

Metacarpophalangeal joint hyperextension in rhizarthrosis: is surgical correction necessary?

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Abstract. *Background and aim:* Rhizarthrosis represents 10% of all arthritic manifestations and its prevalence increases with age and in women. The hyperextension of the metacarpophalangeal joint (MCPj) is consequent to a progressive dorsoradial subluxation of the trapeziometacarpal joint (TMj) in advanced osteoarthritis. The aim of this retrospective study is to evaluate the clinical and functional results of 32 patients affected by advanced rhizarthrosis who underwent to modified Burton-Pellegrini's trapeziectomy in absence of surgical correction of MCPj hyperextension in order to understand when this last step is really necessary. *Methods:* Patients were assessed through DASH and PRWHE questionnaires; the functionality of the hand was assessed by carrying out specific test (grip strength, key-pinch, kapandji test, reduction of wrist flexion strength) and the degree of MCP joint hyperextension was recorded. *Results:* Clinical evaluation and individual satisfactory were positive in most cases (mean DASH 19 and mean PRWHE 21.8, with a reduction of 77% of VAS pain score). Kapandji test was excellent in 26 patients and grip strength and key pinch were stackable in operated and non-operated hands. Twenty-five out 32 patients presented a MCP joint hyperextension between 0° and 5°, 5 of 10° and other 2 of 15°. *Conclusion:* Modified Burton-Pellegrini's trapeziectomy is a valid option to treat patient with TMj osteoarthritis. The absence of surgical correction of the MCPj does not affect clinical and functional results in deformities <15°. (www.actabiomedica.it)

Key words: rhizarthrosis, metacarpophalangeal joint hyperextension, surgical correction, trapeziectomy.

Introduction

The trapeziometacarpal joint (TMj) is the most common site of surgical reconstruction for osteoarthritis (OA) in the upper extremity.

Typically, patients have pain localised at the base of the thumb that is often radiated to thenar eminence and metacarpophalangeal joint (MCPj). At the beginning the pain is activity-related; however, as the arthritis progresses, pain becomes constant and associated to weakness and loss of motion (1).

The prevalence of TMj osteoarthritis increases with age and mainly pertains to women in their fifth to sixth decades of life; in subjects older than age of 75 years, the prevalence of TMj radiographic degeneration is 25% in men and 40% in women (2, 3).

The main cause is weakening of the palmar beak ligament, resulting in increased metacarpal translation on the trapezium bone. In areas of high contact, shear stress forces can damage the articular cartilage, which can progress to degenerative osteoarthritis.

With advancing TMj arthritis, there is progressive

dorsoradial subluxation at the trapeziometacarpal joint; as consequence, the thumb is positioned into a flexed and adducted position, thus causing the affected patient to hyperextend the MCPj in order to increase the functional capacity for grip, given the decreased effective volume in the first web space. The subluxation of the metacarpal also leads to an increase in pull of the extensor pollicis brevis, contributing to MCP hyperextension (4). A “zig-zag” deformity results, as described by Landsmeer (5).

The type of treatment is decided after a clinical and radiological evaluation. The goals of treatment are to alleviate pain and restore joint stability both for TMj OA and for MCPj deformity.

Several surgical technique are available to treat TMj OA when conservative measures have failed.

In 1986, Burton et al. (6) were the first to describe the trapeziectomy with ligament reconstruction with tendon interposition (LRTI) arthroplasty (Burton-Pellegrini technique). They used half of the flexor carpi radialis tendon and a bone tunnel at the base of the thumb metacarpal in order to maintain the trapezium height after resection of the trapezium bone and thus, theoretically, preserve thumb strength.

Several studies have demonstrated that this technique can eliminate pain and increase grip and pinch strength (7,8).

The approach to thumb MCPj deformity (hyperextension/adduction) is based on physical examination and radiographic findings of degenerative joint disease (Figure 1).

