**Author’s response to reviews**

**Title:** Clinical effect analysis and radiographic outcomes of Isobar TTL system for two-segmental lumbar degenerative disease: a retrospective study

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**Author’s response to reviews:**

Chi heon Kim (Reviewer 1): I enjoyed to read the article titled as Clinical effect analysis and radiographic outcomes of Isobar TTL system for two segmental lumbar degenerative disease: a retrospective study.

1 The condition of patients should be same to be compared with each other. The radiological characteristics in both groups did not described in the table 1. How did the author decide surgical technique?

Response:

Thanks for the question. The patients were allocated into two groups by clinical symptoms, images result as well as patients’ willingness.

2 What was the indication of 2 levels fusion? Did the patients have instability? What made the surgeon to go to between TTL dynamic stabilization and rigid stabilization?

Response:
Thanks for the questions. We appreciate the comments. The selection of fusion segments is based on the degree of disc degeneration and the severity of their disease. Fusion criteria are shown below: (a) Severe disc degeneration; (b) Intervertebral instability; (c) Significant lumbar degenerative scoliosis, kyphosis or spondylolisthesis; (d) Bilateral facetectomy &gt;1/3-1/2, excision more than 50% of the pars interarticularis, bilateral discectomy in addition to partial facetectom. If it doesn't meet the criteria for spinal fusion surgery, we choose non-fusion surgery. If the patient has two segments that need to be treated, one segment needs fusion surgery, and the other segment does not need fusion surgery, then TTL dynamic stabilization is selected. If the patient has two segments that require fusion, we would choose rigid stabilization. Furthermore, if the patient has two segments that do not require fusion surgery, other fixation materials will be selected, and these cases are not included in this study.

3 When I calculated p value from table 5, p value was 0.67. There was no statistical difference in proximal adjacent segment disease. How did the author dichotomize Pfirrmann (Pfirrmann was wrong) grade and UCLA system?

Response:

Thanks for the questions. The modified Pfirrmann grading system and UCLA system can be used to assess the extent of disc degeneration. Therefore, we used two different methods to make sure that our results were reliable. We have checked p value in table 5 was a mistake and it was deleted. Although there was no statistical difference in proximal adjacent segment disease by the modified Pfirrmann grading system, it has a tendency to improve adjacent segments. In addition, it was statistical difference with UCLA system. In conclusion, Isobar TTL system got better radiographic outcomes with less impact on the proximal adjacent segment.

4 What would be a reason for a less excellent or good result after rigid fusion?

Response:

Thanks for the question. The adjacent disc degenerative acceleration is one of the most factor that may have a negative impact on the rigid fusion. PJK, PJF are more and more reported by rigid fusion. Interbody fusion is recognized as the "gold standard" in the treatment of lumbar degenerative diseases, but spinal fusion surgery often brings many complications to patients, including donor place ailment, the morbidity of the surgery, and adjacent segment disease. After traditional rigid fusion, the transmission mode of spinal mechanics was changed, the stress of adjacent segments was increased, and then adjacent segment degeneration was easy to occur. This is a reason for a less excellent or good result after rigid fusion.

5 One shortcoming of Isobar system may be a less lumbar lordosis that was shown in the author's cases. This issue needs to be discussed in the discussion section.

Response:
Yes, it is a good point. In the cases we reported, we may use the isobar system in the fixed lumbar level, middle lumbar segments, the lordosis is good for most cases. For some extreme cases, the surgeon can use bending tools to prepare the isobar system to an expected lordosis angle. In addition, we didn’t assess lumbar lordosis of two groups, but our results showed there was no statistical difference in the total lumbar ROM between the two groups at the last follow-up.

Guang-Xun Lin (Reviewer 2): The authors selected 41 patients with two-segmental lumbar degenerative disease who underwent surgical treatment by Isobar TTL dynamic stabilization system (n=20) and rigid system (n=21) from January 2013 to June 2017. They conducted that Isobar TTL system could get a good clinical effect for treatment of two segmental lumbar degenerative disease. Compared with rigid fixation, Isobar TTL system can get better radiographic outcomes and maintain the mobility of the stabilized segments with less influence on the proximal adjacent segment.

Some information needs to be clearly described:

1 Remove your affiliation from the main text;

Response: Thanks, we will do that. We have made the revision in general data.

2 Please specify the selection criteria for two groups;

Response:

Thanks, the two groups are allocated according to the patients’ symptoms, physical examinations as well as the patients’ willingness to use the new technology to relief the clinical symptoms.

3 There have been many similar articles published, and no new information and messages in the present research.

Response:

Thanks, we have a long clinical review period and huge patients’ volume. We found that our finding was very similar to the previous clinical retrospective studies. Both suggesting that the Isobar system have better clinical results compare with the rigid systems. In addition, a perspective study may be needed to perform to certify the clinical effects of isobar TTL system, but is difficult to perform in current station.
Jincai Yang (Reviewer 3):

1. Fusion surgery is the gold standard for the lumbar degenerative diseases. Minimally invasive surgery become popular. So, what's the advantages of isobar TTL system compared with these two kinds of surgeries?

Response:

Thanks Professor Yang: the Isobar system provide a connection between the rigid fusion and non-fusion. It can be implanted by open procedures and minimally invasive surgeries, there is no conflict between the isobar system and MIS system. In some cases, the isobar can be placed by MIS systems.

2. As the authors described the isobar TTL was introduced in 1993, is there any improvement in the past 20 years?

Response:

Thanks for the questions. The Isobar system have been evaluated in the past 15 years. Most of the updated happened before 2000s, so the system we used in the research is the latest version.

3. Is there any different indications between fusion surgery and isobar TTL?

Response:

Yes, the patients were allocated into different groups according to the patients’ symptoms, image results as well as the willingness to participate the research. The image results of these patients indicate that there two level of degenerative changes, but the upper level have a more several degenerative changes.

4. Please provide more information on the technique of isobar TTL, is there any difference on it? Is there any special complication on isobar TTL?

Response:

The surgical technology of isobar TTL is very similar to traditional TLIF or PLIF. The main difference between them is last step on placing the rod, using the Isobar system replace the existing rigid titanium rod system.

5. Please compare your results with the outcomes in previous studies, is there any difference?

Response:
In the discussion section, we found that our finding was very similar to the previous clinical retrospective studies. Both suggesting that the Isobar system have better clinical results compare with the rigid systems.

6. A perspective study may be needed to perform to certify the clinical effects of isobar TTL system.

Response:

Yes, you are right. The perspective study is difficult to perform in current station. Especially for the low back pain patients in china, we must put the patients’ symptoms and clinical physical examinations & image results into consideration.

7. What's the disadvantages of the isobar TTL?

Response:

So far, the disadvantage of isobar TTL is the system can only preserve one segment’s mobility capability, the system had to fuse one-disc level.