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ORIGINAL PAPER

Suspension arthroplasty versus interposition arthroplasty in the treatment of trapeziometacarpal osteoarthritis: a clinical and magnetic resonance imaging study

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Abstract

Introduction Biological arthroplasties are the most used surgical techniques, for the treatment of trapeziometacarpal osteoarthritis; all of them provide the reconstruction of trapeziometacarpal joint by a tendon graft. The aim of the study is to compare two surgical techniques: interposition arthroplasty and suspension arthroplasty at 12-month follow-up in order to evaluate the clinical and radiographic results.

Methods Sixty-seven patients surgically treated for basal thumb osteoarthritis were divided into two groups: 36 patients, (8 M; 27 F) (39 hands), treated with interposition arthroplasty are included in group A and 31 patients, (6 M; 25 F) (34 hands), treated with suspension are included in group B. Both groups were radiographically evaluated with X-ray and MRI at 12 months and clinically evaluated with DASH score, VAS, Grind test, hand grip tests, Kapandji test and ROM before surgery and at final follow-up.

Results At final follow-up about Kapandji test, in group A, 31 hands (79.4%) presented Kapandji score of 10 and eight hands (20.6%), a Kapandji score of 8. In group B, six hands (17.6%) reported a Kapandji score of 8 and 28 patients (82.4%), a Kapandji score of 10 ($p < 0.05$). Regarding the radial abduction, patients of group A recovered on average 79.5° of abduction and in group B recovered on average 78°. About DASH score and VAS score, group B shows better results. Mean decalage was 2.3 mm in group A and 0 mm in group B. Jamar dynamometer shows statistically better results for group B in all tests (hand grip test, pulp pinch and key pinch test).

Conclusions Suspension arthroplasty seems to guarantee better outcomes in terms of pain reduction, clinical score and recovery of grip strength. Moreover, it seem to be associated with better results at MRI like absence of I ray decalage and minor scaphoid subchondral oedema at final follow-up.

Keywords Osteoarthritis · Surgical techniques · Magnetic resonance imaging

Introduction

First carpometacarpal (CMC) joint osteoarthritis (OA) is more prevalent than knee or hip OA [1]. The thumb accounts for approximately 50% of overall hand function and is essential in our daily activities (holding objects, preparing meals, writing) [2]. Basal thumb osteoarthritis causes swelling, crepitus, weakness, deformity and severe pain, at the base of the thumb, this situation leads to marked disability of the hand, the patients with first CMC osteoarthritis reported persistent pain at the thumb base which limits their hand functions, reducing both thumb mobility and hand strength, thereby affecting their daily activities [3–5]. Basal thumb osteoarthritis was found to be more prevalent in women than men, but the prevalence steadily increases with age in both genders. The prevalence of symptomatic first CMC osteoarthritis (as defined by the presence of clinical symptoms with or without radiographic findings) and the rates vary between 1.0 and 15.9% [6–9]. The goal of successful treatment of thumb basal joint arthritis is relief of pain with retention of motion and stability.

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Management of basal thumb osteoarthritis involves various modalities including pharmacological therapy, corticosteroid/hyaluronic acid injections, hand exercises, joint protection education, assistive devices, physical agent modality and finally surgery [10–12].

A variety of surgical procedures are available to treat the condition when conservative measures have failed, in order to control symptoms and improve function, such biological arthroplasty with trapeziectomy (suspension arthroplasty, interposition arthroplasty), arthrodesis of trapeziometacarpal joint, prosthesis, or distraction arthroplasty [13]. Biological arthroplasties are the most used surgical techniques, for the treatment of TMO; all of them provide the reconstruction of TM joint by a tendon graft. The aim of the present study is to compare two widely used surgical techniques: interposition arthroplasty described by Robinson [14] and suspension arthroplasty described by Burton and Pellegrini [15], modified by Altissimi [16], in order to evaluate any changes in the tendon graft by an MRI study and to compare clinical outcomes in both techniques at 12-month follow-up.

Materials and methods

Sixty-seven patients surgically treated for basal thumb osteoarthritis were divided into two groups: 36 patients, (8 M; 27 F) (39 hands), treated with interposition arthroplasty are included in group A and 31 patients, (6 M; 25 F) (34 hands), treated with suspension are included in group B.