According to some studies in severe deformities it is important to correct MCP joint because if this hyperextension is left untreated, it may lead to weakness and potentially worsen postoperative hand function after surgical treatment of TM joint arthritis (9).

Blank and Feldon outlined an algorithm that depends on the passive flexion of the thumb MCP joint and the presence or absence of degenerative changes (10).

Surgical intervention is not necessary when MCP hyperextension is less than 10°. Often, TM joint -arthroplasty itself is sufficient to correct any minor deformity. With residual deformity, however, surgical correction could be necessary and it is followed by postoperatively thumb spica casting with the MCP joint maintained at 20° of flexion (10).

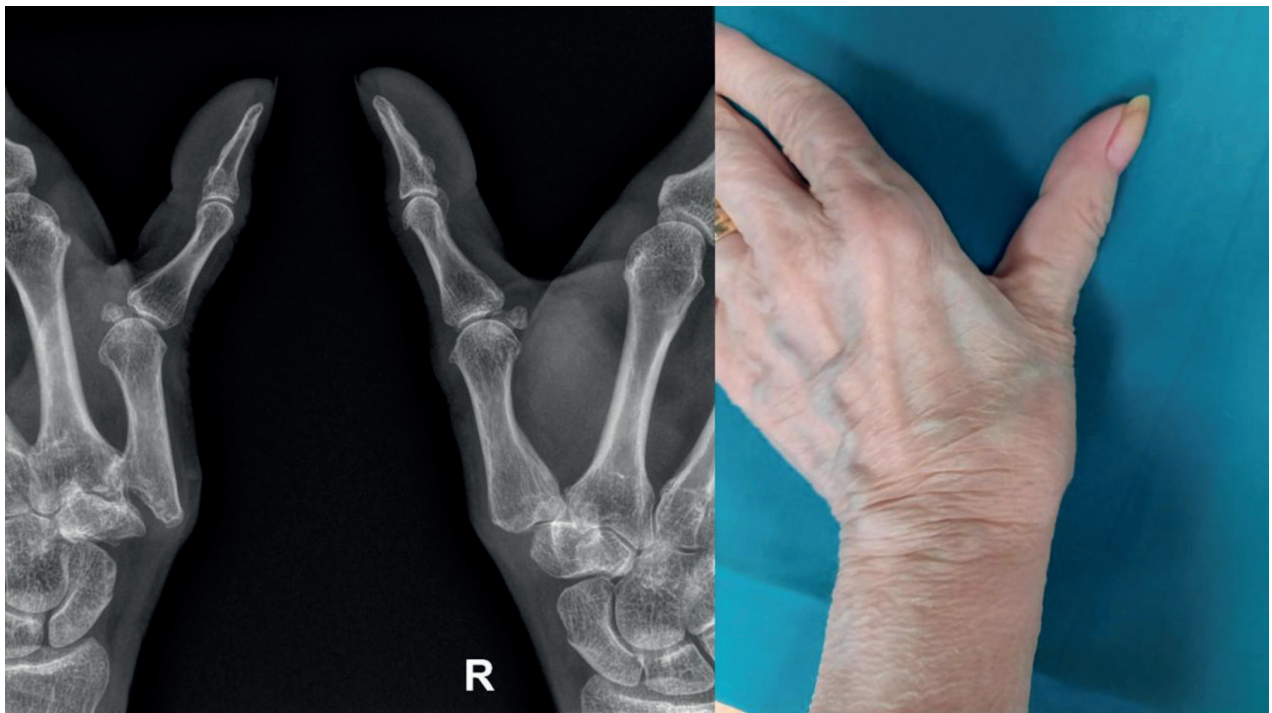


Figure 1. Advanced left rhizarthrosis associated with MCPj hyperextension >40°. X-rays and clinical view.

When MCP hyperextension reaches 10° to 20°, two surgical treatment options, or their combinations, may be used. These options are represented by extensor pollicis brevis (EPB) transfer to the thumb metacarpal and percutaneous pinning of MCP joint in 25° to 35° of flexion (10,11).

