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ORIGINAL STUDY

Prospective functional analysis of trapeziectomy combined with intermetacarpal tendon stabilisation in trapeziometacarpal arthritis

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We conducted a prospective study to evaluate the functional status of patients surgically treated by trapeziectomy with intermetacarpal tendon stabilisation. Pain relief, the height of the trapezial cavity, hand impairment, and manual ability were measured in a group of 18 patients at a mean of 2.3 years after surgery. Complete relief of pain was achieved in 89% of our patients. The height of the trapezial cavity was significantly reduced. Hand strength and digital dexterity were not impaired after the operation. Manual ability was significantly improved by the trapeziectomy as demonstrated by the median VAS values of 53.5 before and 95.5 after surgery. The ABILHAND questionnaire revealed that most of the patients were satisfied with the functional results of the trapeziectomy. Based on our findings in this prospective study, it appears that trapeziectomy with intermetacarpal tendon stabilisation relieved pain in almost 90% of patients suffering from trapeziometacarpal osteoarthritis, at no functional cost.

INTRODUCTION

Trapeziometacarpal osteoarthritis is a common condition which can adversely affect the quality of life. Pain localised at the base of the thumb and disability due to painful grasp are the major reasons for consultations. Treatment usually begins with conservative methods (*8*) but if these are ineffective, surgery is considered. Patients want to be pain free, but the functional cost of surgery must also be considered. We therefore conducted a prospective study to evaluate the pre- and postoperative functional status of patients treated surgically. Many surgical procedures have been developed to treat osteoarthritis. We used trapeziectomy with intermetacarpal tendon stabilisation because this technique removes any conflict at the scaphotrapezial joint, it stabilises the thumb ray, it eliminates the adduction contracture of the first web space, and it corrects the metacarpophalangeal collapse posture (*2, 17, 24, 25*).

The goal of our study was to evaluate the effects of trapeziectomy with tendon stabilisation on pain relief, height of trapezial cavity, hand impairment, and manual ability in patients with painful trapeziometacarpal osteoarthritis.

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PATIENTS AND METHODS

Patients

A group of 18 consecutive patients (10 women, 8 men) operated on by two senior surgeons was studied in a prospective manner. The patients' major complaint was pain at the base of the thumb, related to power-pinch activity. Before surgery, conservative treatment consisting of oral anti-inflammatory agents and corticosteroid injections had been attempted in all cases. Custom-made splints to stabilise the base of the first ray and to open the first intermetacarpal space were also used. Operative treatment was offered when conservative treatments had failed.

The men's professions included carpenter, farmer, engraver, mechanic, and factory worker, while the women's included secretary, nurse, factory worker, and seamstress. Thus many of the patients had occupational activities demanding on the thumb. Two patients had a history of trauma. One had had a fracture of the wrist and the other a severe strain of the thumb. Eleven patients had radiographic evidence of bilateral rhizarthrosis.

Handedness was quantified by using the Edinburgh inventory (22) ; the dominant thumb was involved in 12 patients. The range of postoperative follow-up was from 1 to 5 years (mean 2.3 years). The average age of the patients at review was 56 years (range : 43-76 years).