The mean age of the patients is 66.5 years (range 51–86) and all of them presented from II to IV stage of Eaton-Littler classification.

All patients underwent the same post-operative protocol with a rhizo-splint for three weeks. After removing the brace at the end of the third week, the patient begins rehabilitation time for recovery of full ROM and force of thumb especially in opposition.

Both groups were radiographically evaluated with pre-operative and post-operative X-ray and at 12-month follow-up.

Magnetic resonance imaging scan was performed post-operatively and at 12-month follow-up to evaluate any changes in tendon graft.

The use of MRI, that is the most specific and sensible technique for these kind of evaluations, allowed to study the presence of tendon graft fibrosis, the possible presence of subchondral oedema, the grade of effusion and synovitis of articulation, and therefore to compare these information to have a more objective comparison of results of both techniques.

Clinical evaluation was performed with DASH score, VAS, Grind test, hand grip tests with Jamar dynamometer, Kapandji test and ROM (radial abduction) before surgery and at the final follow-up (12 months). Post-operatively, the decalage of the first ray was radiographically evaluated in both groups.

Surgical techniques

Group A: In the interposition arthroplasty after the dissection and proximal release of one of the slips of the APL and after the excision of the trapezium, the synovial tissue and the osteophytes, the released slip of the APL, is rolled up into the cavity created after the excision of the trapezium and the joint capsule is sutured over it as shown in (Fig. 1).

Group B: In patients treated with tendon suspension arthroplasty, after a total trapeziectomy, a tenotomy of half flexor carpi radialis (FCR) is performed. The cut is performed proximal to the radial styloid, keeping the insertion on the second metacarpal bone. The half tendon is therefore overturned on the first metacarpal and fixed with a 2 mm anchor with the first metacarpal in distraction position. The final result is shown in (Fig. 2).

Statistical analysis

The clinical and radiological differences in the two groups were compared using a Mann-Whitney test and Student's *t* test. All the data were analysed by a single-blinded researcher.

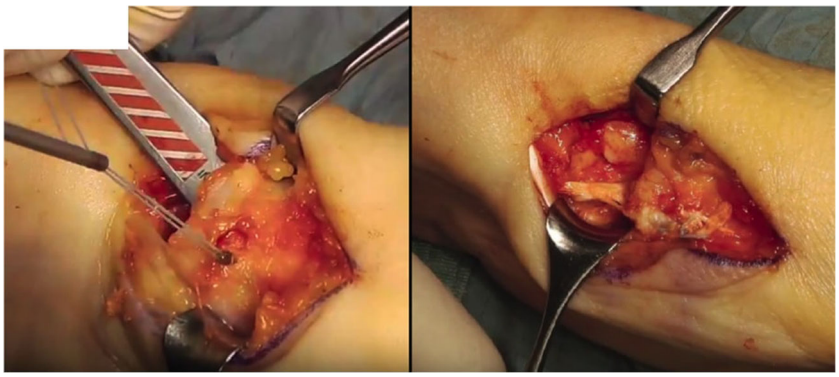

Fig. 1 In the interposition arthroplasty, the released slip of the APL is rolled up into the cavity created after the excision of the trapezium

Fig. 2 In the suspension arthroplasty, the half tendon is overturned on the first metacarpal and fixed with a 2 mm anchor with the first metacarpal in distraction position

Statistical Package for the Social Sciences (SPSS) version 22 was used for calculations.

This article has been approved by the institutional review board (IRB) and from each patient was obtained informed consent, as well as any necessary HIPAA consent.

