Peer Review File

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Reviewer A

The authors present a longitudinal case series of 28 patients who underwent L4-5 PLIF with 12-degree lordotic cages. The authors measured relevant radiographic parameters and had excellent follow-up rates up to two years postoperatively. Their main conclusions were logical and supported by their results.

It is well established that increasing segmental lordosis in the lower lumbar arc with a single-level lordotic cage, total facetectomies can prevent PI-LL mismatch and positive sagittal balance and resulting iatrogenic flat back. However, the authors' long-term radiographic follow-up and findings of low incidence of ASD are significant and add to the current body of knowledge, emphasizing the importance of maintaining spinopelvic harmony to prevent the long-term complication of ASD following lumbar arthrodesis procedures.

Thank you very much for these comments.

There are a few points that the authors should address to strengthen their manuscript.

Comment 1: In terms of clinical results, the authors only recorded the JOA. The authors could add to the clinical findings of the study if they were to calculate the minimum clinically important difference (MCID) from preop to 2y post-op. Further, reporting other standardized patient-reported outcomes such as Oswestry disability index (ODI), EuroQol- 5 Dimension questionnaire (EQ-5D), and numeric rating scale (NRS) back and leg pain scores, if collected, would strengthen the correlation of the radiographic outcomes to the clinical outcomes.

Reply 1:
As you pointed out, calculating the MCID and reporting patient-reported outcomes is important. However, to the best of our knowledge, no previous reports have evaluated associations between the use of MCID and improvements in JOA score after PLIF. In contrast, Fujimori et al. reported on the relationship between the JOA scoring system and patient -reported improvements after PLIF (Fujimori T et al. Spine Journal 16 (2016) 728-736). They reported that the JOA scoring system is a valid method for assessing patient-reported improvements in clinical practice. Moreover, the cutoff point that patients recognized as “Improved” in their cohort was 13 points for the amount of change from the preoperative condition, 67% for the recovery rate, and 23 points for the postoperative score in the JOA scoring system. They concluded that patient-reported improvements are more likely to be associated with the final condition, such as postoperative score or recovery rate. In the present study, a change of 12.6 points from the preoperative condition, 84.9% for the recovery rate and 26.8 points for 2 years postoperatively in the JOA scoring system were results associated with high postoperative score or recovery rate. Therefore, this study did not collect patient-reported outcomes such as ODI, EQ-5D or NRS, but we consider that our results indicated improvements in

the self-reported status of patients.
If necessary, I can add the sentence “Fourth, patient-reported clinical outcomes were not evaluated, but our results from JOA scores up to 2 years postoperatively indicated self-reported improvements based on a previous report regarding the relationship between JOA scores and patient-reported improvements (Fujimori T et al. Spine Journal 16 (2016) 728-736)” in the revised limitations section (Page 9, line 271).

Comment 2: On page 5, line 146, the authors need to explicitly state at what postop time point they evaluated for R-ASD. I would presume 2y, but this is not stated.

Reply 2:
Thank you very much for pointing out this oversight.
As the reviewer pointed out, R-ASD was evaluated at 2 years postoperatively. We have therefore added the phrase “at 2 years postoperatively” on Page 5, line 146.
Changes in the text: “at 2 years postoperatively” on Page 5, line 146.

Comment 3: The authors found a correlation between change in segmental lordosis with ΔSVA ($r= -0.37$, $P<0.05$) and ΔLL ($r= 0.53$, $P<0.01$). While statistically significant, these are weak correlations with the low r value. Biomechanically this is logical given that the authors performed a single-level PLIF. The authors should discuss this as a limitation on page 8, lines 239-244j.

Reply 3:
As the reviewer suggested, the correlations between change in segmental lordosis and both ΔSVA ($r= -0.37$, $P<0.05$) and ΔLL ($r= 0.53$, $P<0.01$) were weak, with low r values. We have therefore added the following sentence: “However, these correlations were weak with low r values, because the effect of PLIF between single-segments alone on global alignment is limited” (Page 8, line 244).
Changes in the text: “However, these correlations were weak with low r values, because the effect of PLIF between single-segments alone on global alignment is limited” (Page 8, line 244).

Comment 4: Correct grammatical errors highlighted in their attached manuscript in the comments.

Reply 4:
Thank you very much for pointing out these errors, which have been corrected in the revised version of the manuscript.

Reviewer B

Congratulations on a meticulous study, well carried out and well presented.
It supports my own long held bias that L4/L5 decompression should always be accompanied by a fusion and that fusion should incorporate an anterior interbody fusion and posterior pedicle screw fixation. And, as you have documented, the lordotic cage is integral to restoring lumbar sagittal parameters and that in turn is integral to preventing adjacent segment problems.
One technical question: A lordotic cage must be or greater height anteriorly than posteriorly, L4/L5

is the widest disc space, so to restore lordosis the cage must have an anterior height of at least 10mm and sometimes 12-15 mm. Inserting a cage of that dimension through a PLIF approach necessitates considerable distraction. Are there any tricks to this?

Reply 1:
Thank you very much for your comments.
This study used insert-and-rotation-type cages with a width of 9 mm.
We were therefore able to insert cages with an anterior height of at least 10 mm if total facetectomies (Ponte osteotomy) were performed and distraction was applied to create a 9-mm space.

Reviewer C

This study is an interesting study investigated the change of segmental and global parameters and incidence of ASD after PLIF using 12° lordotic cages. But there are some points to be improved.
Thank you very much for your comments.

Comment 1: As be stated in limitation, the number of patients is too small. You should increase the number of patients, if you performed PLIF using 12° lordotic cages in the same technique after 2016.

