Reviewer’s report

Title: Biomechanical evaluation of immediate stability with rectangular vs cylindrical interbody cages in stabilization of the lumbar spine

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Reviewer: Dr Peter Cripton

Level of interest: A paper of limited interest

Advice on publication: Unable to decide on acceptance or rejection until the authors have responded to the compulsory revisions

COMPULSORY REVISIONS

General:
The authors have performed a biomechanical investigation of the immediate postoperative stability provided by two distinct lumbar interbody fusion implants. An in vitro experimental protocol was used to compare a new rectangular cage design with cranial-caudal teeth to an established threaded cylindrical cage. Specifically, the authors wished to test the hypothesis that the rectangular cage teeth would allow it to provide comparable stability to the cylindrical cage under axial rotation loading. The stabilizing effect of additional posterior fixation was also evaluated. With a few minor exceptions (see below) the study is well written and the methods and results are clearly explained and presented. However, the methods used in this study to measure spinal stability are significantly different from those used in the majority of the published studies that the authors refer to. This renders the comparisons to the published data inappropriate and calls into question the validity of the study’s conclusions.

Specifically, the authors have used a servo-hydraulic materials testing machine to apply eccentric forces (for flexion/extension and lateral bending) and torsion (for axial torsion) to the specimen. The loading jigs are well documented in Figures 4-6. It is clear from the figures and the accompanying text that the testing jigs resulted in constrained testing of the specimens. Only the main rotation motion was allowed and all coupled motions were prevented. The lumbar spine is known to exhibit coupled motions of lateral bending with axial torsion and vice versa and also of anterior or posterior translation with flexion and extension. Constraining the specimens in this manner could cause reductions in the specimen’s range of motion, which is actually an artifact of the constraining testing apparatus. It is also unclear that this type of constrained testing would have a consistent effect on the specimen’s range of motion both before and after interbody cage insertion.
To prevent these effects, most of the published studies which the authors reference have used non-constraining testing apparatus. The most common method to perform this is by applying pure moments to the specimen to be tested using a series of bearings to release the relevant degrees of freedom. This is described in Lund et al. (reference 4 in the reviewed article). Grassmann et al. [Grassmann S et al, Spine 1998;23:1155-1162] have addressed this issue for axial torsion. They determined that the torsional response of the lumbar spine is highly dependent on axis location under constrained testing conditions.

1) I would like to see these issues discussed by the authors in the context of the present study.

Specific questions and suggestions follow:

Measurement of flexibility section:

2) What was the axis chosen for axial torsion loading?

3) Was the center of the vertebral body aligned with the center of the testing machine actuator?

4) Was a 200 N compressive load applied throughout all tests or just the torsional tests? If it was applied through all tests please explain how this was accomplished for the flexion/extension and lateral bending tests.

Conclusions section:

5) Please clarify point 4.

**Competing interests:**

None declared.