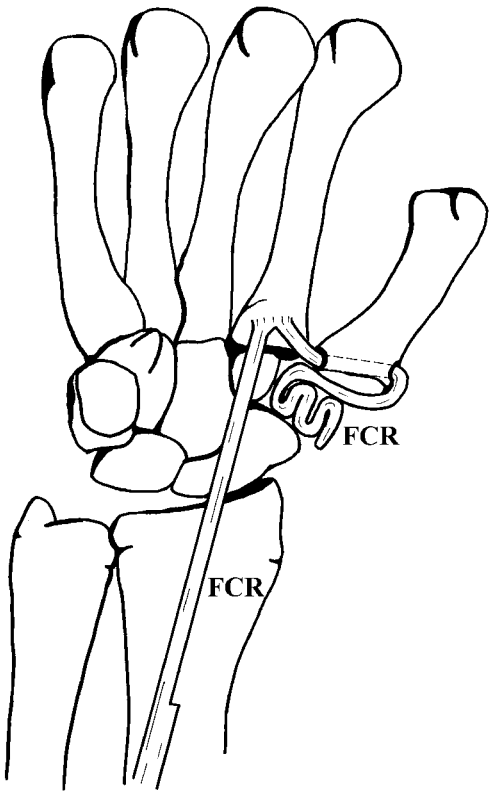

Fig. 1. — Schematic representation of the ligament reconstruction-tendon interposition arthroplasty according to Burton and Pellegrini. FCR : Flexor Carpi Radialis.

Surgical techniques

Our surgical treatment consisted of trapeziectomy, associated in all cases with two adjunctive procedures performed with a tendon strip. These procedures consisted of a tendon stabilisation between the base of the first and second metacarpals and a tendon interposition between the base of the first metacarpal and the scaphoid. Each senior operating surgeon used a particular technique. In group A (10 patients), the procedure was derived from that described by Burton and Pellegrini (*2*). In this technique (fig 1), the tendon stabilisation is performed with a distally-based segment of one-half of the flexor carpi radialis inserted on the base of the second metacarpal and passed through a hole in the base of the first metacarpal. The second adjunctive procedure uses the part of the tendon coming out of the first metacarpal and filling the space created by the complete excision of the trapezium. In group B (8 patients), the technique (fig 2) was derived from that described by Sigfusson and Lundborg (*24*). Here, the intermetacarpal tendon stabilisation is performed with one of the tendons of the abductor pollicis longus, inserted on the base of the first metacarpal. This tendon creates a figure-of-eight sling between the base of the first metacarpal and the insertion of the flexor carpi radialis on the base of the second metacarpal. The tendinous sling thus created also constitutes the second adjunctive procedure to trapeziectomy by filling in the residual trapezial space.

In both groups, the base of the first metacarpal was longitudinally positioned at the same level as the base of the index metacarpal. Transversally, a 2-3 mm space was left between the bases of the two metacarpals to allow free thumb movement. No additional procedure was undertaken at the metacarpophalangeal level.

Associated hand procedures included carpal tunnel release in two cases and trigger finger treatment in one case.

The postoperative program was similar in both groups. A custom-fitted splint in the form of a short-arm

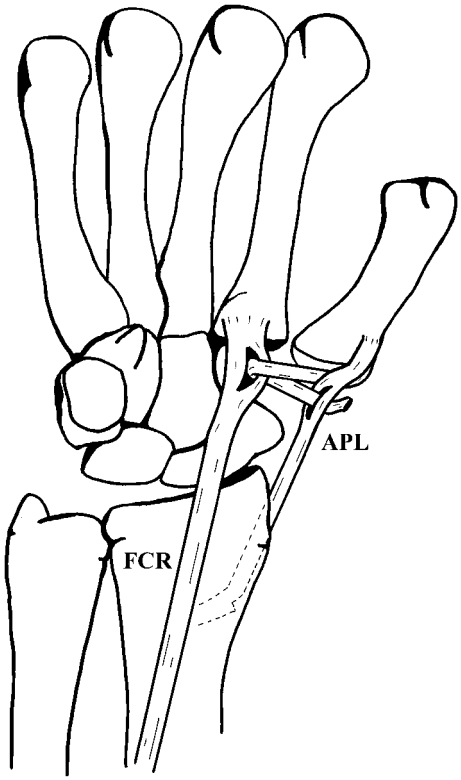

Fig. 2. — Schematic representation of the abductor pollicis longus tendon arthroplasty according to Sigfusson and Lundborg. FCR : Flexor Carpi Radialis ; APL : Abductor Pollicis Longus.

thumb spica was applied for four weeks. This held the first intermetacarpal space open and protected against metacarpophalangeal hyperextension. The interphalangeal joint was left free. After four weeks, exercises were begun.

