Radiological parameters after LLIF for adjacent-level disease treatment

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Abstract

Objective: To analyze the radiological outcomes of using the LLIF technique to treat adjacent-level disease.

Methods: Patients undergoing LLIF surgery for treatment of adjacent level disease, with preoperative radiography and postoperative radiography at 3 months to 1 year of follow-up, who had completed the informed consent form were included. Patients whose radiographs did not allow the measurements proposed in the study to be performed were excluded. The following outcomes were analyzed: pelvic incidence, pelvic version, sacral tilt, lumbar lordosis, and adjacent-level segmental lordosis on preoperative and postoperative radiographs.

Results: 37 patients were included in the study (16 women and 21 men) were included in this study. The most frequently addressed levels were L3L4 (20) and L2L3 (14). Patients had an average of 4.9° (±4.2°) segmental lordosis gain at the addressed level, whereas they had an average of 6.7° (±7.3°) lumbar lordosis correction ($p<0.05$).

Conclusion: The use of the LLIF technique for the treatment of adjacent-level disease can significantly improve several spinopelvic parameters and segmental lordosis.

Keywords: Intersomatic Fusion, Lateral Intersomatic Arthrodesis, Adjacent Level Disease, Segmental Lordosis, Spinopelvic Parameters.

Introduction

In recent decades, posterior spinal arthrodesis (TLIF, PLIF, and PLF) has become a standard technique among surgeons for the treatment of lumbar spine degenerative illnesses. However, previous studies have demonstrated that the complications and effectiveness of these operations should not be underestimated. Compensatory biomechanical mechanisms cause movement in segments next to the lumbar fusion, causing the neighboring level to be overloaded.[1][2][3].

Adjacent-level disease (ASD) is a condition characterized by disc degeneration adjacent to the end vertebra of a prior construct, which causes symptoms such as radiculopathy, stenosis, claudication, axial low back pain, and instability [4].

Furthermore, ASD involves imaging criteria for diagnosis in addition to clinical criteria, with the use of lateral radiographs containing the femoral heads in the neutral, flexion, and extension positions. A reduction in disc height of more than 50% in the neutral position, an increase in vertebral listhesis of more than 3 mm in the neutral position, and a decrease in intervertebral angle of more than 5° in the flexion position can all be symptoms of neighboring-level disease [5].

Traditionally, the surgical treatment of ASD required revision laminectomy and extension of the previous fusion, which made these revisions more challenging and morbid, resulting in dramatic increases in dural injury, blood loss, prolonged hospital stay, and chronic discomfort. Thus, minimally invasive approaches can contribute to the treatment of this condition by correcting and restoring sagittal parameters, while lowering blood loss, surgical time, and soft tissue damage.[6][7].

Among the minimally invasive techniques, lateral lumbar interbody fusion (LLIF) stands out for its high fusion rates, realignment/maintenance of the lumbar lordosis, and the ability to perform indirect decompression of the level in most cases without the need for additional procedures such as laminectomy, resulting in greater stability to the construction [6][8]. Therefore, this technique has been proposed to prevent the occurrence of ASD[9]. In addition, it can be used to treat adjacent-level diseases [10][11].

Therefore, the goal of this study was to examine the radiological effects of employing the LLIF approach in treating neighboring-level illnesses.

Methods

Population and inclusion and exclusion criteria

Patients who had completed the free consent form and underwent LLIF surgery for the treatment of adjacent-level disease with preoperative and postoperative X-rays were included. Patients whose radiographs made it impossible to complete the measurements recommended in this study were excluded.

Outcomes Analyzed

The following outcomes were examined on preoperative and postoperative radiographs: pelvic incidence, pelvic version, sacral tilt, lumbar lordosis, and adjacent-level segmental lordosis (6 to 12 months).

Statistical analyzes

The R software was used to examine the data (version 4.1). According to the best approach to show them, continuous data were described as mean and standard deviation or median, interquartile range, minimum, and maximum. The frequency and percentage of count data were calculated. The Shapiro-Wilk test was used to determine the normality of continuous data, and the t-test or Wilcoxon test was used to estimate the variance of the means, depending on the sample distribution. The chi-square test was used to compare count variables. Statistical significance was defined as $P < 0.05$.

Results

Demography

The study included 37 patients (16 women and 21 males. L3L4 (20) and L2L3 (20) were the most frequently addressed levels (14). The median age of the patients was 71 years (Table 1).

Table 1. Distribution of gender and levels addressed in the sample of the study population.