More aggressive treatment is warranted when MCP hyperextension is between 20° to 40°. In these cases the treatments' options are represented by capsulodesis of the volar aspect of the MCPj and sesamoidesis.

MCPj arthrodesis is the treatment of choice when thumb MCP hyperextension exceeds 40°, the deformity is not passively correct, or advanced degenerative changes are noted (10).

The aim of this retrospective study is to evaluate the clinical and functional results of 32 patients -affected by advanced rhizarthrosis who underwent to modified Burton-Pellegrini's trapeziectomy with -ligamentoplasty using the entire FCR tendon in absence of surgical correction of MCPj hyperextension in order to understand when this last step is really necessary.

Material and Methods

From January 2007 to December 2019, 104 patients (31 males and 73 females) affected by rhizarthrosis with MCPj hyperextension between 0° and 15° were surgically treated.

All patients were surgically treated with trapeziectomy with LRTI arthroplasty by Burton-Pellegrini modified technique without any surgical correction of the MCPj hyperextension.

All subjects treated with partial trapeziectomy or another device like artificial spacer or operated for correction of associated hyperextension of MCPj were excluded.

According to the inclusion criteria and after the exclusion of those who were not contactable or deceased, data regarding the 32 remaining cases were collected from the clinical charts and surgery register. This study was conducted in accordance with the principles of Declaration of Helsinki. All patients signed informed consent to participate in this study and about the treatment they were subjected and the processing of their personal data. The study design protocol was approved

by our Institutional Review Board (34/2021/OSS/AOUPR).

For each patient were registered: gender, age at the time of surgery, dominance, degree of degeneration of the TMj referring to the classification proposed by Eaton and Littler and complications.

Burton-Pellegrini's modified technique foresees that, after trapeziectomy, the surgeon will execute the palmar beak ligament reconstruction using distal portion of the flexor carpi radialis tendon letting it pass through the first metacarpal bone. Then the remaining part of the tendon is used to create an interposition to fill the space created by the absence of the trapezium. A short-arm thumb spica cast with the thumb in 30 degrees of flexion is applied and maintained for 3 weeks postoperatively and later replaced by a spica orthosis for another 8 weeks.

Preoperative and postoperative pain evaluations were made with the visual analogue score (VAS).

Preoperative and postoperative degrees of MCPj hyperextension were recorded with a goniometer.

At follow up, each patient was functionally evaluated through the Kapandji test, the measurement of grip strength with a hydraulic Jamar dynamometer (Mano Exacta, North Coast Medical, CA) and the measurement of key pinch with an hydraulic pinch gauge (B & L Pinch Gauge, North Coast Medical). All measures were taken 3 times and the mean value was recorded.

All subjects were clinically assessed through the DASH and PRWHE questionnaires. A possible reduction in wrist flexion strength and complications were also investigated.

A statistical analysis of the collected data was then performed using the Jamovi 1.6.13.

The mean value of "Vas of pain" before surgery and at a follow-up, the grip strength and pinch test between operated and healthy hands were compared with the T Test; a second statistical analysis of DASH and PRWHE results through the Pearson Correlation Index wanted to highlight the correspondence between the two questionnaires.

Results

Thirty-two patients, 29 females and 3 males were recruited. The average patients' age at the time of

surgery was 69.1 years (range 55-83). The mean follow-up was 86.2 months (range 24- 168). The dominant hand was involved in 16 cases.

According to Eaton's classification, 2 thumbs were grade II, 25 were grade III, and 5 grade IV.

The average DASH score of the operated side was 19 (range 0-71), and the average PRWHE score of the operated side was 21.8 (range: 0-78).

The mean value of VAS of pain was 8.7 preoperatively and 2.1 at follow-up. The decrease was 77%.

The MCP joint hyperextension evaluated preoperatively was the same evaluated postoperatively, Twenty-five out of 32 patients presented a MCP joint hyperextension between 0° and 5°, 5 of 10° and other 2 of 15°.

