Finite element analysis of the pelvis after modular hemipelvic endoprosthesis reconstruction

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Dear Editor

We read the article by Zhou et al. with great interest [1]. The authors conducted a study to investigate the biomechanics of the pelvis reconstructed with a modular hemipelvic prosthesis using finite element (FE) analysis. At the end of the study, they found that stress distribution of the postoperative pelvis was similar to that in the normal pelvis at three different static positions and that reconstruction with a modular hemipelvic prosthesis yielded good biomechanical characteristics.

We appreciate their study, but we believe that the study has some limitations that would essentially effect the conclusion. The main criticism of this article is that the authors neglected to present data that establishes model validity. The second criticism is the lack of details concerning the quality of the FE analysis. Without these details, the results cannot be judged as being or not being valid. We believe that the study should include details on the FE mesh: element type, element edge length relative to smallest geometric features and mesh sensitivity analyses [2, 3]. The paper should also include a figure of the mesh showing the element distribution

for a qualitative evaluation of mesh quality. Third, there is no detail on how the acetabular cup, CS fixator, pubic plate and screw–bone interface was modeled. Fourth, it is not clear how the authors modeled the contact surfaces between the femoral head and the acetabulum. Fifth, we could not determine whether or not articular cartilage, trabecular and subchondral bone were included in this model. Sixth, we believe that it would be more appropriate to clarify the boundary conditions precisely for the three different loadings that were modeled. Also, lack of experimental validation, justification of simplifying assumptions of mechanical properties and interface conditions are other drawbacks of the study.

It is not clear why the authors chose that particular patient to model for their study. If the others were chosen, would they find similar results?

Though the authors mentioned as one of the limitations that the strength of the periacetabular muscle was not considered because it was greatly affected by the widespread resection and could not be calculated accurately, we did not understand whether all 21 muscles [2] inserting onto the pelvic bone or only some that were resected were or were not incorporated in the model. Physiological loads occur under anatomical circumstances; thus, simulations of them should also contain the appropriate model of anatomic structures. Because the muscle forces have a stabilizing effect on pelvic-load transfer, analysis without muscle forces could result in higher stresses at certain locations than in the situation where muscle forces are included [2]. Muscle forces have considerable influence on stress patterns in the pelvic bone also. Analysis without muscle forces show that load transfer is entirely directed along the axis from the sacroiliac joint to the pubic symphysis. The ischial bone and the superior part of the iliac bone remain virtually unloaded, whereas the pubic bone is more highly stressed than in if muscle forces were included. The values and

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directions of the hip-joint reaction force and muscle forces in the three positions considered—sitting, standing on two feet and standing on the foot of the affected side—would also be expected to be different [2].

We believe that lack of all these details we mention limits the validity of the study and that it would be appropriate to clarify the issues pointed out herein in order to make more clinically relevant conclusions.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Zhou Y, Min L, Liu Y, Shi R, Zhang W, Zhang H, Duan H, Tu C (2013) Finite element analysis of the pelvis after modular hemipelvic endoprosthesis reconstruction. *Int Orthop* 37(4):653–658. doi:[10.1007/s00264-012-1756-6](https://doi.org/10.1007/s00264-012-1756-6)
2. Dalstra M, Huiskes R (1995) Load transfer across the pelvic bone. *J Biomech* 28(6):715–724
3. Duda GN, Mandruzzato F, Heller M, Goldhahn J, Moser R, Hehli M, Claes L, Haas NP (2001) Mechanical boundary conditions of fracture healing: borderline indications in the treatment of unreamed tibial nailing. *J Biomech* 34(5):639–650