Three complications were noted. Two patients developed reflex sympathetic dystrophy ; one had markedly improved at the time of evaluation following medical treatment and physiotherapy, while the other remained dissatisfied, with a painful thumb. A painful scar was the other complication.

Methods of evaluation

Each patient was examined independently of the surgeon involved ; the preoperative and outcome assessors were blinded to the specific surgical treatment used.

Pain assessment

Overall pain was prospectively assessed with a 10-cm horizontal visual analogue scale (VAS), with “no pain” at one end (score 0) and “very severe pain” at the other (score 100).

Radiological examination

The patients had a radiological examination of the thumb before and after operation. The most helpful radiographic view was an anteroposterior radiological projection of the trapeziometacarpal joint, in a neutral position as described by Kapandji (*16*). On this view, the grading of osteoarthritis of the trapeziometacarpal joint is based on articular cartilage lesions, osteophyte formation on the distal trapezium, and metacarpal subluxation (*8*).

The height of the trapezial cavity was measured on radiographs before surgery and when reviewing the patient. The height was measured between two parallel lines, one at the distal extremity of the scaphoid and the other at the base of the first metacarpal, on a true anteroposterior view of the thumb and its base (*14*).

Hand impairment

Maximum key-pinch, palmar-pinch, and grip strength were measured with calibrated dynamometers (*21*). Pinch strength was measured on a single Preston pinch meter and grip strength was measured with a Jamar dynamometer. The investigator invited each patient to develop maximum strength, without taking pain into account.

Manipulative digital dexterity, defined as the ability to make rapid, skillful, and controlled manipulative movements of small objects, primarily with the fingers (*11*), was tested with the unimanual and bimanual Purdue Pegboard subtests (*9, 26*).

Manual ability

Manual ability may be defined as the capacity to manage daily activities requiring the use of the upper limbs, whatever the strategies involved. Therefore, manual ability has to be measured directly and not simply inferred from focal impairments (*23*).

It was therefore assessed with a 10-cm horizontal visual analogue scale (VAS), with “no autonomy” at one end (score 0) and “total autonomy” at the other (score 100). The ABILHAND questionnaire was also used to evaluate manual ability in terms of difficulty perceived by a hand-impaired patient on 56 representative unimanual or bimanual activities of daily living (*23*).

