EVALUATION OF FIVE LIGAMENTOUS STABILIZERS OF THE SCAPHOID AND LUNATE

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INTRODUCTION

Ligamentous injuries in the region of the scaphoid and lunate are painful and difficult to treat. This biomechanical study evaluated the function of the scapholunate interosseous ligament (SLIL), radioscaphocapitate ligament (RSC), scaphotrapezium ligament (ST), dorsal radiocarpal ligament (DRC), and the dorsal intercarpal ligament (DIC) and assessed the gap between the scaphoid and lunate. Our hypothesis is that the SLIL is the major stabilizer of the scapholunate joint.

METHODS

Sixteen cadaver forearms were evaluated. Fastrak motion tracking sensors were used to measure the scaphoid and lunate motions. Each wrist was physiologically moved using a wrist joint simulator[1] through repetitive cyclic flexion/extension of the wrist (30° extension to 50° flexion) and wrist radial/ulnar deviation (10° radial deviation to 20° ulnar deviation). Carpal bone motion data were collected in the intact specimens, and in 8 arms after sequentially sectioning the ST, the SLIL, and the RSC. In eight additional arms, data were acquired after sequentially sectioning the DRC, the DIC, and the SLIL. Data were again collected after 1000 cycles of flexion/extension motion. Differences in motion were analyzed using a repeated measures 1 way ANOVA (Duncan's method, $p<.05$). Three dimensional animated models were created of each wrist, based upon serial CT scans. The experimentally collected kinematic scaphoid and lunate data were used to drive the animated motions. To mimic the 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 for each motion.

RESULTS AND DISCUSSION

Sectioning of the ST alone produced no statistical changes in scaphoid or lunate angular position (fig 1). Additional sectioning of the SLIL resulted in statistically significant increases in scaphoid flexion and lunate extension during wrist flexion/extension and in lunate extension during wrist radial/ulnar deviation. Sectioning of the RSC after sectioning the ST and SLIL did not cause any additional significant angular changes. However, 1000 cycles of motion caused additional significant increases in lunate extension.

Paralleling the angular changes, there was no change in the gap between the scaphoid and lunate with sectioning of the ST ligament. An increase did occur with SLIL sectioning (fig 2).

In the second series of arms, sectioning of the DRC, or the DRC and DIC did not alter the scaphoid motion. Slight increases in lunate radial deviation were observed with sectioning of the DRC, or the DRC and DIC. Subsequent sectioning of the SLIL caused increases in scaphoid flexion, scaphoid ulnar deviation and lunate extension.

In comparing the two groups of arms, there was a greater increase in lunate radial deviation during wrist radial/ulnar deviation after cutting the DRC, DIC, and SLIL and 1000 cycles of motion (Group 2) compared to cutting the ST, SLIL, and RSC and 1000 cycles of motion (Group 1). Group 2 visually demonstrated greater instability compared to group 1 as seen in the 3D animations of carpal motion.

CONCLUSIONS

The SLIL was found to be the major stabilizer of the scaphoid and lunate. The RSC and ST are secondary support structures. The DRC and DIC also are secondary stabilizer structures, but may be more important than either the RSC or ST in stabilizing the scaphoid and lunate. Continued wrist use following ligament injury may result in further changes in carpal kinematics.

REFERENCES

1. Werner et al. J Orthop Res 14:639-646, 1996.

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