Forces of the distal radioulnar joint: effects of loading and rotation

G. Giakas¹, H. Shaaban², and V. Lees²

¹SATRU, Geriatric Medicine, University of Manchester, Manchester, UK
²Hand Surgery Unit, Withington Hospital, Manchester, UK.

Introduction

The distal radioulnar joint DRUJ can be a major source of morbidity in the wrist. Traumatic injuries, inflammatory processes and degenerative conditions can produce ulnar-sided wrist pain, instability, restricted forearm motion and decreased grip strength. Surgical treatment of the DRUJ is also unsatisfactory at the present time and its significance is poorly understood. This is because the present generation of operations is based on false premises concerning the function of this joint. Injuries and disorders of the DRUJ are numerous and can vary in complexity. The most common injuries of the DRUJ are the triangular fibrocartilage complex injuries, distal radius fractures involving the DRUJ, instability and dislocation. These injuries can occur from a fall on the outstretched, pronated hand, an excessive rotational force to the forearm, and/or an axial load or distraction injury to the ulnar wrist. DRUJ is also damaged by development of osteoarthritis as well as being involved in specific diseases e.g. rheumatoid arthritis. The mentioned injuries and disorders are very common and may take the injured person off work or favourite hobby, either temporarily or permanently. This explain why the DRUJ is deservedly receiving much interest internationally as surgeons are coming to appreciate that it is the “key” to the wrist joint.

The scientific objective of the research is to define the forces transmitted to DRUJ when the hand is loaded and rotated. The clinical objectives are to properly understand the function, anatomy and biomechanics of the DRUJ and its role in the integrated wrist movement so that ultimately safer and more effective management can be designed to treat the ligamentous and bony injuries in the wrist.

Methods

A custom designed jig (already designed by the Clinical Engineering Department, South Manchester University Hospital) was used to hold the cadaver arm and allow axial forces to be applied to the hand. Contact area and pressure inside the joint were measured using the Tekscan sensor film (Figure 1). Ten arms were loaded axially with 5Kg and 10Kg at each of the following supination (sup) and pronation (pron) positions: Max sup (Smax), 90deg sup (S90), 60deg sup (S60), 30deg sup (S30), neutral (N), 30deg pron (P30), 60deg pron (P60), 90deg pron (P90) and max pron (Pmax).
Figure 1. Tekscan inserted in the distal radioulnar joint

Figure 2. Loading transmitted through the radioulnar joint as a function of forearm rotation and axial loading for one arm (arm 7).
Results and Discussion

In each position within the normal physiological range of rotation, the pressure inside the DRUJ was directly related to the applied axial loading (Figure 2). Generally the pressure increased by loading the hand and decreases by unloading the hand. The $P_{\text{max}}$, $P_{90}$ and $SM$ were not affected by the loading. The $30\text{deg}$ of supination allowed the highest axial force to be transmitted through the distal radioulnar joint. The double increase in the amount of axial loading (from 5Kgr to 10 Kgr) did not double the amount of forces transmitted through the distal radioulnar joint.