Assessment of Dorsal Subluxation in Thumb Carpometacarpal Osteoarthritis

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Abstract

Keywords

- thumb carpometacarpal joint
- osteoarthritis
- dorsal subluxation
- trapeziectomy
- ligament reconstruction

Background Although dorsal subluxation is a typical finding for osteoarthritis of the thumb carpometacarpal (CMC) joint, it is difficult to evaluate the subluxation after trapeziectomy and the significance of its surgical correction combined with trapeziectomy is still controversial. The purpose of this study was to develop a method to evaluate dorsal subluxation without using landmarks on the trapezium.

Methods Thirty patients with thumb CMC arthritis and 13 normal patients were included in this study. Dorsal subluxation of the CMC joint was evaluated by measuring the distance between the volar tip of the thumb metacarpal base and dorsoradial border of the index metacarpal base (M1M2 overlap) on the X-ray true lateral view of the thumb as well as previously reported methods. Intraclass correlation coefficient (ICC) was used to assess inter- and intraobserver reliability for the measurement of M1M2 overlap by six examiners of different level of expertise. Dorsal subluxation was also evaluated after trapeziectomy with ligament reconstruction.

Results There were almost perfect interobserver (ICC = 0.94) and intraobserver (ICC = 0.95 for an expert and 0.97 for a novice) reliabilities for the measurement of M1M2 overlap. There was a weak correlation between our method and previously reported methods. M1M2 overlap of the normal patients and the patients were 4.6 ± 1.2 mm and 2.3 ± 2.3 mm (mean $\pm$ SD), respectively. M1M2 overlap was corrected significantly after trapeziectomy with ligament reconstruction.

Conclusion Dorsal subluxation of the thumb CMC joint could be evaluated by M1M2 overlap before and after trapeziectomy.

Introduction

Dorsal subluxation is a typical finding of thumb carpometacarpal (CMC) osteoarthritis, which indicates ligament laxity and instability of the joint.^{1,2} Ligament reconstruction, therefore, is one of the surgical treatments for painful thumb CMC joints.² Although trapeziectomy with ligament reconstruction and tendon interposition (LRTI) is a popular surgical procedure for advanced thumb CMC arthritis,^{3,4} the significance of correcting the dorsal subluxation combined with trapeziectomy is still controversial.^{5,6}

Trumble et al reported correlations between better clinical outcomes and decreasing subluxation of the thumb CMC

joint after hemiresection of the trapezium with ligament reconstruction and allograft costochondral interposition.⁵ Reissner et al, on the other hand, reported that the postoperative position of the metacarpal base of the thumb does not affect clinical or subjective outcomes after LRTI.⁶

Dorsal subluxation of the thumb CMC joint has been evaluated by angle or distance using landmarks on the trapezium. Kurosawa et al measured the angle formed by a tangent drawn on the dorsal margin of the thumb metacarpal base and trapezium and the longitudinal axis of the index metacarpal.⁷ Trumble et al assessed the distance between a line connecting the superior and inferior edges on the ulnar

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border of the trapezium and a line parallel to this incorporating the ulnar margin of the thumb metacarpal.^{5,8} Because these landmarks on the trapezium cannot be used after trapeziectomy, it is difficult to evaluate the postoperative position of the thumb after trapeziectomy.

The purpose of this study was to develop a new method of evaluating dorsal subluxation, or translation, of the thumb CMC joint without using landmarks on the trapezium.

Methods

We conducted this retrospective study with the approval of our institutional review board. Consecutive patients with thumb CMC osteoarthritis who visited our clinic between July 2012 and March 2015 were reviewed. Exclusion criteria included inflammatory arthritis, patients with other concomitant disease in the thumb, and patients with short follow-up period less than 12 months. Thirty patients who had been monitored for at least 12 months were enrolled in this study. All patients received conservative treatment with a splint for at least 2 months. Fifteen patients responded well with the conservative treatment (conservative group). The remaining 15 patients for whom conservative treatment failed underwent LRTI (surgical group). All surgical cases were followed up for at least 12 months after surgery. Radiographs of 13 patients without pain in the thumb CMC joint were also included in this study to provide normal values for our radiographic evaluation.