	Frequency	%
Gênero		
Female	16	43.24
Male	21	56.76
Nível		
L3L4	20	55.56
L2L3	14	38.89
L4L5	1	2.78
L1L2	1	2.78

Radiological Data

Patients achieved 4.9° (4.2°) segmental lordosis at the index level ($p = 0.001$). (Figure 1). With a lumbar lordosis (L1-S1) correction of 6.7° (7.3°) on average (p 0.05) (Figure 2).

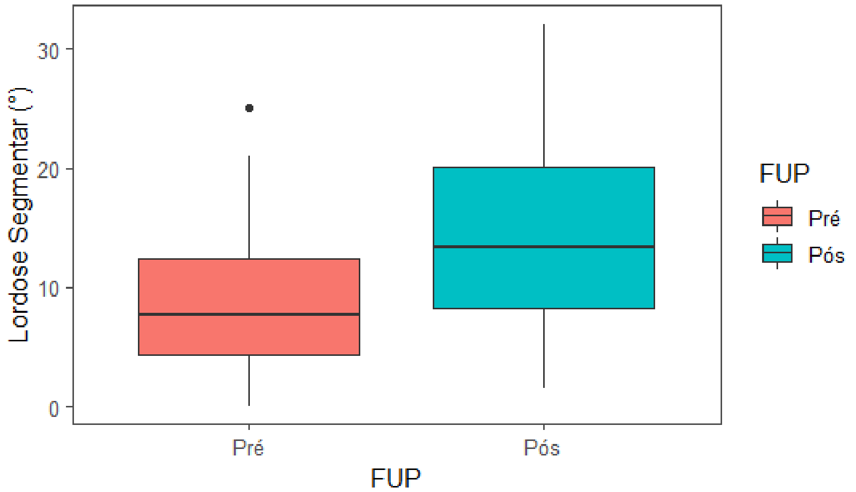

Figure 1. Boxplot demonstrating the distribution of segmental lordosis values in both the pre- and post-operative periods.

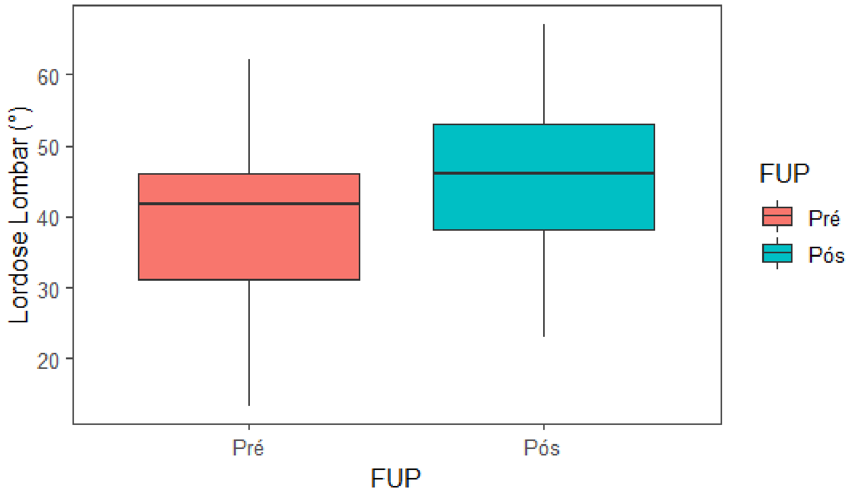

Figure 2. Boxplot demonstrating the distribution of lumbar lordosis values in both the pre- and post-operative periods.

There was also a significant correction of the Lumbar Mismatch 5.6° (9.5°) p 0.05 (Figure 3).

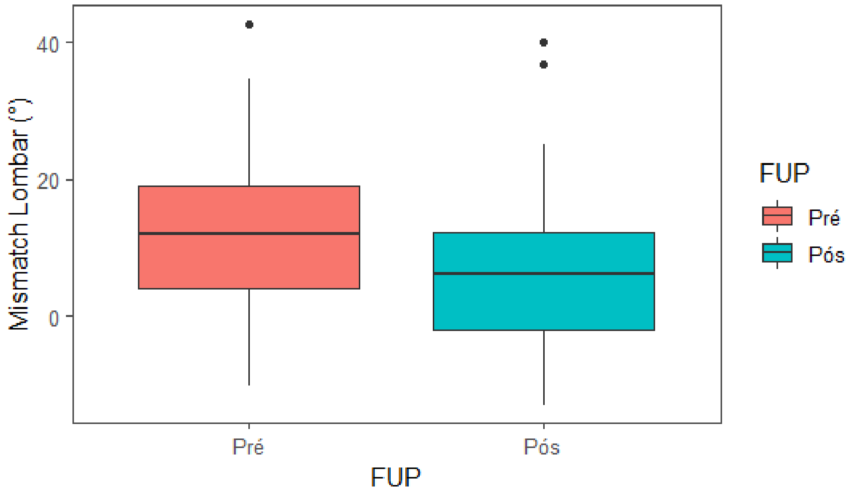

Figure 3. Boxplot demonstrating the distribution of lumbar mismatch values pre- and post-operatively.

