Discussion: "Stress Changes in Intervertebral Discs of the Cervical Spine Due to Partial Discectomies and Fusion" [Tchako, A., and Sadegh, A. M., 2009, ASME J. Biomech. Eng., 131(5), p. 051013)

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We have great interests after reading the paper by Tchako and Sadegh. In the abstract, the method to judge the necessary amount of bone graft needed for discectomy left us with a deep impression. However, as spine surgeons, we think that the model of the study would be more accepted by clinicians if the model's fidelity were improved.

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When the numerical model of a cervical vertebra is established for finite element analysis, it is idealistic to model all anatomical details to make it with great fidelity to the bone. In the previous studies [1–3], the major anatomical structures including the transverse processes were considered. In this study, if the transverse processes were modeled and added to the established vertebra model of cervical spine, the model would be with greater fidelity. The authors of this study validated the model and compared their data to those in the literature. However, improvement of the model's fidelity will make the model more acceptable to the spine surgeons.

Material property plays an important role in finite element analysis. The vertebra of cervical spine consists of three parts, such as cortical shell, cancellous core and posterior element. Posterior element includes the spinous processes and facets. The material properties of posterior element are different from those of vertebral body because of their different micro-structural characteristic. In the previously published papers, a wide range of material properties values has been used in the spinal FE model because there are many experimental data available in the literature. Many studies have compared the model predictions with corresponding in vitro tests, but there have been limited studies on the sensitivity of the results to the material properties used. In this study, the material property settings of posterior element were the same as those of the vertebral body, which weaken the model's fidelity. The model validation was not sensitive to the change of the settings in this study. However, we do not know whether the settings played a negative role in the subsequent analysis or not. If the posterior element is distinguished from the vertebral bone in the numerical model and the new model is validated, the new model would be with greater fidelity to the bone. The analysis would be more accepted by spine surgeons.

References

[1] Maurel, N., Lavaste, F., and Skalli, W., 1997, "A Three-Dimensional Parameterized Finite Element Model of the Lower Cervical Spine. Study of the Influence of the Posterior Articular Facets," J. Biomech., **30**(9), pp. 921–931.
[2] Yoganandan, N., Pintar, F. A., and Klienberger, M., 1998, "Cervical Spine Vertebral and Facet Joint Kinematics Under Whiplash," ASME J. Biomech. Eng., **120**(2), pp. 305–307.
[3] Teo, E. C., Zhang, Q. H., and Huang, R. C., 2007, "Finite Element Analysis of Head–Neck Kinematics During Motor Vehicle Accidents: Analysis in Multiple Planes," Med. Eng. Phys., **29**(1), pp. 54–60.