Reply 1:
As you noted, the small number of patients represented a key limitation to this study. However, this study was performed prospectively over a 2-year period from 2014 to 2016. After that, the cages used at that time are not currently in use, and we are now using different types of cages or lateral lumbar interbody fusion. Increasing the number of patients included in this study is not currently feasible.

Comment 2: In the case you want to emphasize the usefulness of 12° lordotic cages, you should compare to other lordotic angle cages, such as 4° or 8°. If you have data using another lordotic cages between the periods using 0° rectangular cages and 12° lordotic cages, it is better to compare 12° lordotic cages and another lordotic cages regarding the change of segmental lordosis, SVA, and clinical outcome.

Reply 2
As you pointed out, ideally we would have data for other lordotic angle cages as a control group, but we do not possess any data for other lordotic angle cages. This is because we have previously reported that PLIF with 0° rectangular cages cannot achieve the correction of segmental lordosis (Matsumoto T et al. J Neurosurg Spine. 2017;26(4):435-40). After reporting that data, we considered that hyper-lordotic cages were not needed to achieve segmental lordosis at lower lumbar levels, so we have changed cages from 0° rectangular cages to 12° lordotic cages without using cages of any other angle. We have therefore added the following sentence “Third, cages with other lordotic angles were not evaluated as a control group” in the Limitations section (Page 9, line 271).

Changes in the text: “Third, cages with other lordotic angles were not evaluated as a control group” in the Limitations section (Page 9, line 271).

Comment 3: You should add posterior slippage using the lateral extension radiograph at the adjacent segment level in the definition of radiographical ASD.

Reply 3: As suggested, we have added progression of posterior slippage >3 mm on lateral extension radiographs to the definition of radiographic ASD. We have therefore changed the sentence on page 5, lines 146–149 to the following sentence: “Radiological ASD (R-ASD) at 2 years postoperatively was defined as a condition in which a narrowing of disc height by >3 mm on lateral radiograph, posterior opening angle >5°, progression of anterior slippage by >3 mm on lateral flexion radiograph, or progression of posterior slippage by >3 mm on lateral extension radiograph was seen in comparison with preoperative radiographs at the adjacent segment level (L3/4 or L5/S).”
Moreover, one patient showed progression of posterior slippage >3 mm on lateral extension radiograph. We have changed the sentence on page 7, lines 193–196 to the following, “R-ASD was observed in 3 patients (11.1%). Two patients showed narrowing of disc height by >3 mm at the L5/S level and one patient showed progression of posterior slippage by >3 mm at the L3/4 level. No patients displayed posterior opening >5° or progression of anterior slippage by >3 mm.” We have also corrected Table 2 based on the new results.
Changes in the text: “Radiological ASD (R-ASD) at 2 years postoperatively was defined as a condition in which a narrowing of disc height by >3 mm on lateral radiograph, posterior opening angle >5°, progression of anterior slippage by >3 mm on lateral flexion radiograph, or progression of posterior slippage by >3 mm on lateral extension radiograph was seen in comparison with preoperative radiographs at the adjacent segment level (L3/4 or L5/S)” on Page 5, line 146.
“R-ASD was observed in 3 patients (11.1%). Two patients showed narrowing of disc height by >3 mm at the L5/S level and one patient showed progression of posterior slippage by >3 mm at the L3/4 level. No patients displayed posterior opening >5° or progression of anterior slippage by >3 mm” on Page 7, line 193.

Comment 4: How about the cage subsidence or bone union at the fusion segment? Were there no cage subsidence and non-union?

Reply 4: Thank you for raising this issue.
The rate of bone union was 82.1% (n=23) at 1 year postoperatively and 96.3% (n=26) at 2 years postoperatively. The rate of cage subsidence was 18.5% (n=5) at 2 years postoperatively. We have therefore added the following sentence “The bone union rate was 82.1% (n=23) at 1 year postoperatively and 96.3% (n=26) at 2 years postoperatively. The rate of cage subsidence was 18.5% (n=5) at 2 years postoperatively.” on page 6, line 174. Moreover, we have added the following sentence: “Cage subsidence was evaluated using lateral radiographs at 3 months and 2 years postoperatively, and was defined as present if a cage was observed to sink into an adjacent vertebral body by 2 mm.” (Page 5, line 145).
Changes in the text: “The bone union rate was 82.1% (n=23) at 1 year postoperatively and 96.3% (n=26) at 2 years postoperatively. The rate of cage subsidence was 18.5% (n=5) at 2 years postoperatively” (Page 6, line 174).

“Cage subsidence was evaluated using lateral radiographs at 3 months and 2 years postoperatively, and was defined as present if a cage was observed to sink into an adjacent vertebral body by 2 mm.” (page 5, line 145).

Comment 5: When was R-ASD estimated? Was it using not whole spine radiograph but lateral flexion radiograph?

Reply 5: Thank you very much for your comment.
R-ASD was evaluated at 2 years postoperatively. We have changed the sentence on page 5, lines 146–149 to the following sentence: “Radiological ASD (R-ASD) at 2 years postoperatively was defined as a condition in which a narrowing of disc height by >3 mm on lateral radiograph, posterior opening angle >5°, progression of anterior slippage by >3 mm on lateral flexion radiograph, or progression of posterior slippage by >3 mm on lateral extension radiograph was seen in comparison with preoperative radiographs at the adjacent segment level (L3/4 or L5/S).”
Changes in the text: “Radiological ASD (R-ASD) at 2 years postoperatively was defined as a condition in which a narrowing of disc height by >3 mm on lateral radiograph, posterior opening angle >5°, progression of anterior slippage by >3 mm on lateral flexion radiograph, or progression of posterior slippage by >3 mm on lateral extension radiograph was seen in comparison with preoperative radiographs at the adjacent segment level (L3/4 or L5/S)” (Page 5, line 146).