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Original article

Long-term results after modified Burton-Pellegrini's technique in 24 cases affected by advanced rhizarthrosis

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Abstract. *Background and aim:* Rhizarthrosis iscommon in elderly and represents 10% of all artrhitic manifestations. Trapeziectomy with ligament reconstruction and tendon interposition remains the gold standard for stages II to IV according to Eaton and Littler. This retrospective study aimed to evaluate the results of 24 patients affected by advanced rhizarthrosis who underwent to modified Burton-Pellegrini's trapeziectomy with ligamentoplasty using the entire flexor carpi radialis tendon. *Methods:* Patients were assessed through DASH and PRWHE questionnaires; the examination focused also on pain symptoms (VAS score) and the results obtained in carrying out specific tests to evaluate the trapezius-metacarpal functionality (key-pinch, grip strength, Kapandji test, reduction of wrist flexion strength). Furthermore, postoperative complications were evaluated. *Results:* Clinical evaluation and individual satisfaction were positive in most cases (mean DASH 18,8 and mean PRWHE 21,7). VAS pain score reduced of 76.7%, grip strength and key pinch were similar to those of the non-operated hand and Kapandji test was excellent in 20 patients. One superficial wound infection was encountered which resolved by specific antibiotic therapy. *Conclusions:* The choice of the most appropriate treatment depends on clinical conditions and socio-occupational factors of the patient (age, sex and functional needs), the degree of osteoarthritis and the presence of deformities of the first metacarpophalangeal joint. Surgery aims to relief pain and to improve joint function and strength. According to the results observed this surgical technique has to be considered a valid option for the treatment of advanced rhizarthrosis as it provides pain relief, stability and mobility of the thumb. (www.actabiomedica.it)

Key words: trapeziometacarpal joint osteoarthritis, Burton-Pellegrini, trapeziectomy, rhizarthrosis.

Introduction

Trapeziometacarpal joint (TMj) osteoarthritis is a common cause of pain localised to the base of the thumb and represents 10% of all osteoarthritis localizations (1). The prevalence of TMj oteoarthritis increases with age and mainly interests women in their fifth and sixth decades of life, affecting the 33% of postmenopausal women versus an 11% of men older than 55 years (2,3).

Female predisposition may be attributed to hormonal factors, increased ligament laxity, and presence of smaller and less congruous trapeziometacarpal joint, resulting in greater joint contact pressure (4). Other causes that can favor the development of the disease are increased BMI, previous traumatic injures such as Bennet fracture or anterior oblique ligament tear and a history of inflammatory arthritis (5).

In all these situations the disease starts with a weakening of the palmar beak ligament which results in an increased metacarpal translation on the trapezium bone. In areas of high contact, shear stress forces damage the articular cartilage, with progressive development of degenerative osteoarthritis.

The type of treatment is decided after a clinical and radiological evaluation with the aim to alleviate pain and to restore joint stability.

Several surgical techniques are available to treat TMj osteoarthritis when conservative measures have failed. Simple trapeziectomy was the first procedure proposed by Gervis in 1947 to treat TMj osteoarthritis (6). This technique has shown to decrease pain but lead to complication such as first-ray subluxation, shortening and impingment and loss of strength. To avert these complication in 1970 Froimson proposed trapeziectomy associated with flexor carpi radialis (FCR) tendon interposition (7).

In 1986, Burton et al. (8) were the first to describe ligament reconstruction with tendon interposition (LRTI) arthroplasty (Burton-Pellegrini's technique), based on the work of Gervis (9) on trapeziectomy and of Eaton and Littler (10) on volar ligament reconstruction using the FCR tendon. They used half of the FCR tendon and a bone tunnel at the base of the thumb metacarpal to maintain the trapezial height after removal of the trapezium. Several reports have proved that this technique can eliminate pain and increase grip and pinch strength (11-13).

The aim of this retrospective study is to evaluate the clinical and functional results of 24 patients affected by advanced rhizarthrosis who underwent to modified Burton-Pellegrini's trapeziectomy with ligamentoplasty using the entire FCR tendon.

Materials and Methods

Ninety-four subjects (26 males and 68 females), aged between 56 and 82 (mean age: 68,2 years) affected by TMj osteoarthritis who were surgically treated with trapeziectomy with ligament reconstruction and tendon interposition arthroplasty by modified Burton-Pellegrini technique between January 2007 and December 2018 were analysed.

