

# The Influence of Ulna Length on DRUJ Contact

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## Background

Ulnocarpal impaction syndrome is a common disorder of the forearm, that involves excessive loading at the ulnocarpal joint. This disorder is commonly treated by ulna osteotomy, where the ulna is shortened to reduce that load. While effective at reducing ulnocarpal pain, the procedure also affects articulation at the distal radioulnar joint (DRUJ), where postoperative cartilage degeneration has been noted<sup>1,2</sup>. At present, the relationship between ulna length and DRUJ contact is not well understood.

The goal of this work was to develop a computational model with which to investigate the influence ulna length has on DRUJ contact.

## Method

1. High resolution MR imaging data was used to create a geometrically accurate anatomical model of the DRUJ.

2. A computational model, based on the theory of finite elasticity, was developed to predict articular cartilage deformation at the joint.

(1) **Governing equation:** static Cauchy equation.

(2) **Neumann boundary conditions:** Estimated muscle force during maximal pronation and supination.

(3) **Constitutive properties:** neo-Hookean hyperelastic model.

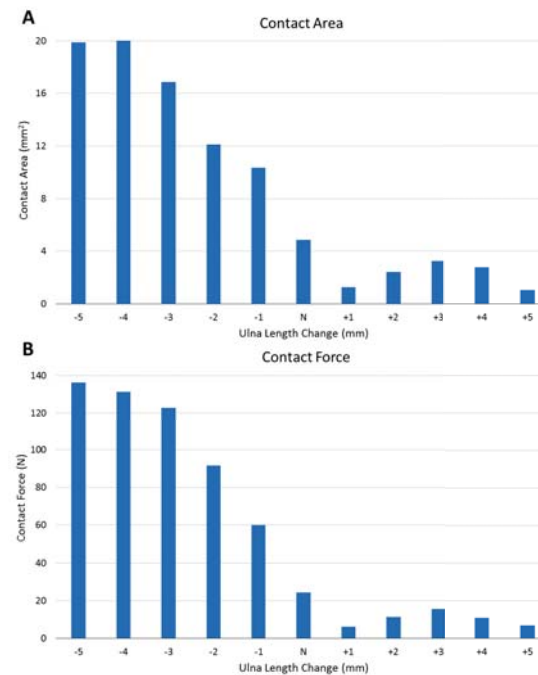
(4) **Contact constraint:** imposed using a gap function and penalty method.

(5) **Incompressibility constraint:** Lagrange multiplier method.

3. The ulna bone model was lengthened and shortened in 1 mm increments up to +/- 5 mm.

4. DRUJ contact was simulated at each ulna length.

## Results



## References

- Köppel, M., Hargreaves, I. C., & Herbert, T. J. (1997). Ulnar shortening osteotomy for ulnar carpal instability and ulnar carpal impaction. *The Journal of Hand Surgery: British & European Volume*, 22(4), 451-456.
- Minami, A., & Kato, H. (1998). Ulnar shortening for triangular fibrocartilage complex tears associated with ulnar positive variance. *The Journal of Hand Surgery*, 23A(5), 904-908.

## Summary

### Ulna lengthening:

- ↓ Contact area and force
- Slight ↓ contact pressure
- Distal shift in contact location

### Ulna Shortening:

- ↑ Contact area and force
- Slight ↑ contact pressure
- Proximal shift in contact location with dislocation at -3 mm