A true lateral view of the thumb CMC joint was obtained with the forearm pronated at 20 degrees using the method by Kapandji.⁹ We confirmed that the thumbnail was vertical to the film to obtain the true lateral view. The overlapping distance between the volar apex of the thumb metacarpal base and dorsoradial border of the index metacarpal base (M1M2 overlap) was measured and used as an indicator of dorsal subluxation or dorsal translation (► **Fig. 1**). When there was no overlap between the metacarpals, the gap was measured and shown as a negative value.

We assessed the inter- and intraobserver reliability of the measurement of M1M2 overlap. Six examiners of different level of expertise (three hand surgeons and three residents of orthopaedic surgery) reviewed radiographic films of 13 normal persons and 30 patients. Two observers (one hand surgeon and one resident) performed a second measurement several days after the first measurement. Intraclass correlation coefficient (ICC) was used to assess inter- and intraobserver reliabilities.

Dorsal subluxation of the thumb CMC joint was evaluated by the methods of Trumble et al⁸ and Kurosawa et al⁷ as well as by our original method. Correlations between M1M2 overlap and the measurement values by Trumble or Kurosawa were evaluated by the Pearson correlation coefficients.

All surgical procedures were performed by the same surgeon. We used the abductor pollicis longus (APL) tendon for ligament reconstruction in combination with total trapeziectomy. One slip of the APL tendon was cut at its musculotendinous junction with the distal insertion attached to the thumb metacarpal. The tendon slip was wrapped around the flexor carpi radialis (FCR) tendon and pulled distally and was sutured to the index metacarpal base using a bone anchor. Finally, the rest of the tendon was interposed into the space between the scaphoid and the metacarpal. The thumb was immobilized with a splint for 3 weeks after surgery.

M1M2 overlap, pain relief, and the quick disability of the arm, shoulder, and hand (QuickDASH) score were also evaluated at 6 and 12 months after surgery in surgical group.

Data Analysis

Statistical analysis was performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). One-way analysis of variance (ANOVA) with Bonferroni's multiple comparison test was used for analysis of M1M2 overlap between groups. Univariate repeated measures ANOVA with Bonferroni's multiple comparison test was used for analysis of M1M2 overlaps before and after surgery.

Fig. 1 Our method of evaluating dorsal subluxation of the thumb CMC joint. The overlapping distance between the volar apex of the thumb metacarpal base and a line incorporating the radial facet of the intermetacarpal joint between the thumb and the index finger (M1M2 overlap) was used to indicate dorsal subluxation in normal persons (**A**) and patients with thumb CMC arthritis before (**B**) and after surgery (**C**).

Results

Inter- and intraobserver consistency for M1M2 overlap was indicated by ICC and 95% confidence interval (CI). Interobserver reliability showed almost perfect level of agreements both in expert hand surgeons (ICC = 0.953, 95% CI: 0.924–0.973) and in residents (ICC = 0.918, 95% CI: 0.869–0.952) (ICC for all examiners = 0.940, 95% CI: 0.909–0.963). Intraobserver reliability showed almost perfect level agreements both in an expert hand surgeon (ICC = 0.953, 95% CI: 0.915–0.978) and in a resident (ICC = 0.968, 95% CI: 0.943–0.983).

Our method was compared with other methods. There was a weak correlation between our method and those of Trumble ($p = 0.04$, $R = -0.3$) and Kurosawa ($p = 0.009$, $R = -0.4$) (► Fig. 2).

M1M2 overlaps of normal persons and patients with thumb CMC osteoarthritis were 4.6 ± 1.2 mm and 2.3 ± 2.3 mm (mean $\pm$ standard deviation [SD]), respectively, which were significantly different ($p = 0.0015$). Post hoc analysis revealed that the power was 0.87 to detect a difference of M1M2 overlap between normal persons and patients. When the patients were divided into the conservative group and the surgical group, M1M2 overlaps of these groups were 3.3 ± 1.2 mm and 1.2 ± 2.6 mm (mean $\pm$ SD), respectively. There were significant differences among these groups ($p < 0.0001$) (► Fig. 3). Post hoc analysis showed that M1M2 overlap of the surgical group was significantly smaller than that of the conservative group ($p = 0.0072$).

