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A Modified Technique of Partial Trapeziectomy with Capsular Interposition as Treatment for Trapeziometacarpal Osteoarthritis: A Biomechanical Study, Short-Term Retrospective Review, and Medium-Term Follow-Up

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INTRODUCTION

- Osteoarthritis (OA) of the trapeziometacarpal (TMC) joint is a common problem, affecting one in four people over the age of 45 with a 6:1 female predominance. (Fig. 1)
- Symptoms include pain at the base of the thumb, swelling and stiffness of the joint, and decreased pinch and grip strength – significantly affecting quality of life.
- Multiple surgical procedures are described for treating the symptoms of this disease, but none has been described which alleviates pain, preserves thumb length, stability, and strength.

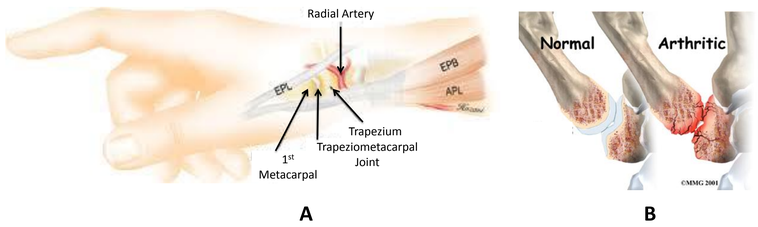

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Figure 1: A. The trapeziometacarpal joint connects the trapezium bone of the wrist to the first thumb metacarpal. B. Representative images of normal and arthritic joints.

PURPOSE

- We present a modified surgical technique of partial trapeziectomy with capsular interposition (PTCI) for treatment of TMC OA. In a matched-paired cadaveric study, short term retrospective review, and medium term follow-up of clinical cases, we demonstrate the possible advantages of this technique.

METHODS

Surgical Technique:

- The articular surface of the base of the 1st metacarpal (~2mm) is excised
- The distal articular surface of the trapezium (~2mm) is excised (Fig. 2A)
- Local soft tissue is utilized as interposition graft by capturing redundant capsular tissue with 1 or 2 figure-of-eight sutures (Fig. 2B)

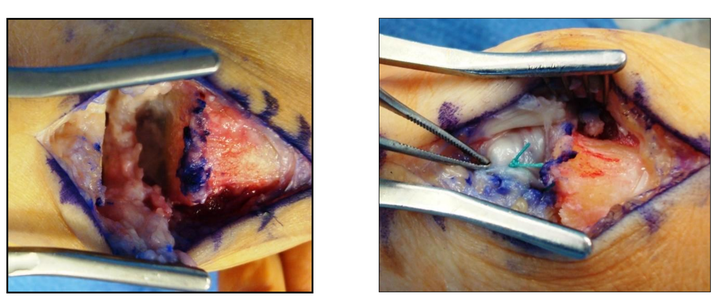

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Figure 2: A. Modified partial trapeziectomy technique characterized by removal of ~2mm of the distal surface of the trapezium and ~2mm of the proximal surface of the first metacarpal. B. Interposition arthroplasty with local capsular tissue.

METHODS

Biomechanical Study:

- We quantified the metacarpal to scaphoid (M to S) distance from specimens treated with partial trapeziectomy (PTCI) and compare results with total trapezium resection (TRCI) in the contralateral limb
- Eight matched pairs of fresh frozen cadaveric hands were randomized into two groups:
  - Group 1: total trapeziectomy (TRCI)
  - Group 2: partial trapeziectomy (PTCI)
  - Capsular interposition was utilized in both techniques
- K-wires were placed in the scaphoid and base of the metacarpal as reference points.
- Hands were stabilized in a custom jig and weighted sutures were attached to 6 tendons to allow lateral pinch thumb position. (Fig. 3)
- Calibrated antero-posterior images were taken using a mini-fluoroscopy unit to obtain native (untreated) joint measurements
- Specimens were treated with PTCI or TRCI and imaging was repeated
- M to S distance was measured with custom software
- A paired t-test was used to compare loss in thumb length determined by the relative M to S distance between native and treated joints

Figure 3: Experimental testing fixture showing trajectory of tendon loading and thumb lateral pinch motion.

Short-term Retrospective Review:

- A retrospective review was completed of 71 consecutive surgeries in 67 patients (20 male/51 female; mean age 58.5+-7.0 y/o) performed over a 4 year period
- Inclusion criteria were all patients over 18 years of age who presented with TMC OA treated with PTCI by the senior surgeon
- Demographics, handedness, side of surgery, pre- and post-operative grip and pinch strength data were collected at 6 months to assess short-term outcomes

Medium-term Follow-up:

- 22 patients (25 surgeries) returned (35%) to assess medium-term outcomes
- Grip and pinch strength, range of motion, first web space distance, and Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaires were collected

RESULTS

Biomechanical Study:

- The relative M to S distance between native and treated joints was significantly different between the TRCI and PTCI groups (p=0.04; 7.75+-3.09mm and 4.31+-3.25mm, respectively)

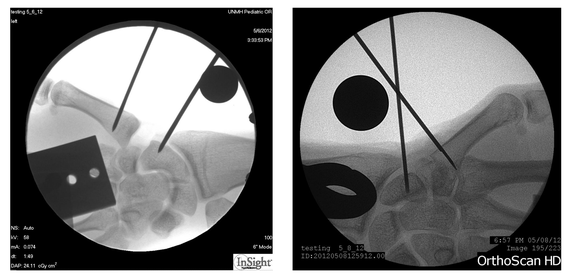

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Figure 4: Antero-posterior radiographs showing K-wire placement in metacarpal and scaphoid bones plus spherical calibration marker after treatment with A. TRCI and B. PTCI.

Short-term Retrospective Review:

- The difference in pre- and post-operative grip and pinch strength was not significant (0.4+-8.5kg and -0.8+-3.8kg, respectively)
- Complication rate was 2.86% (2 patients); 1 patient developing septic wrist with osteomyelitis of the distal ulna 3 months postoperatively; 1 patient developed proximal migration of 1st metacarpal with trapezial impingement

Medium-term Follow-up:

- The difference in pre- and post-operative grip strength was significant (4.0+-4.3kg)
- There was no significant difference between the pre- and post-operative pinch strength (0.5+-2.0kg)

CONCLUSIONS

- The biomechanical study showed PTCI minimized the loss in thumb length over the TRCI group by 3.44mm
- Medium-term clinical results show no loss in pinch strength and increased grip strength after PTCI

CLINICAL RELEVANCE

- It has been shown that thumb shortening correlates with a reduction in thumb strength; PTCI maintains greater thumb length over common treatment for TMC OA (total trapeziectomy)
- Minimizing bone resection with less disruption of soft-tissue may lead to a more functional thumb

ACKNOWLEDGEMENTS

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