**Introduction:** Forearm supination and pronation greatly enhance our ability to reach for and grasp objects essential to our activities of daily living. This motion is guided by a complex interaction of bony geometry, ligamentous structures, and muscle function. To better understand the musculoskeletal activity of forearm rotation, analytical models are needed to examine normal function, the effect of injuries, and the benefits of corrective surgery. Existing models are either static in nature or limited in how articulating joints are represented. This model is the first dynamic model to simulate three dimensional forearm supination and pronation with realistic bone geometry and ligamentous structures stabilizing articulating joints. The initial objective is to use this model to better understand the role of the distal radioulnar joint ligaments in forearm rotation.

**Methods:** A three dimensional model of the entire radius and ulna (Figure 1) was created from 300 contiguous axial CT scans of a normal cadaver forearm. The outlines of the radius and ulna for each slice were combined to form a three dimensional surface rendering of the radius and ulna. This model was then imported into Working Model Motion software where ligamentous structures and muscle actions could be represented as passive or dynamic elements. The proximal ulna was rigidly attached to a simulated humerus at 90 degrees of elbow flexion. The proximal radius was connected to the humerus by a spherical joint. The distal radioulnar joint was represented by convex-concave surfaces with a coefficient of friction of 0.02. Forearm stability was provided by 1) the interosseous membrane which was represented by three spring damper elements, two of which were nonlinear, representing the central band, the distal accessory band and the proximal interosseous band 2) the distal radioulnar ligaments which were represented by two nonlinear spring damper elements, one for the dorsal radioulnar ligament (DRUL) and one for the palmar radioulnar ligament (PRUL) and 3) the annular ligament. In this model, the DRUL and PRUL simulated the anatomical deep portion attachments of these ligaments to the ulna. Two models were created, one in which the radius moved from neutral forearm rotation into pronation by the activation of the pronator teres and pronator quadratus, while resistive forces were applied by the biceps and supinator muscles. In the other model, the radius was supinated about the ulna by activation of the supinator and biceps while being resisted by the pronator quadratus and pronator teres. The muscle force magnitudes and time of activation were determined from a cadaver experiment in which the forearm was dynamically pronated and supinated using these muscles. The motion of the forearm and ligament force levels were determined by numerical integration (Kutta-Merson) of the equations representing each of the structures.

**Results:** Figures 2 and 3 show the tension in the DRUL, PRUL, and central band during forearm pronation and supination. The increase in tension in the DRUL in pronation, and the increase in tension in the PRUL in supination, agree with the experimental results of others. The tension in the central band was greatest in supination. Others have experimentally found the central band tension to be greatest in neutral or slight pronation. The tension in the distal accessory band decreases in pronation however it never exceeds 10 N in supination or pronation. The proximal interosseous band tension increases in the extremes of forearm rotation, especially in supination. The addition of an axial forearm load did not alter the loading patterns other than to decrease the amount of forearm rotation.

**Discussion:** This is the first physiologically based, three dimensional dynamic model of forearm rotation, based upon off-the-shelf software. Only with the inclusion of ligamentous structures could the distal radioulnar joint be stabilized and forearm rotation be limited. The results from this model support the concept that the DRUL has a primary stabilizing role in pronation and in neutral forearm rotation. Conversely, the PRUL’s role is neutral and supination. It also suggests that the proximal accessory band has a more important role than previously thought. This type of model will be of value in examining the benefit of surgical reconstructions of the distal radioulnar joint and the interosseous membrane, or tendon transfers.