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

According to the inclusion criteria and after the exclusion of those who were not contactable or deceased, data regarding the 24 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 about the treatment they were subjected and the processing of their personal data.

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

The procedure (Figure 1) is performed using a tourniquet. The skin incision is longitudinal over the TMj. Superficial dissection is performed carefully in order to identify and protect the branches of the radial sensory nerve and of the radial artery. The joint capsule is opened longitudinally to expose the dorsal first metacarpal base and its proximal shaft, and the trapezium until the scaphoid. The trapezium is removed as a bone block or after its resection into 4 pieces by a perpendicular osteotomy as well as any osteophytes remained. Through 2 small transverse volar forearm incisions, the entire width of the FCR is cut at the miotendineous junction, harvested, split, and pulled out through the incision at the first metacarpal base. A tunnel is drilled throughout the metacarpal base and enlarged progressively with curettes 1 cm distal to the metacarpal base on the dorsal and the radial sides of the joint surface. The deep volar capsule is then closed with 4-0 non-absorbable sutures and an additional stitch with long extremities is placed on the floor to secure the FCR a second time. The free extremity of the FCR is passed through the hole from the base to the dorsal cortex. The thumb is then placed in traction and placed into palmar adduction and moderate radial extension. The FCR tendon is maintained in tension and sutured to the periosteum of the dorsal metacarpal and to itself in the depths of the wound at the volar cortex of the thumb-metacarpal with non-absorbable sutures. The remaining FCR is folded upon itself over 2 straight needles, through which the previously described non-absorbable sutures are passed from the deep capsule. The tendon is sutured, pushed into the trapezial fossa, and secured safely with the previous sutures. In order to complete the procedure, the capsule and the skin are then closed. Pinning is not necessary. A short-arm thumb spica cast with the thumb in 30 degrees of flexion is applied and maintained for

