Influences of Rheumatoid Arthritis on Elbow: A Finite Element Analysis

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Abstract:
The elbow is composed of three bones namely humerus, ulna and radius which their movements are provided by three separate joints: ulnohumeral joint, radioulnar joint and radiohumeral joint. Rheumatoid arthritis is one of the most common causes of elbow arthritis. Three major events, i.e., proliferative synovitis, destruction of articulation cartilage and destruction of medial and lateral collateral ligament complexes are observed during the progression of this disease. Finite element analysis method has been shown to be a reliable tool for investigative purposes. The aim of the present study was to determine the disease progression of rheumatoid arthritis disease involving the elbow. An elbow affected by rheumatoid arthritis was simulated incorporating the three previously described characteristics. Three dimensional of healthy and rheumatoid arthritis elbow bones were constructed. The models were analyzed using computational software. Bones, ligaments and cartilages were considered linear and therefore were categorized as isotropic materials. The distal humerus was fixed while the values of muscle force used in this study were obtained from previous experiments. Result showed changes in the biomechanical behavior of rheumatoid elbow as compared to healthy elbow. In both elbow models, the stress distribution was in the region of the proximal ulna: an average of 17.5 Mpa in the rheumatoid elbow and 2.5 Mpa in the healthy elbow. However in the cancellous bones, rheumatoid elbow experienced stress distribution of 4 Mpa on average, while in the healthy elbow the magnitude of stress was on average 3 Mpa. CONCLUSION: The present study demonstrates that the rheumatoid elbow joint model is subjected to higher stresses as compared to healthy elbow joint.

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