TREATMENT OF SCAPHOLUNATE DISSOCIATION WITH A BIORESORBABLE POLYMER PLATE

Introduction: Wrist ligament injuries are now as common as tunnel syndrome. Of all wrist ligament injuries, 20 to 30% result in wrist instability. They typically occur at the scapholunate joint resulting in pain and eventually arthritis. There are no consistently reliable soft tissue surgical procedures to repair the ligament damage. Attempts to fuse these bones fail. The purpose of this biomechanical study was to evaluate a new surgical repair for scapholunate dissociation using a bioresorbable polymer approved for human applications.

Methods: Eight 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. Physiological loads were applied to the major wrist flexor and extensor tendons. Fastrak motion tracking sensors were indirectly attached to the scaphoid and lunate via posts cemented into each carpal bone and directly onto the third metacarpal to measure angular and translational motion of these bones. Scaphoid and lunate motion were continuously recorded during each cyclic wrist motion in the intact specimen. The scapholunate (SLIL), dorsal radiocarpal (DRC) and dorsal intercarpal (DIC) ligaments were then sectioned to create a static scapholunate dissociation (SLD) based upon previous studies. Scaphoid and lunate motion data were again collected during the cyclic motions. In the third step of the experiment, the SLD was reduced and a four hole plate was applied to the non-articular dorsal portion of the scaphoid and lunate using two screws each in the scaphoid and lunate (fig 1). The plate and screws are made of a polymer of D and L lactic acid. This material is designed to act as a scaffold to initially stabilize the wrist and over six months to degrade to carbon dioxide and water. After application of the plate, scaphoid and lunate positional data were again obtained during cyclic flexion/extension and radioulnar deviation motions. The specimen was then moved through 1000 cycles of motion to mimic continued use after surgery and data were again collected. 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 these measurement of carpal instability, the minimum distance between the same way they moved experimentally. To mimic the 1D clinical motion simulator. Physiological loads were applied to the major wrist flexor and extensor tendons. Fastrak motion tracking sensors were indirectly attached to the scaphoid and lunate via posts cemented into each carpal bone and directly onto the third metacarpal to measure angular and translational motion of these bones. Scaphoid and lunate motion were continuously recorded during each cyclic wrist motion in the intact specimen. The scapholunate (SLIL), dorsal radiocarpal (DRC) and dorsal intercarpal (DIC) ligaments were then sectioned to create a static scapholunate dissociation (SLD) based upon previous studies. Scaphoid and lunate motion data were again collected during the cyclic motions. In the third step of the experiment, the SLD was reduced and a four hole plate was applied to the non-articular dorsal portion of the scaphoid and lunate using two screws each in the scaphoid and lunate (fig 1). The plate and screws are made of a polymer of D and L lactic acid. This material is designed to act as a scaffold to initially stabilize the wrist and over six months to degrade to carbon dioxide and water. After application of the plate, scaphoid and lunate positional data were again obtained during cyclic flexion/extension and radioulnar deviation motions. The specimen was then moved through 1000 cycles of motion to mimic continued use after surgery and data were again collected. 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: Sectioning the SLIL, DRC, and DIC resulted in static SLD. Statistical increases in scaphoid flexion (fig 2), scaphoid ulnar deviation (fig 3) and lunate extension (fig 4) occurred during both wrist flexion/extension and radioulnar deviation. Application of the bioresorbable polymer plate statistically restored the scaphoid and lunate kinematics to that of the intact specimen. Scapholunate instability and any gap between the bones was eliminated. After 1000 cycles of motion the plate maintained intact kinematics of the scaphoid and lunate in five of eight arms. During repetitive motion, either the plate failed or the screws pulled out in the remaining three arms. This occurred in smaller arms in which positioning a sensor post and two screws in the small lunate compromised the pullout strength of the screws.

Conclusion: The use of a resorbable polymer plate in restoring normal kinematics in patients with SLD is supported by this study. Clinically the scaphoid and lunate could be reduced using k-wires, the torn SLIL repaired, and the resorbable plate applied. Theoretically the native SLIL would regain strength while the polymer plate resorbs resulting in restoration of normal carpal kinematics.

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