INTRODUCTION:

The radioscapholunate (RSL) fusion is a salvage procedure indicated in the case of traumatic or degenerative osteoarthritis of the radiocarpal joint, involving the lunate facet of the radius. Remaining movement of the wrist joint will take place in the midcarpal joint. This cadaver study focuses on range of motion changes due to radioscapholunate arthrodesis and surgical techniques to improve the range of motion. At the same time these techniques might show other long-term benefits, such as diminishing mechanical stress which might otherwise cause development of midcarpal osteoarthritis.

We tested the hypotheses that (1) RSL-fusion would diminish the amplitudes of movements of the wrist in all directions, (2) range of motion in the RSL-fused wrist would improve after scaphoidectomy, (3) range of motion would further improve after triquetrectomy, and (4) RSL-fusion would cause a significant change in kinematics between the hamate and the triquetrum.

METHODS AND PROCEDURES:

Six fresh frozen cadaver arms from four women and two men, averaging 86 years of age (range 75-92), were obtained from the Mayo Anatomical Bequest program (Mayo Clinic, Rochester). These arms were prepared and placed in a custom frame with the elbow in 90 degrees flexion and the forearm in neutral position, the hand pointing upwards. The wrist flexors and extensors were loaded with a total of 100 N (Figure 1A). Range of motion measurements were recorded using a magnetic tracking device (FASTRAK; Polhemus, Colchester, VT, USA) (Figure 1B). A sequence of surgical steps was carried out and measurements: maximum flexion/extension (F/E) and radial/ulnar deviation (R/U) were taken in the intact situation and after each surgical step. These steps were subsequently: RSL-fusion, distal scaphoidectomy, and triquetrectomy. For the fusion, two 2.4 LCP distal radius plates were used. The data analysis was completed using Motion Monitor software (The Motion Monitor; Innovative Sports Training, Chicago, IL, USA). Maximum total range of motion in flexion/extension and radial/ulnar deviation were determined for the third metacarpal (3 MC), the hamate (Ham) and the triquetrum (Tri) versus the radius (Rad) and of the hamate versus the triquetrum. A paired differences test using t-test and sign test was carried out on the logarithm of the ratios (e.g. ratio of Fused to Intact).

RESULTS:

RSL-fusion reduced total wrist motion (3 MC/Rad) in the F/E axis to an average of 49% of F/E in the unfused wrist. Subsequent distal scaphoidectomy and triquetrectomy augmented F/E from 49% to respectively 75% and 88% of the unfused situation (Figure 2). RSL-fusion reduced R/U deviation to respectively 83% and 98% of the unfused situation (Figure 3).

DISCUSSION:

Coming back to our hypotheses, we conclude that RSL-fusion diminishes the amplitudes of movements of the wrist in all directions. Range of motion in the RSL-fused wrist improves after distal scaphoidectomy. Range of motion further improves after triquetrectomy (88% of original F/E and 98% of original R/U deviation). RSL-fusion causes a significant change in kinematics between the hamate and the triquetrum in F/E.

Certain limitations exist in this study. Only six cadaver arms were used, all of which were elderly with possible age related degenerative changes and stiffness. Repeatedly opening and repairing the wrist capsule in the cadaver wrist results in decreased ligamentous strength and may have influenced the results.

Whether these results can be reproduced in the clinical situation has yet to be shown by future research. Instability and stiffness due to scarring and fibrosis might give lesser results than the cadaver study suggests. Whether or not the propriocepsis of the wrist will be influenced by triquetrectomy is another question to be answered in the clinical setting.

ACKNOWLEDGEMENTS:

This study was supported by a grant from the Dutch Society for Hand Surgery and a grant from the Anna Fonds. The materials for bone fixation were cordially provided by Synthes, Solothurn, Switzerland.