Oral Presentation
Thread 1: Computational Methods in Biomechanics and Mechanobiology
T1.14 Image-based Anatomical Modelling for CAD/FEA Applications

Abstract: 6087

Citation: Journal of Biomechanics 2006; Vol. 39 Suppl. 1, page S424

Development of CT /MRI-based 3D models for implant simulation and optimization

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The aim of this study is to analyze different positions of the sockets of the HAS Shoulder Prothesis (Stryker Howmedica). The normal angle between the ventral surface and the articular surface of the scapula is 65°, in atrophic shoulder joints the angle could be reduced down to 45°. Stresses in the scapula are explored by insertions of the socket from 65° to 45°.
Therefore, a finite element (FE) analysis is used. Based on data acquired by computed tomography (CT), the anatomic conditions of patients are analyzed and modeled using the software Mimics (Materialise, Belgium). The advantage of Mimics is that it combines important steps for the generation of 3D models based on CT/MRI images as well as the necessary preprocessing for further analysis.
The FE analysis is done with ANSYS (CADFEM GmbH, Austria) Using this FE software, the structural mechanical properties of the implant, and its interaction with the given anatomy and the stress in the bone are analyzed. Based on this information, the implant position and angles are optimized optimized according to internal stresses, deflections and deformations for given loads [1,2].
The transfer of data from the CT or MRI image of a patient to the FE model of the implant and the anatomy can be done individually for each patient. It offers the possibility to calculate a patients ``optimized'' implant.
If manufacturing techniques to produce the implants also are taken into account, the production of implants could be influenced substantially. Furthermore, this approach can be used to plan the operation and achieve optimal positioning of the implant.

Reference: *1. Murphy L.A., Prendergast P.J., Resch H. Structural analysis of an offset-keel design glenoid component compared with a center-keel design. J. Shoulder Elbow Surg. 2001; 10(6): 568-579.*
2. Maurel N., Diop A., Grimberg J. A 3D finite element model of an implanted scapula: importance of a multiparametric validation using experimental data. J. Biomech. 2005; 38: 1865-1872.