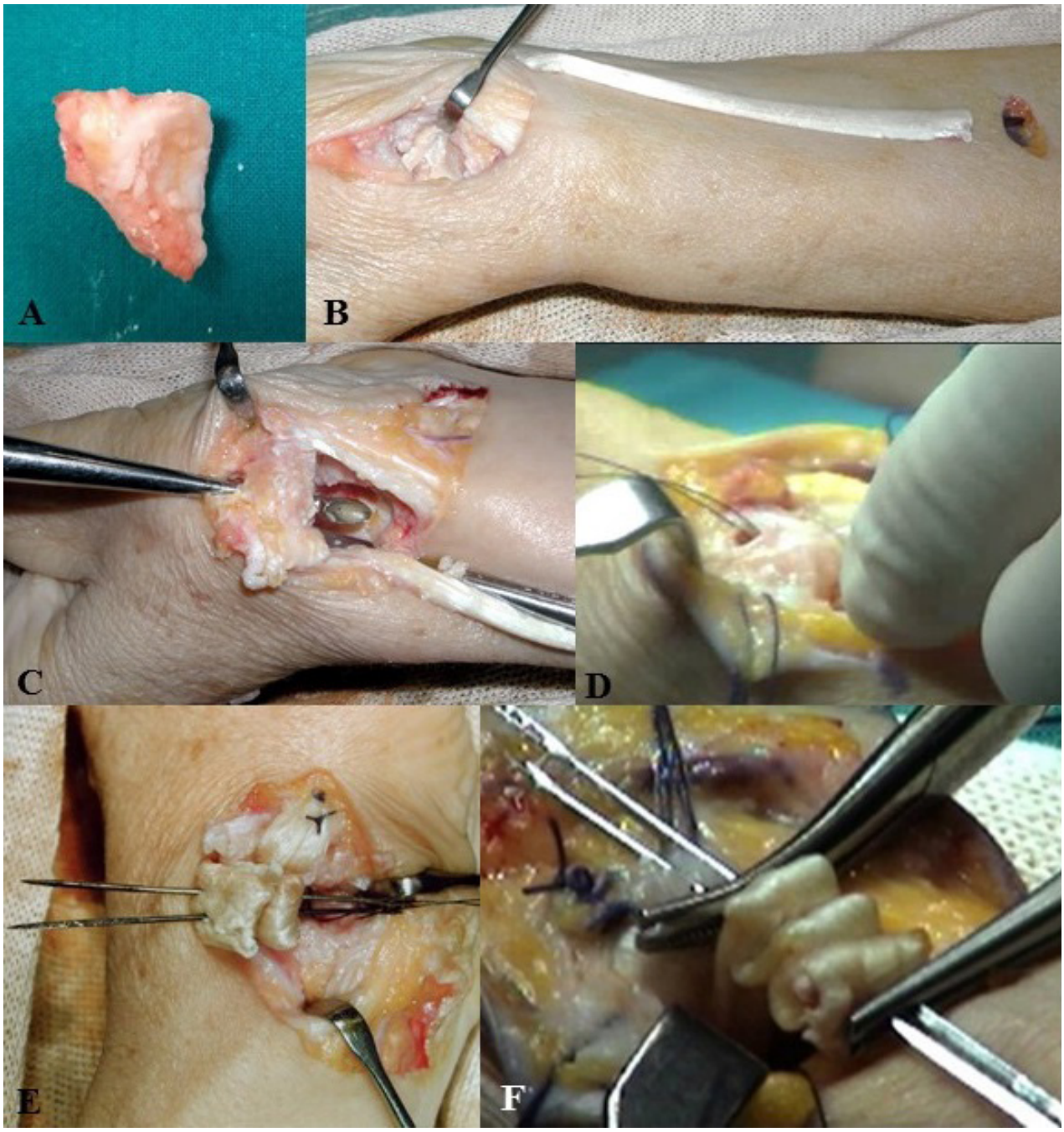


Figure 1. Surgical procedure. Trapezium (A) and FCR tendon removal (B), preparation of the hole at the base of the first metacarpal (C), passage of the tendon through the hole (D) and preparation and positioning of the tendon in the place of the trapezium (E and F).

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).

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

All patients were also subjected to a clinical assessment 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 and 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

Twenty-four patients, 22 females (91.7%) and 2 males (8.3%) were recruited.

The average patients' age at the time of surgery was 68.2 years (range 56-82).

The non-dominant hand was involved in 14 cases (58.3%).

The mean follow-up was 85.2 months (range 24-168).

According to the Eaton classification, 1 thumb was grade II, 19 were grade III, and 4 were grade IV.

The average DASH score of the operated side was 18.8 (range 0-70.6), and the average PRWHE score of the operated side was 21.7 (range 0-77.5).

The mean value of VAS of pain was 8.6 preoperatively and 2 at follow-up. The decrease was 76.7%.

The mean postoperative grip strength of the operated side was 21.9 kg (range, 0.6 to 37.3 kg) and the postoperative grip strength of the non-operated side was 22.3 kg (range,0.5 to 40.6 kg).

Key pinch of the operated side and non-operated side were 2.0 kg (range, 0 to 5.6 kg) and 2.5 kg (range, 0.5 to 4.5 kg), respectively, after surgical treatment.

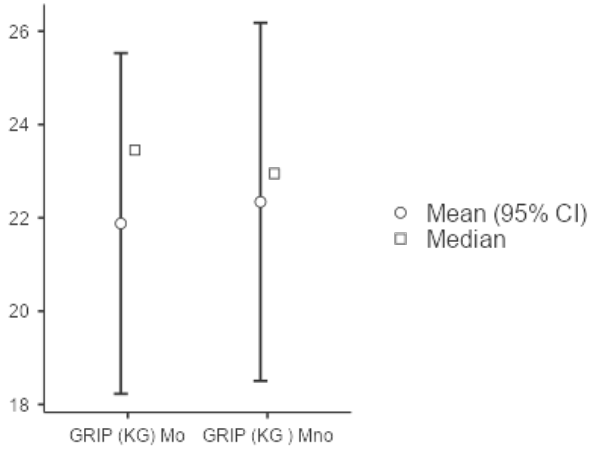
The analysis by means of the "t Test" revealed a non-statistically significant difference between the values of the grip test (p=0.8) and pinch test (p=0.086) of the operated side and those of the non-operated side , and statistically significant difference between the pain before surgery and at follow-up in the operated hand(p<0.001) (Graphs 1, 2 and 3).

