VARIATIONS IN SCAPHOLUNATE GAP WITH VARIOUS TYPES OF LIGAMENTOUS SECTIONING

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INTRODUCTION

Instability of the scapholunate joint is frequently manifested by wrist pain but determining which ligament or ligaments are torn is difficult. Most studies agree that the scapholunate interosseous ligament (SLIL) is the primary stabilizing structure. However, there are secondary stabilizing structures such as the dorsal intercarpal (DIC) and dorsal radiocarpal (DRC) ligaments. Pre-surgical determination of which structures are damaged would be of value to the surgeon when attempting to repair the torn ligaments. The purpose of this study was to determine if various gap patterns between the scaphoid and lunate could be related to which ligaments were ruptured. A secondary purpose was to determine which wrist position might best differentiate these effects.

METHODS

Ten cadaver forearms were evaluated. Fastrak motion tracking sensors were attached to the scaphoid, lunate and third metacarpal to measure angular and translational motion of these bones. Each wrist was physiologically moved using a wrist joint simulator 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 5 arms after sequentially sectioning the DRC, the DIC, and the SLIL. In five additional arms, data were acquired after sequentially sectioning the DIC, the SLIL, and the DRC. Data were again collected after 1000 cycles of flexion/extension motion following complete ligament sectioning to mimic continued use after injury. 3D animated models were created of each wrist, based upon serial CT scans to aid in analyzing the data. The experimental kinematic scaphoid and lunate data were used to drive the animated motions. Two anatomical landmarks were identified on the lunate (dorsal lunate, volar lunate) and two on the scaphoid (dorsal scaphoid and volar scaphoid). Using the models and kinematic data, the distances between the dorsal points and between the volar points were determined during each motion (fig 1) for each level of ligament sectioning using customized CAD software. Additionally, a projected quadrilateral area was computed from these four points.

RESULTS AND DISCUSSION

Sectioning of only the DRC (1st group of arms) or only the DIC (2nd group of arms) caused no increase in the gap between the bones (fig 2, table 1). Subsequent sectioning of the SLIL caused an average 35 to 55% increase in the dorsal and volar gaps during flexion/extension and an average 10 to 40% increase during radial/ulnar deviation. Even though the gaps during wrist flexion/extension were greater than during radial/ulnar deviation, the wrist angle during flexion/extension at which the largest gap occurred varied among arms. Typically the gap increased the least in wrist extension. However, during radial/ulnar deviation, the largest gaps were consistently observed in ulnar deviation. With cyclic motion, the gaps increased, especially during the radial/ulnar deviation motion.

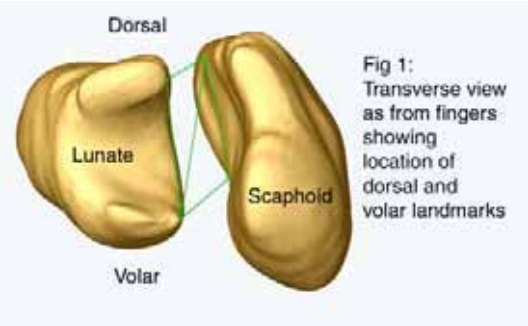

Fig 1: Transverse view as from fingers showing location of dorsal and volar landmarks

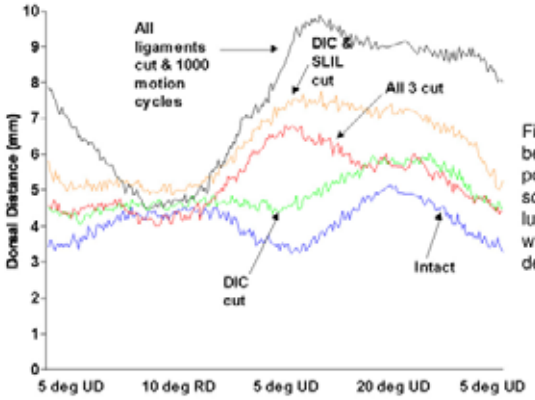

Fig 2: Gap between dorsal points on scaphoid and lunate during wrist radial/ulnar deviation

CONCLUSIONS

Following wrist ligament injury, detection of major gap changes, between the scaphoid and lunate, may be best detected in wrist ulnar deviation.

ACKNOWLEDGEMENTS

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Group 1 arms - Table 1	Average % increase from intact flexion/extension motion			
	DRC cut	DRC&DIC cut	DRC, DIC, & SLIL cut	All 3 cut and 1000 cycles
Dorsal Gap	-1.0	1.7	53.1	70.1
Volar Gap	0.4	1.4	37.9	49.6
Areal gap	0.7	3.5	40.9	54.4