M1M2 overlap in the surgical group had increased at 6 and 12 months after surgery compared with the preoperative value ($p < 0.0001$) (► Fig. 4). All patients in the surgical group had complete or partial pain relief, and no patient had no improvement or worsened. QuickDASH score (52 ± 20 , preoperatively) improved significantly at 6 and 12 months after surgery (14 ± 14 and 16 ± 11 , respectively) ($p < 0.0001$).

Discussion

Although LRTI is a popular procedure for thumb CMC arthritis and various methods of ligament reconstruction have been proposed, the roles of ligament reconstruction are still to

be elucidated.^{10–14} Ligament reconstruction possibly prevents dorsal subluxation as well as subsidence of the thumb metacarpal after trapeziectomy. Although subsidence of the metacarpal has often been reported, dorsal subluxation has rarely been evaluated after LRTI. One of the reasons for the deficiency of studies on dorsal subluxation may be the lack of proper measurement methods of dorsal subluxation or translation after trapeziectomy. Since previous methods have evaluated dorsal subluxation using landmarks on the trapezium, it has been difficult to measure dorsal subluxation after trapeziectomy. Our method does not use landmarks on the trapezium, and we could evaluate dorsal subluxation or translation even after trapeziectomy.

Fig. 3 M1M2 overlap in normal persons (N), patients treated conservatively (C), and patients requiring surgery (S). There was a significant difference among groups, and M1M2 overlap of the surgical group was significantly decreased compared with those of the normal persons and the conservative group. *Statistically significant: $p < 0.01$.

Fig. 2 Correlation between our method and conventional methods: the ratio of the dorsal subluxation distance divided by the width of the articular surface by Trumble (left) and the dorsal subluxation angle by Kurosawa (right).

Fig. 4 Before-after study in the surgical group: M1M2 overlap was increased postoperatively and maintained at 12 months after trapeziectomy with ligament reconstruction. *Statistically significant: $p < 0.001$.

Recently, Reissner et al evaluated dorsal subluxation without using landmarks on the trapezium by measuring the distance from the scaphoid axis to the tangent through the thumb metacarpal bone on an anteroposterior view of the wrist.⁶ It was, however, an oblique view for the thumb CMC joint and was not suitable for the assessment of dorsal subluxation. We believe that standardized radiographs of the thumb are important for accurate evaluation of dorsal subluxation. We recommend the true lateral view of the thumb by Kapandji.⁹

Our study showed that M1M2 overlap not only correlated with previous methods, but it was also reliable with almost perfect level of agreement in examiners of different level of expertise. The volar tip of the thumb metacarpal base and the dorsoradial border of the index metacarpal base, which we used as landmarks, were suggested to be easy to identify even in a severe osteoarthritic joint.

Previous studies demonstrated that clinical symptoms of the osteoarthritis of the thumb CMC joint may not correspond to radiographic findings.^{15,16} Hoffler et al showed that radiographic severity does not correlate with validated patient-reported symptom scores, although they used radiographic staging by Eaton et al in 1984,² which does not include subluxation as defining criteria.¹⁶ Further study is required on the correlation between radiographic severity incorporating dorsal subluxation and clinical symptoms.

We showed significant quantitative differences in dorsal subluxation between patients with thumb CMC arthritis and normal patients. Our results also showed that dorsal subluxation was evident in patients who required surgery

compared with those in the conservative group. These results suggest that dorsal subluxation causes symptoms including pain, and it may suggest severity and surgical indications for thumb CMC arthritis.

This study had several limitations. Because we did not perform trapeziectomy without ligament reconstruction and dorsal subluxation of all our patients in the surgical group was sufficiently reduced, we could not compare clinical outcomes between patients with and without reduction in dorsal subluxation. Further comparative study is required to clarify the effect of reducing dorsal subluxation on the clinical outcomes. Another limitation was that our sample size was small for multiple comparisons including handedness or sex differences.

