

The importance of the radiotriquetral ligament for proximal row stability in the wrist: A finite element study

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Introduction

To understand how surgical intervention might help stabilise the wrist joint, an understanding of the importance of specific structures for load transfer is required. The radiotriquetral ligament (RTL) has been identified as one of the main stabilizers of the proximal carpal row¹. This study implemented a detailed 3D finite element (FE) model of the wrist to explore RTL function.

Methods

A 3D FE model was created from wrist MRI scans². Mimics was used for 3D reconstruction and meshing, Abaqus (v.6.9) for FE analysis. Ligaments were modelled with non linear spring elements. Loading was based on gripping force². The impact of variation in RTL laxity and stiffness on load transfer was explored.

Results

Simulated rupture of the RTL resulted in a 2.5mm additional displacement of the triquetrum compared to the intact condition. The displacements of the triquetrum were notably most in ulnar and palmar directions when the ligament was cut. Ligamentous force contributions in the RTL decreased non linearly with decreased ligament laxity. The average force in the intact RTL ligament was calculated as 23.4 N. Changes in the contact stresses at the midcarpal joint were noticed. A dorsal shift of the contact area occurred at the hamitriquetrum articulation when the RTL ligament was cut as well as decrease of the contact area at the capitosaphoid articulation.

Discussion and Conclusion

Detailed FE models can be used to explore the effect of soft tissue disruption on load transfer. RTL disruption causes carpal instability. The displacement of the triquetral bone with the RTL cut, emphasizes the importance of the radiotriquetral ligament on the stability of the carpal row. The findings confirm clinical observation of the function of the RTL and provide further quantitative evidence of wrist joint load transfer and function.

References:

1. Garcia Elias M, Current Trends in Hand Surgery, 41-46 1995.
2. Gíslason M et al, Proc. IMechE Part H, Eng in Med, 223: 849-861 2009.