The Pearson Correlation Index highlighted how the DASH and PRWHE scores are related to each other (r=0.945) (Graph 4).

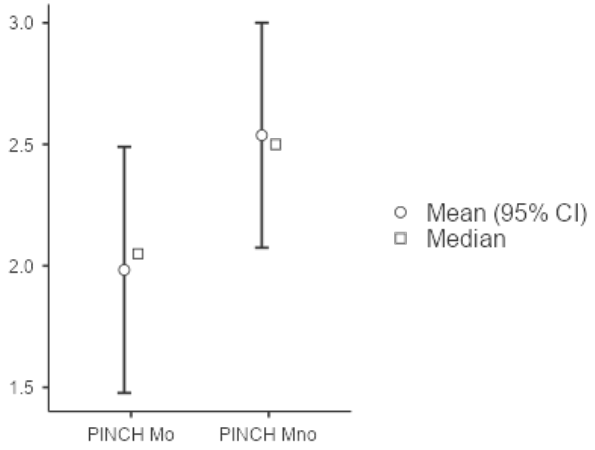
The Kapandji test was excellent in the majority of cases.

A subjective weak reduction in wrist flexion strength was seen in 10 patients.

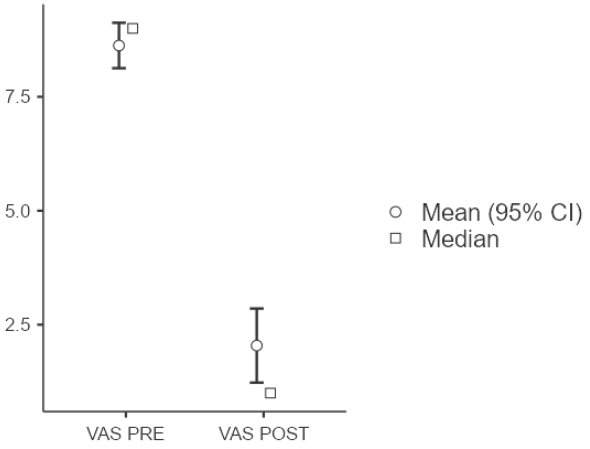
In this case series, there was 1 case of superficial infection at the base thumb incision, which was treated successfully with specific antibiotic, 2 cases of scar hypersensitivity and 1 case of intense pain and reduced functionality of the TMj.



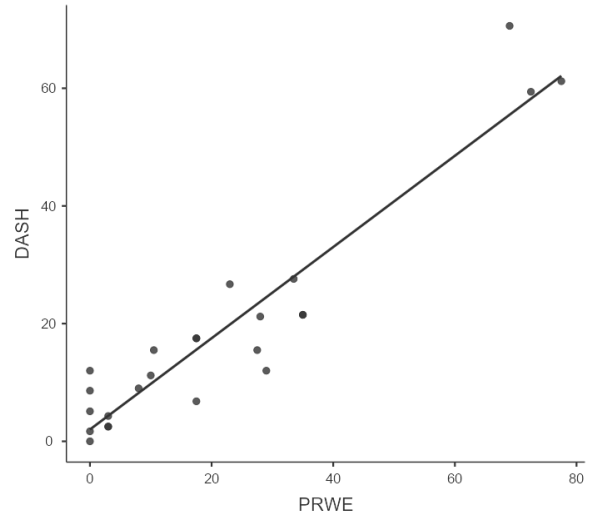
Graph 1. Grip strength; non-statistically significant difference between the operated side (Mo) and the non-operated (Mno).



Graph 2. Pinch test; non-statistically significant difference between the operated side (Mo) and the non-operated (Mno).



Graph 3. VAS of pain; statistically significant difference between the pain before surgery and at follow-up in the operated hand.



Graph 4. The Pearson Correlation Index between the DASH and PRWHE scores (r=0.945).

Discussion

Selecting the optimal surgical procedure in a thumb carpometacarpal joint's osteoarthritis is highly relevant because it can result in a considerable disability.

The choice of the most appropriate treatment is based on a complete clinical evaluation of the patient thus including socio-occupational factors such as age, sex and functional needs. Furthermore, elements related to the degree of osteoarthritis and the presence of deformations of the first metacarpophalangeal joint which, if not adequately treated, can cause therapeutic failure have to be kept in consideration (14-16).

