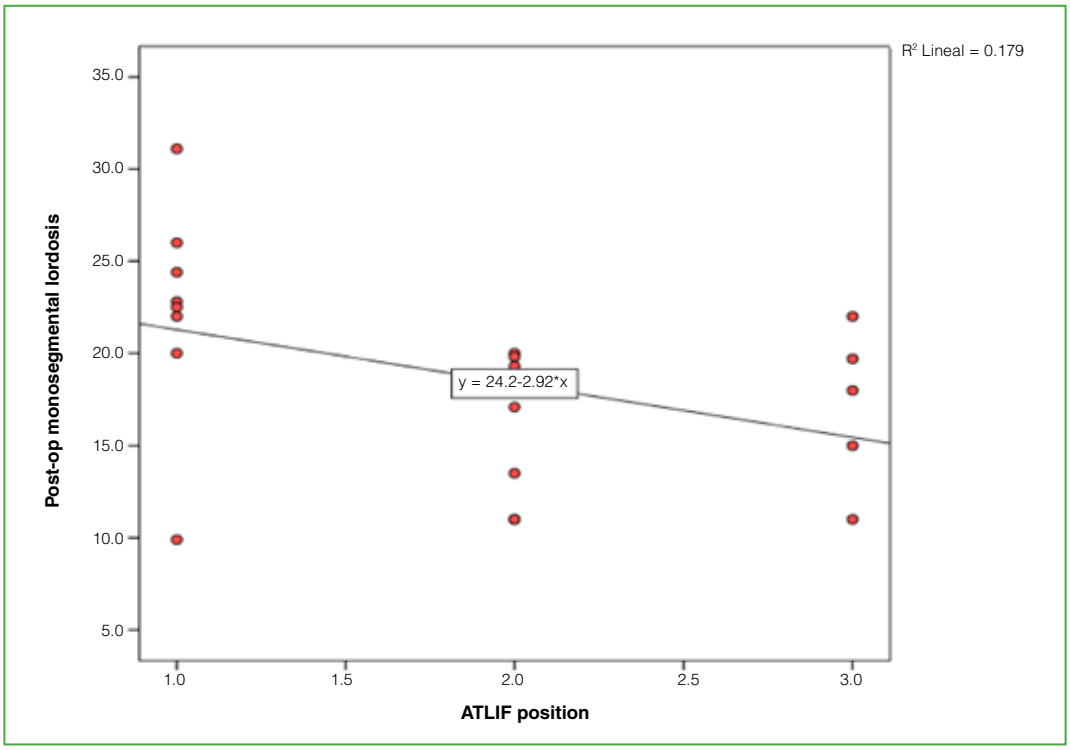

Figure 6. Linear relationship between device placement in position I, II, or III with respect to postoperative monosegmental lordosis.

DISCUSSION

Restoration of normal anatomy, including disc height, foraminal decompression, sagittal balance, and lumbar lordosis, to achieve anterior support in the lower lumbar segments (L4-L5 and L5-S1) is critical to successful outcomes in spinal surgery.[11] The ALIF device meets these requirements, although in certain cases, this type of intervention has contraindications. On the other hand, with the TLIF technique described by Harms and Jeszenszky,[4] the TLIF device is placed at its most anterior end in order to serve as a fulcrum and, together with the compression of the posterior elements, generate more lordosis. Hsieh et al.[8] reported unfavorable results regarding the generation of lordosis by the TLIF-type device, taking as limiting factors precisely the difficulty of placing the device in the most anterior end of the disc space. In our series, we obtained favorable and statistically significant results, on occasions >10º, in terms of monosegmental and L4-S1 lordosis. We believe that these results are obtained, in part, by the anterior position, which allows the device to be inserted, and the fulcrum it generates, as well as by the facet osteotomy that is performed bilaterally.

Assuming that the fusion rates for all interbody devices are similar,[12,13] it is extremely useful to take full advantage of the possibilities offered by the posterior route. Surgeries with two approaches generate not only an economic cost, but also morbidities with an anterior approach.

Regarding the ideal indications for placing this type of device, we focus on those patients with contraindications for an anterior approach, whether absolute or relative, since they cannot count on the lordosis generated by an ALIF device.

The use of expandable TLIF devices to generate greater segmental lordosis has been described in the literature. Rymarczuk et al.[14] published a series of patients in whom this type of device was used and reported an increase of between 4.47° and 10.55° of segmental lordosis per level. Wang et al.[15] published an increase in lumbar lordosis of 14.78º. These authors refer to the failure to preserve lordosis in the follow-up of patients. In our series, we found an average of 5.48º increase in segmental lordosis and it is interesting to note that, when the device was placed in position I, an average of 7.32º was achieved, with increases of up to 14.2º. The monosegmental lordosis obtained after surgery is greater in zone 3 than in zone 2. In this sense, we believe it is necessary to clarify that there is a linear relationship in terms of the area where the device is placed and the lordosis that is generated, this should be corrected simply by increasing the casuistry. In cadaveric[16] and clinical[17] studies that evaluated the impact of implant placement in the anterior segment, no significant increases in lordosis have been detected. This is largely due to the fact that the technique used lacks bilateral facetectomy.

When comparing our results with those published on different techniques (ALIF, LLIF and TLIF),[8,9,18-20] it was observed that they are similar to those described for techniques such as ALIF and LLIF.

The limitations of this study are the low sample size for the outcomes we evaluated. The results regarding the relationship of variables have a weak and inconclusive significance for the same reason. In turn, we also consider that the lack of clinical correlation with the radiological results obtained is a weakness of the study.

Together with another center in our country, we are carrying out a study with a larger number of patients in order to evaluate the results on a larger scale. The use of an objective score would be very useful for the analysis of these patients.

CONCLUSIONS

The results of the placement of this type of device and its relationship with segmental lordosis are encouraging; the importance of the arrangement of these at the anterior end of the disc space is understood. We believe it is vitally important to carry out a study that includes more patients, clinical-radiographic correlation, and registration of complications/long-term follow-up.

Conflict of interest: Dr. Enrique Gobbi declares a conflict of interest with Nuvasive®." por "Dr. Enrique Gobbi receives a payment as a Nuvasive® speaker.

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