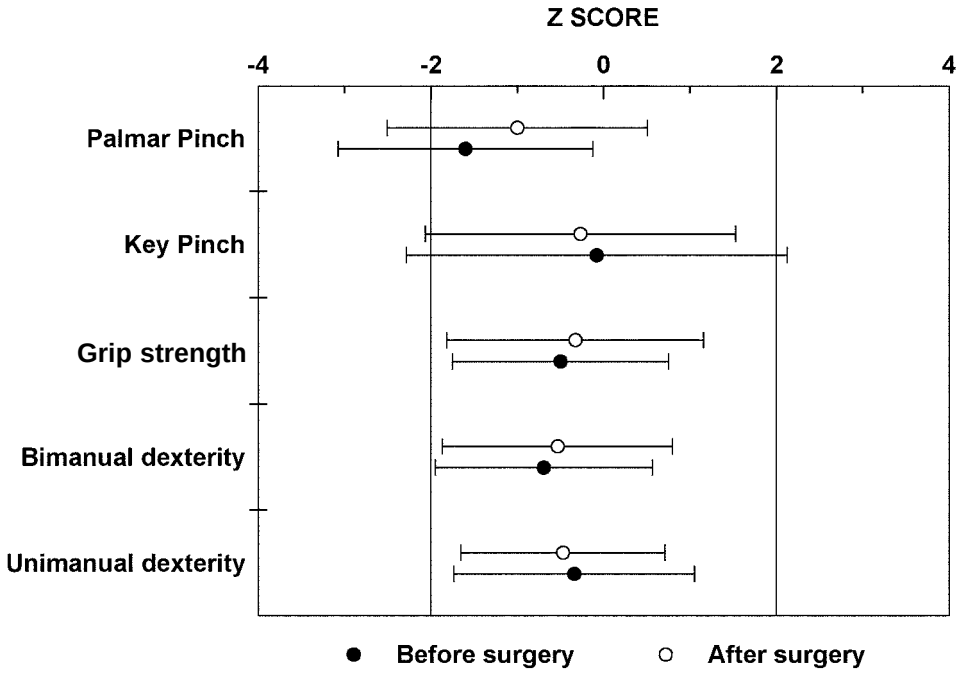

Fig. 3. — Comparison of our 18 patients before and after trapeziectomy with normal subjects. Range of scores for upper limb impairment. The mean and standard deviation of Z-scores are given for each variable. Ninety-five percent of the normal population have Z-scores between 2 and –2. The Z-score is the difference between the value for the patient and the average value for the normal population, normalised to the standard deviation for normal subjects.

Data analysis

Our sample was made up of 18 patients divided into two groups according to the surgical technique : 10 patients in group A and 8 in group B. In the first part of the analysis, the results of the two groups were compared in order to detect a potential effect of the surgical technique on pain relief, trapezial space height, hand impairment, and manual ability.

In the second part of the analysis, the patients were regrouped and the effects of surgery were studied by comparing the status of the 18 patients before and after trapeziectomy.

We used the Wilcoxon signed rank test for pain and manual ability. For the impairment variables (dexterity and strength) and trapezial space height, we used the Student paired t-test when tests for normality and equal variance were passed ; otherwise a Wilcoxon signed rank test was used. The significance level was set at $p < 0.05$ for all tests.

In the third part of the analysis, the patients were compared with normal subjects by calculating the Z-score for every patient and for each impairment variable, taking into account the effect of sex, age, and handedness. For strength and dexterity, normal values have been published (*9, 21, 26*). The Z- scores represent the difference between the value for the patient and the average value for the normal population, normalised to the standard deviation for normal subjects. Ninety-five per cent of the normal population have Z- scores between 2 and –2.

RESULTS

No significant differences were found between the two surgical techniques with respect to pain relief, height of trapezial cavity, hand impairment and manual ability ($p > 0.05$). Therefore, it was concluded that the surgical technique had no statistically significant effect on our results.

The two groups were then merged into one (18 patients) and the scores obtained before and after trapeziectomy were compared. Pain was very severe before trapeziectomy in all patients. Most of them (89%) were completely relieved of pain by the trapeziectomy, as indicated by the median VAS

values of 70 before and 2 after the operation ($p < 0.001$). The height of the trapezial cavity was significantly reduced from 10.9 ± 1.5 mm before the operation to 5.65 ± 0.8 mm after ($p < 0.001$). Hand-impairment ratings did not show any significant differences ($p > 0.05$) after trapeziectomy (table I). Hand strength and digital dexterity were not impaired after the operation. Manual ability was significantly improved by the trapeziectomy as demonstrated by the median VAS values of 53.5 before and 95.5 after surgery ($p < 0.001$). The ABILHAND questionnaire (*23*) revealed that most of the patients were satisfied with the functional results of the trapeziectomy. Five patients could easily perform the 56 activities of the questionnaire. Six had difficulties opening a screw-topped jar. Two could not screw on a nut or wind up a wrist watch, both tasks imposing torsion torques on the thumb. Three patients reported some difficulties while executing tasks demanding precision, such as threading a needle, buttoning up trousers, peeling onions, and cutting their nails. However, they easily performed the other tasks of daily living like eating a sandwich, brushing their hair, using a spoon, pulling up a trouser zipper, counting bank notes etc. Two patients reported very poor manual ability ; the first suffered from a painful reflex sympathetic dystrophy in the postoperative period, and the second presented with arthritis in several joints including the elbow and wrist, with a direct impact on her manual ability.

Finally, we compared the hand strength and the digital dexterity of our patients with the normal population. Figure 3 shows that the scores before and after surgery were within two standard deviations of the published normal values for the five variables studied.

