**Title:** Effects of multilevel posterior ligament dissection after spinal instrumentation on adjacent segment biomechanics as a potential risk factor for proximal junctional kyphosis: a biomechanical study.

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**Author’s response to reviews:**

"Additionally, the authors' response letter has been included as a supplementary file."

Chee Kidd Chiu (Reviewer 1):

The manuscript is adequately written. The methodology and result are presented adequately. However, the major flaw of this study is the research idea, inference and conclusion. The authors concluded that the progressive dissection of the posterior ligaments as a potential risk factor for proximal junctional kyphosis, but the study only can prove that there is more absolute ROM and not the risk of PJK. Moreover, the amount degree increase is minuscule of about 1-2 degrees. This may mislead readers of such conclusions. Therefore, I think the author cannot conclude that the dissection of PL will lead PJK but only can prove that there is significant increase in degree of ROM of about 1-2 degrees. I would also suggest that the authors to provide more evidence e.g. to include data on the changes in the angle of disc spaces and changes in the pressure/stress on the disc/vertebra if they are still keen to for the publication of this study.

Authors’ reply:

We assumed, that with an increase in RoM also the risk of PJK will increase. This is stated explicitly in the abstract and in the conclusion of the manuscript, but we have added this assumption to the background section p. 6, lines 4-8.
The change in kyphosis of the UIV is supported and shown by the change in the neutral zone towards flexion (see page 13, line 3 ff.). The measured increase in RoM (Fig. 4) and shift of the neutral zone (Fig. 5) was of the magnitude of 1-2 degrees, which might not look substantial at first glance. However, it must be considered, that this increase in RoM and shift in neutral zone could already be shown after 250 cycles of loading. With an increasing number of load cycles these changes are expected to increase as well. In the present study only a limited number of load cycles was applied due to time constraints of in vitro testing with cadaveric specimens (maximal one day of testing before degradation sets in). With the experimental design of stepwise dissection of the posterior ligamentous structures we had to limit the number of load cycles for each specimen not to exceed one day of testing (see page 7, lines 12-14). In clinical practice the occurrence of PJK is a progressive disease which emerges over several months and not as a result of a sudden traumatic event. Therefore it can be expected that the measured changes of 1-2 degrees will become much greater with a higher number of load cycles.

The absolute value of the angle of disc space at UIV/UIV+1 increases by a mean of 2.03° (+19.4%) compared to the baseline measurement in the treatment group and by a mean of only 0.98° (+8.7%) in the control group.

The changes in the pressure/stress of the disc can not be included, as they were not measured during the experiment. The change of the disc space is not trivial to determine experimentally. As this always depends on the load applied to the specimen and the position in the span of the neutral zone, in which the measurement was conducted. Therefore we reported the shift of the neutral zone, which can be considered the change in the angle of disc space. As defined for biomechanical testing the neutral zone is the angular range, in which the specimen is not subjected to a bending moment during a motion cycle (in this case from flexion to extension). Therefore a change in the angular position of neutral zone towards flexion can be considered a change in the segmental alignment towards flexion. (see page 13, line 3ff.).

Chuwen Lin (Reviewer 2):

This study examined the effect of a progressive posterior ligament dissection on proximal junctional kyphosis. The major concern is the sample size. What's the statistical power in these analysis between control and treated groups?

Authors’ reply:

We fully comprehend your point regarding a sample-size justification. However, in the present biomechanical study the clinically relevant and meaningful difference in ROM of the various tested instrumentations is not known at all. Therefore a sample size calculation which requires a predefined difference in the outcome variable (ROM) would not be meaningful and relevant.

Additionally, biomechanical investigations are generally carried out in a very controlled laboratory environment, without the confounding variables usually occurring in a clinical trial. Therefore, an a priori power analysis is not the general standard and a limited number of specimens (i.e. N=12) is generally accepted (Wilke et al., 1998, European Spine Journal / Lange
et al., 2017, Spine Journal). Assuming that the biomechanical effect or difference of interventions can not be shown in a controlled laboratory environment with a limited sample size, it is deemed to be unlikely that it will have a clinical impact. Moreover, in personal communication with the AO Clinical investigation department about a priori power analysis in biomechanical in vitro laboratory studies it was mutually agreed that 12 specimens are sufficient due to the controlled laboratory environment (also see other similar biomechanical studies such as Kornblum et al., 2013) (see page 14, lines 14 ff.).