THE ROLE OF THE DORSAL RADIOCARPAL AND DORSAL INTERCARPAL LIGAMENTS IN STABILIZING THE SCAPHOID AND LUNATE

Introduction: Ligament injuries in the region of the scaphoid and lunate are difficult to diagnose and treatment can lead to uncertain results. A fall on an outstretched hand may cause injury to one or more of the ligaments that stabilize the scaphoid and lunate. The usual diagnostic studies such as a physical exam and x-rays can be unreliable. If untreated, this will lead to diminished function and degenerative arthritis. Previously we and others have shown the scapholunate interosseous ligament (SLIL) to be a major stabilizer of the scaphoid and lunate. Some have suggested that the dorsal radiocarpal ligament and dorsal intercarpal (DIC) ligament have a role in preventing scapholunate instability. The purpose of this study was to determine the order of importance of the SLIL, the DRC and the DIC in stabilizing the scapholunate joint.

Methods: Sixteen fresh cadaver forearms were physiologically moved through cyclic flexion/extension (30° extension to 50° flexion) and radioulnar deviation (10° radial to 20° ulnar) motions using a wrist joint motion simulator. Fastrak motion tracking sensors were indirectly attached to the scaphoid and lunate and directly onto the third metacarpal to measure angular and translational motion of these bones. Carpal bone motion data were recorded for the intact specimens, and in 8 arms after sequentially sectioning of the DRC, DIC and SLIL (Group 1). In 8 additional arms, data were acquired after sequentially sectioning the DIC, SLIL and DRC (Group 2). Data were again collected after 1000 cycles of flexion/extension motion following complete ligament sectioning to mimic continued use after injury. Three dimensional animated models were created of each wrist, based upon serial CT scans to aid in analyzing the data. The scaphoid and lunate kinematic data were used to cause animation of these bones in the same way they moved experimentally. To mimic the 1D clinical measurement of carpal instability, the minimum distance between the scaphoid and lunate (excluding the cartilage) was calculated using these models for each arm and each motion. Differences in carpal motion and distance were analyzed using a repeated measures 1 way ANOVA (Duncan’s method, p<.05).

Results: In the first group of arms, sectioning of the DRC alone caused a slight statistical increase in lunate radial deviation during wrist flexion (fig 1). The data are shown plotted for a complete cycle of wrist motion. A further increase in lunate radial deviation was statistically observed only after the SLIL was sectioned. Scaphoid motion was not affected by sectioning of the DRC alone during either wrist flexion/extension or radial/ulnar deviation. DIC sectioning following DRC sectioning had no statistical effect on scaphoid or lunate motion during either wrist motion. In the second group of arms, sectioning of the DIC alone again did not statistically alter scaphoid or lunate motion (fig 2) during either wrist motion. In both groups of arms, sectioning of the SLIL was required to statistically observe an increase in scaphoid flexion, scaphoid ulnar deviation, and lunate extension from the intact condition. 1000 cycles of cyclic motion caused additional statistical increases in carpal motion for both wrist motions. In both series of arms, the minimum distance between the scaphoid and lunate statistically increased only after the SLIL was sectioned (fig 3). Sectioning of only the DRC or only the DIC did not statistically alter the gap between the bones. The gap was seen to be greater in wrist flexion or in wrist ulnar deviation. Of interest, the gap due to ligament sectioning would frequently reduce as the wrist moved to extreme wrist flexion (50°) or ulnar deviation (20°).

Discussion: These results show that the SLIL is the primary stabilizer of the scapholunate joint and that the DRC and DIC are secondary supporting structures. The DRC may have more of a role than the DIC as shown by the changes in lunate radial deviation after sectioning of only the DRC. As the DRC originates on the dorsal margin of the distal radius and attaches to the dorsal lunate and triquetrum with no attachment to the scaphoid, this kinematic change is not unexpected. With the large statistical increase in carpal bone motion changes after repetitive wrist motion, this study demonstrates the value of early diagnosis of ligament injury following the initial injury.