In conclusion, dorsal subluxation in the thumb CMC osteoarthritis could be evaluated with M1M2 overlap, and it could be reduced by ligament reconstruction combined with trapeziectomy.

Conflict of Interest

None.

References

- Miura T, Ohe T, Masuko T. Comparative in vivo kinematic analysis of normal and osteoarthritic trapeziometacarpal joints. *J Hand Surg Am* 2004;29(2):252–257
- Eaton RG, Lane LB, Littler JW, Keyser JJ. Ligament reconstruction for the painful thumb carpometacarpal joint: a long-term assessment. *J Hand Surg Am* 1984;9(5):692–699
- Burton RI, Pellegrini VD Jr. Surgical management of basal joint arthritis of the thumb. Part II. Ligament reconstruction with tendon interposition arthroplasty. *J Hand Surg Am* 1986;11(3):324–332
- Wolf JM, Delaronde S. Current trends in nonoperative and operative treatment of trapeziometacarpal osteoarthritis: a survey of US hand surgeons. *J Hand Surg Am* 2012;37(1):77–82
- Trumble T, Rafijah G, Heaton D. Thumb carpometacarpal arthroplasty with ligament reconstruction and interposition costochondral arthroplasty. *J Wrist Surg* 2013;2(3):220–227
- Reissner L, Marks M, Schindele S, Herren DB. Comparison of clinical outcome with radiological findings after trapeziectomy with ligament reconstruction and tendon interposition. *J Hand Surg Eur Vol* 2016;41(3):335–339
- Kurosawa K, Tsuchiya I, Takagishi K. Trapezial-metacarpal joint arthritis: radiographic correlation between first metacarpal articular tilt and dorsal subluxation. *J Hand Surg Am* 2013;38(2):302–308
- Trumble TE, Rafijah G, Gilbert M, Allan CH, North E, McCallister WV. Thumb trapeziometacarpal joint arthritis: partial trapeziectomy with ligament reconstruction and interposition costochondral allograft. *J Hand Surg Am* 2000;25(1):61–76
- Kapandji A. Clinical opposition and reposition test of the thumb. *Chir Main* 1986;5:67–73
- Field J, Buchanan D. To suspend or not to suspend: a randomised single blind trial of simple trapeziectomy versus trapeziectomy and flexor carpi radialis suspension. *J Hand Surg Eur Vol* 2007;32(4):462–466
- Gangopadhyay S, McKenna H, Burke FD, Davis TRC. Five- to 18-year follow-up for treatment of trapeziometacarpal osteoarthritis: a prospective comparison of excision, tendon interposition, and ligament reconstruction and tendon interposition. *J Hand Surg Am* 2012;37(3):411–417

- 12 De Smet L, Sioen W, Spaepen D, van Ransbeeck H. Treatment of basal joint arthritis of the thumb: trapeziectomy with or without tendon interposition/ligament reconstruction. *Hand Surg* 2004;9(1):5–9
- 13 Li YK, White C, Ignacy TA, Thoma A. Comparison of trapeziectomy and trapeziectomy with ligament reconstruction and tendon interposition: a systematic literature review. *Plast Reconstr Surg* 2011;128(1):199–207
- 14 Nikkhah D, Rodrigues J, Saleh DB, Jeffers R. Can we really say that no patients benefit from ligament reconstruction tendon interposition? *Plast Reconstr Surg* 2012;129(3):557e–558e
- 15 Ladd AL, Messana JM, Berger AJ, Weiss AP. Correlation of clinical disease severity to radiographic thumb osteoarthritis index. *J Hand Surg Am* 2015;40(3):474–482
- 16 Hoffler CE II, Matzon JL, Lutsky KF, Kim N, Beredjiklian PK. Radiographic stage does not correlate with symptom severity in thumb basilar joint osteoarthritis. *J Am Acad Orthop Surg* 2015;23(12):778–782