Results

Clinical results

At final follow-up in group A, five hands (12.8%) presented positive Grind test for pain. In group B, 100% of hands was negative for Grind test ($p > 0.05$). About Kapandji test, in group A, 31 hands (79.4%) presented Kapandji score of 10 and eight hands (20.6%), a Kapandji score of 8. In group B, six hands (17.6%) reported a Kapandji score of 8 and 28 patients (82.4%), a Kapandji score of 10 ($p < 0.05$). Regarding the radial abduction, patients of group A recovered on average 78° (range 70–83) and patients of group B recovered on average 79.5° of abduction (range 68–86) ($p > 0.05$). Mean DASH score in group A was 49.1 (range 31–87) and 38.25 (range 32–41) in group B ($p > 0.05$). Mean VAS score in group A was 2.4 and 0 in group B ($p < 0.05$). Mean decalage was 2.3 mm range (1.1–4.2) in group A, while for the group B, there was no decalage (maintaining in the follow-up the initial distance between the scaphoid and IMC with a mean value of 7.6 mm) ($p < 0.05$). All patients were evaluated with dynamometer of Jamar to test the hand strength and the results were 26 kg (contralateral hand 25.6 kg) for group B and 23 kg (contralateral hand 25.9 kg) for group A for hand grip test ($p > 0.05$); 7.7 kg (contralateral hand 7.25 kg) for group B and 6.4 kg (contralateral hand 7.2 kg) for group A for pulp pinch test ($p < 0.05$); and 7.6 kg (contralateral hand 6.6 kg) for group B and 5.4 kg (contralateral hand 6.8 kg) for group A for key pinch test ($p < 0.05$). All clinical results are shown in (Table 1).

Instrumental results

MRI images at final follow-up (12 months) showed in group A fibrosis of APL tendon graft in 100% of patients, scaphoid subchondral edema in 12 hands (30.7%), and reactive synovitis and effusion in 19 hands (48.7%) as shown in (Fig. 3). MRI in group B showed slight fibrosis of the graft of FCR

Table 1 Clinical results at final follow-up (12 months)

		Group A	Group B	*p* value
Grind test		+, 12.8%	+, 0%	$p > 0.05$
Kapandji test		10: 79.4% 8/9: 20.6%	10: 82.4% 8/9: 17.6%	$p < 0.05$
Radial abduction ROM		78° (range 68–86°)	79.5° (range 70–83°)	$p > 0.05$
VAS		2.4 (>6 12.5%)	0	$p < 0.05$
DASH		49.1 (range 31–87)	38.25 (range 32–41)	$p < 0.05$
Hand Grip test	treated side	23 kg	26 kg	$p > 0.05$
	contralateral	25.9 kg	25.6 kg	
Pulp Pinch test	treated side	6.4 kg	7.7 kg	$p < 0.05$
	contralateral	7.2 kg	7.25 kg	
Key Pinch test	treated side	5.4 kg	7.6 kg	$p < 0.05$
	contralateral	6.8 kg	6.6 kg	
Decalage		2.3 mm (range 1.1–4.2)	0	$p < 0.05$

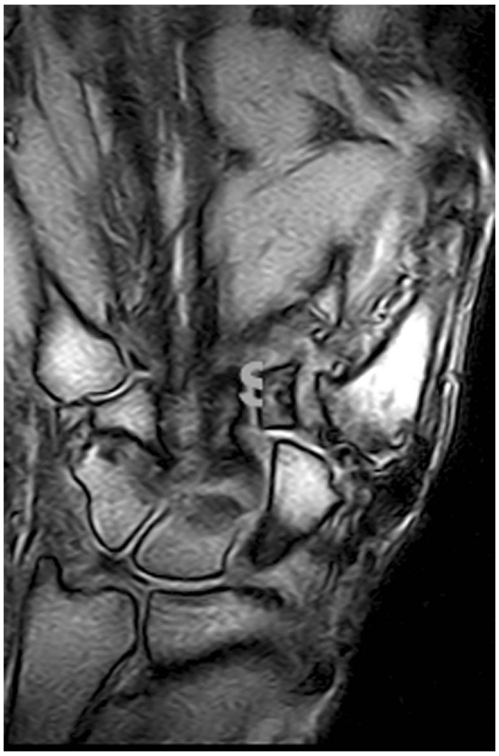

Fig. 3 MRI at final follow-up of a patient treated with interposition arthroplasty, important scaphoid subchondral oedema

tendon in eight hands (23.5%), scaphoid subchondral oedema was present in six hands (17.6%) and in 27 hands (79.4%) was completely absent, reactive synovitis and effusion was absent in 100% of patients as shown in **(**Fig. 4**).** Radiographic results are shown in **(**Table 2**).**

