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Biomechanical Performance of the Synovial Capsule of the Glenohumeral Joint with a BANKART Lesion through Finite Element Analysis

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Abstract : Mechanical Computation is a great tool to study the performance of complex models. An example of it is the study of the human body structure. This paper took advantage of different types of software to make a 3D model of the glenohumeral joint and apply a finite element analysis. The main objective was to study the change in the biomechanical properties of the joint when it presents an injury. Specifically, a BANKART lesion, which consists in the detachment of the anteroinferior labrum from the glenoid. Stress and strain distribution of the soft tissues were the focus of this study. First, a 3D model was made of a joint without any pathology, as a control sample, using segmentation software for the bones with the support of medical imagery and a cadaveric model to represent the soft tissue. The joint was built to simulate a compression and external rotation test using CAD to prepare the model in the adequate position. When the healthy model was finished, it was submitted to a finite element analysis and the results were validated with experimental model data. With the validated model, it was sensitized to obtain the best mesh measurement. Finally, the geometry of the 3D model was changed to imitate a BANKART lesion. Then, the contact zone of the glenoid with the labrum was slightly separated simulating a tissue detachment. With this new geometry, the finite element analysis was applied again, and the results were compared with the control sample created initially. With the data gathered, this study can be used to improve understanding of the labrum tears. Nevertheless, it is important to remember that the computational analysis are approximations and the initial data was taken from an in vitro assay.

Keywords : biomechanics, computational model, finite elements, glenohumeral joint, bankart lesion, labrum
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