

Biomechanical analysis of rheumatoid arthritis of the wrist joint

Abstract

The wrist is the most complex joint for virtual three-dimensional simulations, and the complexity is even more pronounced when dealing with skeletal disorders of the joint such, as rheumatoid arthritis (RA). In order to analyse the biomechanical difference between healthy and diseased joints, three-dimensional models of these two wrist conditions were developed from computed tomography images. These images consist of eight carpal bones, five metacarpal bones, the distal radius and ulna. The cartilages were developed based on the shape of the available articulations and ligaments were simulated via mechanical links. The RA model was developed accurately by simulating all ten common criteria of the disease related to the wrist. Results from the finite element (FE) analyses showed that the RA model produced three times higher contact pressure at the articulations compared to the healthy model. Normal physiological load transfer also changed from predominantly through the radial side to an increased load transfer approximately 5% towards the ulnar. Based on an extensive literature search, this is the first ever reported work that simulates the pathological conditions of the rheumatoid arthritis of the wrist joint.