The mean postoperative grip strength of the operated side was 22 kg (range: 0.6- 38 kg) and the postoperative grip strength of the non-operated side was 22.8 kg (range: 0.5-42 kg).

Key pinch of the operated side and non-operated side were 2.1 kg (range: 0- 5.7 kg) and 2.5 kg (range: 0.5-4.5 kg), respectively, after surgical treatment.

The analysis by means of the "t Test" revealed a non-statistically significant difference between the values of the grip test ($p=0.75$) and pinch test ($p=0.09$) of the operated side and those of the non-operated side, and statistically significant difference between the pain before surgery and at follow-up in the operated hand ($p<0.001$).

The Pearson Correlation Index highlighted how the DASH and PRWHE scores are related to each other ($r=0.948$).

The Kapandji test was excellent in the majority of cases.

A subjective weak reduction in wrist flexion strength was seen in 14 patients.

In this case series, there were 2 cases of superficial infection at the base thumb incision, which was treated successfully with specific antibiotic, 3 cases of scar hypersensitivity and 1 case of intense pain and reduced functionality of the TMj.

Discussion

The success of surgical treatment of TMj OA depends on a complete clinical evaluation of the patient.

thus including socio-occupational factors such as age, sex and functional needs.

Furthermore, a fully understanding of intercalated longitudinal collapse that occurs in this condition is necessary (12-14).

The arthritic process is initiated by attenuation of the anterior oblique ligament that results in capsular laxity, which, when compounded by heterotopic osteophytes, is followed by a dorsoradial subluxation of the thumb metacarpal on the trapezium. With progressive subluxation, the first metacarpal is forced into flexion and adduction. Understanding, recognizing, and effectively addressing the hyperextension deformity is essential to maximize a functional outcome. In evaluating the patient who has symptomatic carpo-metacarpal OA, it is important to assess the degree of deformity, passive range of motion, and radiographic findings of joint degeneration. The surgeon may then plan operative intervention both of the TMj and of the MCPj (15).

In the algorithm outlined by Blank and Feldon, the choice of treatment is determined by the passive flexion of the thumb MCP joint and the presence or absence of degenerative changes.

Surgical intervention is not necessary when MCP hyperextension is less than 10°. Often, TM joint arthroplasty itself is sufficient to correct any minor associated deformity. With residual deformity, however, treatment is necessary and is accomplished by postoperatively thumb spica casting with the MCP joint maintained at 20° of flexion (10).

When MCP hyperextension reaches 10° to 20°, two surgical treatment options, or their combinations, may be adopted. These options are represented by EPB transfer to the thumb metacarpal and percutaneous pinning of MCP joint in 25° to 35° of flexion (10,11).

More aggressive treatment is warranted when MCP hyperextension is between 20° to 40°. In these cases the two treatments options are represented by capsulodesis of the volar aspect of the MCP joint and sesamoidesis.

MCPj arthrodesis is instead indicated when thumb MCP hyperextension exceeds 40°, the deformity is not passively correct, or advanced degenerative changes are present (10).

Although there is currently no good evidence to recommend one treatment over another.

Several studies indicate the importance to correct MCP joint hyperextension. Moineau and colleagues studied the prognostic factors associated with a successful outcome after trapeziectomy and ligament stabilization. Between the variables identified, they noted that 36 out of 51 patients had untreated hyperextension of the MCP joint (average 26°) and that this contributed to a loss of trapezial height, weakness, and subsequent worse hand function postoperatively (16).