DISCUSSION

We conducted a prospective study to examine the effects of trapeziectomy associated with tendon stabilisation and interposition on pain relief, height of trapezial cavity, hand impairments and manual ability in patients with painful trapeziometacarpal osteoarthritis. By comparing each variable before and after surgery we demonstrated that this operation relieved pain and improved manual ability without impairing grip strength or digital dexterity.

The high preoperative median value for pain characterises the essential reason for seeking treatment in trapeziometacarpal arthritis. Our results confirm previous studies that showed the efficacy of trapeziectomy alone or in combination with tendon stabilisation on pain relief (*2, 3, 7, 8, 13, 17, 24, 25, 27*). The concept of excision of the trapezium in the management of osteoarthritis of the basal joint of the thumb (*13*) was not widely accepted initially because of concerns regarding loss of pinch strength, shortening of the thumb, persistent adduction positioning of the first metacarpal (*12*), and painful scaphometacarpal conflict (*5*). The association of trapeziectomy with intermetacarpal tendon stabilisation and tendon interposition in the trapezial space tends to overcome those problems and has become an accepted technique (*2, 3, 17, 24, 25, 27*). Our results confirm the broad indications for and the durable results of trapeziectomy associated with tendon stabilisation in comparison to other treatments of trapeziometacarpal osteoarthritis,

Table I. — Results of the hand impairment measures before and after surgery.

Tests	Before surgery		After surgery		Effect of surgery		
	mean	sd	mean	sd	df	t	p-value
Unimanual dexterity (n)	15	2.1	15	1.8	16	0.955	0.354
Bimanual dexterity (n)	12	1.7	12	1.8	14	-0.591	0.564
Grip strength (N)	265	124.5	271	133.7	17	-0.363	0.721
Key pinch (N)	78	32.6	77	33.7	15	0.181	0.859
Palmar pinch (N)	54	21.8	63	18.1	16	-1.311	0.209

such as trapeziectomy alone (*8*), first metacarpal osteotomy (*28*), trapeziometacarpal arthrodesis (*4*), or prosthetic joint arthroplasty (*18*). Moreover, the tendon stabilisation of the base of the first metacarpal allows opening of the first intermetacarpal space, limiting the need for compensatory metacarpophalangeal hyperextension (*17, 24*), which is a painful position decreasing the pinch strength (*25*). No additional procedure at the metacarpophalangeal level was necessary in our patients. The intermetacarpal stabilisation by a tendon strip provided good stability in the longitudinal and lateral planes with minimal postoperative immobilisation and no need for K-wires, which represent a potential septic risk and require subsequent removal (*7*).

The high values for strength could be related to the high proportion of active patients and male patients in our group, when compared to other studies (*2, 7*). No significant postoperative improvement in strength was noted, with the same statistical power limitation as in other studies (*7*).

The stability of the first metacarpal base is of prime importance to obtain a functional and painless thumb. We measured the residual height of the scaphometacarpal space, which has been described as an index of stability at rest (*1, 14*). Similar to other studies, this height was reduced by half in our group of patients (*17, 19, 25*). However, our study tends to confirm previous studies suggesting that the height of the trapezial space has no effect on pain relief and functional status (*7, 10, 19, 25*). Our results also confirm that the stability of the thumb base is not completely reflected by this measure. Indeed, in the pinch action, the resultant force is directed not only proximally but also radiodorsally (*6*). This could explain the benefits of intermetacarpal tendinous stabilisation, despite the fact that similar excellent results have been reported after trapeziectomy alone (*7*).

The effect of trapeziectomy on hand function is difficult to judge in a retrospective manner by using radiological or laboratory measures. The contralateral hand cannot serve as a basis for comparison because the osteoarthritic process may impair it as well. Many studies report patient satisfaction with trapeziectomy and ligamentoplasty (*3, 15*). However, the concept of satisfaction reflects multiple and poorly defined dimensions (*20*). Therefore, only a prospective study comparing the pre- and postoperative function of the hand and the upper limb can adequately provide a dynamic view of the treatment process. This prospective study allows us to conclude that surgery relieves pain in almost 90% of patients at no functional cost.

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