In this context the classification of Eaton and Littler (10) in 4 stages is still valid in the diagnosis and treatment planning. Stage I shows normal radiographs without joint space narrowing, cyst formation, or subchondral changes, but this stage instead might have joint space widening attributable to synovitis, effusion, or laxity of the TMj. Stage II features joint-space narrowing with osteophytes or loose bodies smaller than 2 mm in diameter. Stage III features greater than 1/3 subluxation of the TMj and osteophytes exceeding 2 mm in diameter. Eaton and Littler originally described Stage IV with advanced degenerative changes, including substantial subluxation, joint space narrowing, and subchondral cysts and sclerosis. They stated that this stage was generally applicable to rheumatoid arthritis. This stage later was modified by Eaton and Glickel as showing deterioration of the CMC joint, as in Stage III arthrosis, but with the addition of joint space narrowing and cystic or sclerotic changes in the scaphotrapezial joint (16).

Various surgical techniques (trapeziectomy alone, trapeziectomy with tendon interposition or with LRTI, prosthesis and arthrodesis) have been proposed in advance stages (II, III and IV) of TMj osteoarthritis but systematic reviews have found insufficient evidence to establish the optimum one (17,18).

In a recent systematic review, Vermeulen et al. (18) concluded that no procedure has been shown to be better in terms of pain, physical function, patient global assessment, range of motion or strength. Several authors have compared trapeziectomy alone to trapeziectomy with tendon interposition or with LRTI. Even though it seems logical to reconstruct the stabilizing ligaments of the TM joint to prevent proximal migration or dorsal subluxation of the first metacarpal, LRTI has never demonstrated any additional benefit over trapeziectomy alone (19). In addition, Wajon et al. (20,21) showed in two Cochrane systematic reviews that LRTI led to more complications than trapezium. Therefore, trapeziectomy alone appeared to be a safer option for the treatment of basal joint arthritis. Nevertheless, LRTI is nowadays considered the treatment of choice by the majority of surgeons thus showing that surgeons' clinical impressions differ from these findings (11-13,22).

This study confirms this assumption and showed that use of the full FCR tendon for LRTI associated with trapeziectomy leads to very satisfying outcomes after a mean follow-up of 85 months. The data obtained from the DASH and PRWHE questionnaires allowed us to have a view of the disability.

With reference to the DASH, it was observed that the residual disability is rather modest, with an average DASH score that stands at a value of 18.8 out of 100.

The analysis of the PRWHE questionnaire also showed that the residual disability found was modest, with an average PRWHE score recorded of 21.7 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 (22).

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 (23).

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.

Finally, the Kapandji opposition test showed that 11 patients regained full ability to oppose the thumb obtaining a score of 10, 7 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 case, all patients regained more than 50% of the normal range of motion of the thumb.

Systematic reviews (17,19-21) referring that trapeziectomy with LRTI was a safer option included articles in which half-FCR or APL tendons were used to perform the LRTI. Use of a half-FCR tendon has led to good results (11,12,24-26) but complications directly related to this technique have been described such as postoperative FCR pain, tendon rupture, K-wire complications and tendon adhesions leading to scar tenderness (19,27). All these complications could have been avoided by using the entire FCR tendon, as described by Tomaino et al. (11). Indeed, using the full FCR tendon is a compelling alternative as it is less challenging to harvest than a half-FCR tendon and it prevents leaving a half-split tendon, which could be a source of pain and adhesions. In addition, use of an anterior approach in this technique allows the dorsoradial ligament to remain intact, which has been described as the primary restraint to dorsal translation of the TM joint (28-31). For all these reason Authors prefers the use of an entire FCR tendon.

The main limitation of this study is the low number of subjects included and the absence of a comparator 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 osteoarthritis.

Conclusion

Results observed are satisfactory in terms of strength, stability improvement, and pain relief and the low rate of complication confirms that trapeziectomy, ligament reconstruction, and tendon interposition arthroplasty by modified Burton-Pellegrini surgical technique is a reliable choice for advanced stages of TMj osteoarthritis.

Conflict of interest: Authors declare that they have 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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