However, no significant correction of PT -0.1° (5.7°) was observed (Figure 4).

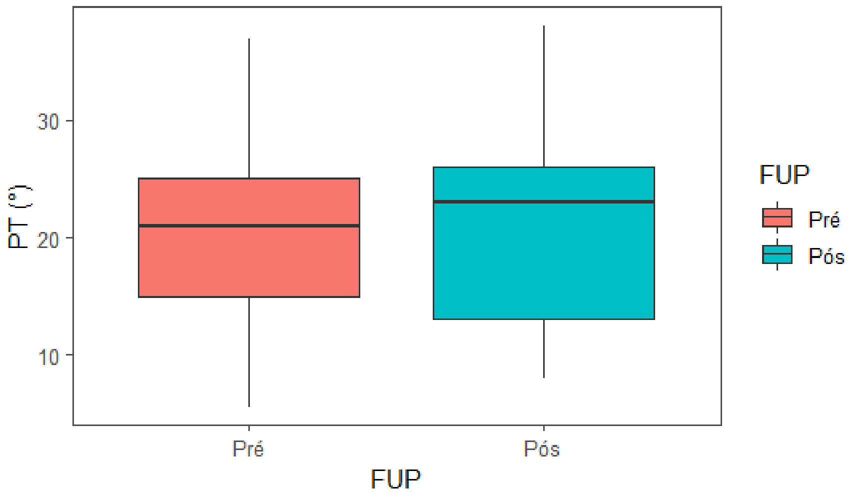

Figure 4. Boxplot showing the distribution of pelvic retroversion (PT) values pre- and post-operatively.

Discussion

A potential long-term complication of spinal surgery is the development of adjacent segment disease, which results in radiographic alterations in the discs adjacent to previously treated levels and can lead to instability, loss of sagittal alignment, and stenosis [5][12]. The current investigation demonstrated that the LLIF approach is capable of significantly correcting radiological parameters in cases with adjacent-level disease

LLIF in the treatment of adjacent level disease

According to biomechanical studies, the insertion of an LLIF cage to treat the adjacent-level disease can promote a drastic reduction in mobility of the treated level, an effect that is enhanced by the addition of pedicle screws or lateral plates.[13][14].

Furthermore, some publications have highlighted several therapeutic and radiological benefits of LLIF in the treatment of adjacent-level diseases. Wang et al. (2014) were among the first to report the use of LLIF for the treatment of adjacent-level disease. In their study, patients showed a substantial improvement in the pain scale in both legs and back, as well as an increase of 2.1° in the lordosis of the operated segment, but a loss of 2° in the lumbar lordosis (L1-S1). Furthermore, some publications have highlighted several therapeutic and radiological benefits of LLIF in treating adjacent-level diseases. Wang et al. (2014) were among the first to report the use of LLIF for the treatment of adjacent-level disease. In their study, patients showed substantial improvement in the pain scale in both legs and back, as well as an increase of 2.1° in the lordosis of the operated segment, but a loss of 2° in the lumbar lordosis (L1-S1) [15]. Aichmar et al, 2017 revealed that patients undergoing LLIF for adjacent level disease demonstrated a significant improvement in quality-of-life questionnaires, as well as a considerable rise in segmental lordosis, 3.1°, and 2.3° gain in lumbar lordosis [11].

Other researchers have investigated the benefits of employing solo LLIF for the treatment of adjacent-level disease. In a study of 25 patients, Louie et al. (2018) found that patients who had standalone LLIF improved significantly in both clinical and radiologic outcomes.[16]. Screven et al., 2021, also examining the benefits of standalone LLIF, reported that the procedure was capable of causing considerable clinical improvement in quality-of-life scores in a study with 44 patients.[10]. Finally, Aichmair et al. (2017) demonstrated in a retrospective study of 52 patients comparing LLIF with posterior fixation and standalone LLIF that both procedures were able to significantly enhance the quality-of-life scores and segmental lordosis at the operated level [11].

Limitations

The fundamental weakness of this study was its retrospective design. However, because the data were obtained prospectively, the potential biases of wholly retrospective investigations were reduced. Another limitation was the use of only one measurer to perform radiological evaluations, which the authors attempted to overcome by employing a measuring guide and prior training with the device for all measurements included in the study.

Conclusion

When used to treat adjacent-level disease, the LLIF approach has the potential to bring about significant improvements in a multitude of spinopelvic parameters, as well as in segmental lordosis.

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