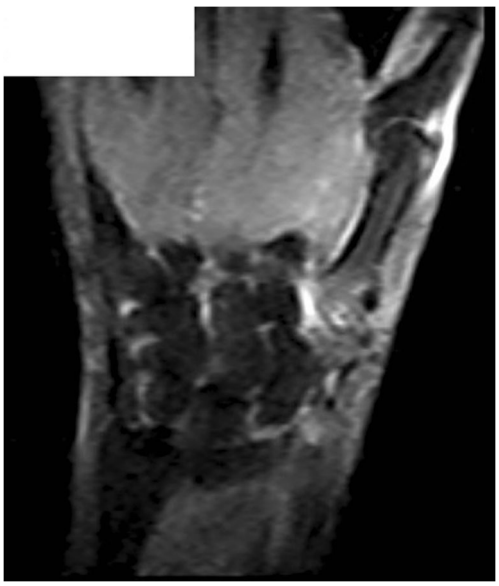

Fig. 4 MRI at final follow-up of a patient treated with suspension arthroplasty

Table 2 Radiographic results at final follow-up (12 months)

Group A	Group B
▪ Tendon fibrosis 100% ▪ Scaphoid subchondral edema 37.5% ▪ Reactive synovitis and effusion 50%	▪ Tendon fibrosis 26.6% ▪ Scaphoid subchondral edema (partial) 20% ▪ Reactive synovitis and effusion 0%

Discussion

During the years, numerous surgical techniques has been proposed for the treatment of basal thumb osteoarthritis; however, simple excision of the trapezium results in an unstable and painful joint, in addition in up to one third of patients an adduction deformity of the thumb develops. Implantation of a silicone rubber trapezium implant carries a high morbidity rate. In up to one third of patients the implant dislocates [16]**.** Furthermore, such implants can cause silicone-particle induced synovitis resulting in a painful and dysfunctional thumb and wrist [17–19]. Moreover, previous study shows how trapeziectomy with ligament reconstruction had a significantly better pain reduction and functional improvement compared with the trapeziometacarpal arthrodesis in primary trapeziometacarpal osteoarthritis [20].

The principal aim of the surgical procedures is to achieve a stable and painless thumb. Additional aims are achieving reasonable mobility and strength. The advantages of arthroplasties with tendon interposition and suspension are the simplicity of the operation and the good clinical results present in literature. The most feared complication in that procedure is probably damage to the superficial radial nerve, with ensuing development of neuromas. This complication has been avoided by careful dissection and protection of the various branches [21, 22]. However, in our cases, no superficial radial nerve injury has been reported.

Our results suggest that suspension arthroplasty seems to be more effective to avoiding first ray decalage, due to FCR tendon, that is sectioned longitudinally and the half tendon is fixed with an anchor to the base of the I metacarpal bone, to suspend the bone. This technique seems to guarantee better clinical and radiological results than interposition arthroplasty at final follow-up (12 months). Clinical evaluations shows statistically significant better results in VAS and DASH score in group B. X-ray examination and MRI analysis demonstrate how patients of group B had absence of decalage, minor scaphoid subchondral oedema, and no reactive synovitis and effusion compared to group A. In fact, MRI has allowed us to demonstrate the presence of tendon vitality in the majority of patients of group B, experiencing fibrosis only in eight of them (23.5%), but above all, MRI showed partial subcondary oedema of the scaphoid only in six hands (17.6%), while synovitis and effusion were completely absent. Suspension

arthroplasty seems to constitute a support system for the first radius, which is less traumatic for the structures of the carpus. In addition, even the minor decalage of the thumb in group B goes to support the best clinical results.

Conclusion

In summary, this study indicates that interposition arthroplasty and suspension arthroplasty are both safe and validated surgical procedures for basal thumb osteoarthritis; however, suspension arthroplasty seems to guarantee better outcomes in terms of pain reduction (VAS score), recovery of grip strength, and clinical score (DASH); moreover, it seem to be associated with better results at MRI like absence of I ray decalage and minor scaphoid subchondral edema at final follow-up (12 months), with a less fibrosis on the tendon graft.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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