Poulter and Davis recently examined the outcome of patients who underwent surgical treatment of trapeziometacarpal joint arthritis with varying degrees of MCP joint hyperextension. Of the 297 thumbs treated, 196 had severe preoperative hyperextension deformities (168 with 30° and 28 with 35°). Of these, 157 of the former group and 8 of the latter were not treated. The remaining 31 patients were treated by a number of procedures including temporary K-wire insertion, sesamoid bone tethering to the metacarpal head, volar capsulodesis, and arthrodesis. The decision and type of technique used to address MCP hyperextension were left to the surgeons' discretion. After 1 year of follow-up, the authors found no significant difference in clinical outcomes (including key pinch, tip pinch, grip strength, and pain) between patients who did or did not have surgical correction of MCP hyperextension less than 30°. There were relatively few patients who had hyperextension greater than 35°, which led the authors to conclude that, although surgery may correct the deformity, it may not lead to improved clinical results (17).

Finally, the study conducted by Brogan et al. recommends treatment when patients display dynamic MCP hyperextension with pinching or MCP hyperextension greater than 20° (18).

The present study showed that use of the full FCR tendon for LRTI associated with trapeziectomy in absence of the surgical correction of hyperextension at the MCPj leads to very satisfying outcomes for the treatment of patients with TMj osteoarthritis and MCPj hyperextension < 15°.

The data obtained from the DASH and PRWHE questionnaires allowed us to have a view of the disability.

With reference to the DASH and the PRWHE, it was observed that the residual disability found was modest, with an average DASH score that stands at a

value of 19 out of 100 and an average PRWHE score recorded of 21.8 out of 100.

These data are similar with the results obtained from other studies carried out for evaluating the effectiveness of LRTI arthroplasty such as the one carried out by Vermeulen et al. in which it had been shown that one year after surgery, patients had an average DASH score of 20.6 out of 100 and an average PRWHE score of 27.1 out of 100 (19).

As already demonstrated by Macdermid et al., from the statistical analysis on the DASH and the PRWHE scores obtained in the present study, a good correspondence emerged between the results of the two questionnaires (20).

The data collected showed a significative improvement in painful symptoms at follow-up.

The results obtained with the grip test and the pinch test between the operated and non-operated hands did not show statistically significant differences, demonstrating that the operated hands regained strength and grip following the surgery.

The Kapandji opposition test showed that 17 -patients regained full ability to oppose the thumb obtaining a score of 10, 9 patients obtained a score of 9, 2 patients obtained a score of 2, 3 obtained a score of 7 and only one patient obtained a score of 6. This demonstrated that even in worst cases, all patients regained more than 50% of the normal range of motion of the thumb.

Finally, preoperatively and postoperatively evaluations of the degree of MCP joint hyperextension showed the absence of any MCP joint hyperextension in 13 out of 32 patients, 5° in 12, 10° in 5 and other 15° in 2.

The data we collected showed no differences in the degree of MCP joint hyperextension between preoperatively and follow-up period.

These data were collected in order to identify those cases in which MCPj correction is necessary.

According to Blank and Feldon algorithm, -Authors can confirm that in the patient with a degree of MCP joint hyperextension < 10°, the only correction of TM joint was adequate to successfully correct the TMP joint hyperextension if associated to postoperatively application of a thumb spica casting with the MCP joint maintained at 20° of flexion (10).

In the 2 patients with 15° of MCP joint hyperextension results were worse. Authors suggested to correct MCPj deformity through EPB transfer to the thumb metacarpal and percutaneous pinning of MCPj in 25° to 35° of flexion.

The 2 patients that showed 15° of MCP joint hyperextension refused any surgical treatment to correct the deformity.

The main limitation of this study is the low number of subjects included and the absence of a control group. However, the results of this retrospective study associated with the low rate of complications confirm that LRTI using the entire FCR tendon is an efficient and safe treatment for advanced carpometacarpal OA (6-8,21) and that in MCPj hyperextension >15° additional correction is preferable.

Conclusion

Trapeziectomy with LRTI is a satisfying option to treat patient with TMj OA with a degree of MCPj hyperextension < 15°. In these cases the absence of the surgical correction of hyperextension at MCPj does not affect clinical and functional results.

For major degrees of MCPj hyperextension surgical treatment may be indicated.

Conflict of interest: Each author declares that he/she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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