

Basal thumb metacarpal osteotomy for trapeziometacarpal osteoarthritis

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ABSTRACT

Purpose. To review the subjective and functional results of basal thumb metacarpal osteotomy for the treatment of trapeziometacarpal osteoarthritis.

Methods. Between July 1993 and November 1998, 35 thumb osteotomies without internal fixation were performed on 33 patients in the Christchurch Hospital, New Zealand. Records of 28 thumbs (13 right and 15 left) of 26 patients (17 women and 9 men) were available for review. Patients were reviewed using strength testing and the Michigan Hand Outcomes Questionnaire.

Results. The mean age of the 26 patients was 54 years (range, 30–69 years). Of the 28 thumbs, 22 (21 patients) had good or excellent results, 2 fair, one poor. The remaining 3 thumbs (3 patients) required further revision and were classified as failures. The mean follow-up period of the 25 thumbs (24 patients) not requiring revision was 34 months (range, 12–73 months). Good thumb motion was present in all hands

with no trapeziometacarpal instability seen. Compared with the normative data, the strengths of key pinch, pulp pinch, and tripod pinch of our patients were significantly lower (22–32% lower), but not the grip strength. Michigan Hand Outcomes Questionnaire scores increased 28 (range, 1–56) points after surgery, with significant improvement especially in pain (+44 points), activities of daily living (one-handed tasks, +41 points), and satisfaction (+35 points).

Conclusion. Basal thumb metacarpal osteotomy is a straightforward, conservative procedure that should be considered for grades II and III trapeziometacarpal osteoarthritis.

Key words: metacarpus; osteoarthritis; osteotomy; thumb

INTRODUCTION

Trapeziometacarpal arthritis is a relatively common condition affecting mainly middle-age or older age-groups. Symptoms involve pain and difficulties in

performing work and activities of daily living (ADL), and adduction contracture of the thumb metacarpal in advanced stage. Many treatment procedures have been described, including simple trapezium excision,¹ trapeziometacarpal arthrodesis,² silicone interposition,³ and replacement arthroplasty.⁴ Stabilised resection arthroplasty is the current trend, with several variations described.⁵⁻⁹

Basal thumb metacarpal osteotomy has been performed rarely since the work of Wilson.^{10,11} It is a straightforward and relatively conservative procedure that does not compromise subsequent procedures should revision be required. It avoids the potential complications of instability and weakness after trapezium excision,^{12,13} and problems of stiffness and nonunion after carpometacarpal arthrodesis.^{14,15} Good results have been reported in both mild and moderate stages in the longer term.¹⁶ A biomechanical cadaver study suggested that the osteotomy may unload the palmar contact areas of the joint in early stage but had no effect in more advanced stage.¹⁷

This study aimed to review the subjective and functional results of basal thumb metacarpal osteotomy.

MATERIALS AND METHODS

Between July 1993 and November 1998, 35 basal thumb metacarpal osteotomies were performed on 33 patients in the Christchurch Hospital, New Zealand. Indications for surgery were disabling pain and difficulties in performing ADL. All patients had failed non-operative treatment, including at least one intra-articular steroid injection. It is our practice to perform metacarpal osteotomy for younger or high-demand patients with trapeziometacarpal arthritis, when the joint remains mobile. Contra-indications to osteotomy included fixed deformity of the carpometacarpal joint, scaphotrapezium disease, and metacarpophalangeal joint disease of the thumb. Interposition arthroplasty is reserved for older patients with an immobile trapeziometacarpal joint or with a degenerative scaphotrapezium joint.

Preoperative radiographs were independently assessed by a musculoskeletal radiologist and a consultant orthopaedic surgeon according to the classification of Eaton et al¹⁸—stage I indicates no cartilage degeneration and normal articular contours; stage II indicates joint-space narrowing with osteophytes less than 2 mm in size; stage III indicates significant destruction of the joint and osteophytes greater than 2 mm in size; stage IV indicates scaphotrapezium degeneration in addition

to trapeziometacarpal joint involvement.

The operative technique was the same as that described by Wilson and Bossley¹¹ without internal fixation. A V-shaped incision was made over the dorsoradial aspect of the basal thumb articulation. Terminal branches of the superficial radial nerve were carefully protected. The proximal metaphysis of the metacarpal was exposed and the periosteum reflected. A 25-gauge needle was used to localise the joint. A closing wedge was cut with the base of about 4 mm directed dorsally and radially at the junction of the shaft and metaphysis. The osteotomy was performed with a small power saw and was completed with a fine osteotome. Care was taken not to penetrate the far cortex. The osteotomy site was closed with an absorbable suture through the capsule and periosteum. Supplementary fixation with a Kirschner wire could be used if the osteotomy was mobile, but was not required in any patients in this series. A plaster was applied with the thumb in the corrected position and retained for 6 weeks. Mobilisation under the supervision of a hand therapist was started afterwards. Postoperative radiographs were not routinely performed unless symptoms persisted.

Patients completed the Michigan Hand Outcomes Questionnaire (MHQ)¹⁹ for both their preoperative symptoms and current status. The MHQ is a validated 37-item instrument²⁰ comprising 6 fields: overall hand function, ADL, pain, work performance, aesthetics, and patient satisfaction. The highest score for each field is 100 points, and the mean of the 6 fields is the total score. The preoperative score was calculated retrospectively based on patients' memory. Subjective improvement, recovery time, compensation status, revision surgery, and other joint involvement were also recorded.

Clinical assessment was made by 2 independent observers. The ability to flatten the palm on a table was assessed. Extension and abduction of the thumb (the angle between the thumb and index metacarpals with the thumb extended and abducted maximally) were measured using a goniometer. The ability to oppose the thumb to the tip or base of the little finger was recorded. Crepitus and tenderness of the carpometacarpal joint was assessed as present, mild, or absent. Stability was assessed by attempting to sublux the metacarpal base. Grip strength was measured using a Jamar dynamometer (Asimov Engineering, Los Angeles [CA], US). Strengths of key pinch, pulp pinch, and tripod pinch were measured using a B&L pinch gauge (B&L Engineering, Santa Fe Springs [CA], US). The mean of the 3 measurements was taken for both operated and non-



Figure (a) Preoperative radiograph showing stage-II trapeziometacarpal osteoarthritis. (b) Postoperative radiograph showing bony union following basal thumb metacarpal osteotomy.

operated hands and compared with normative data for age, sex, and hand.²¹

Statistical analysis was performed using the SAS software package (6.03 Edition; SAS Institute, Cary [NC], US). Pearson product-moment correlation, one sample *t*-test and paired *t*-test were used for statistical analysis.

RESULTS

A total of 28 thumbs (13 right and 15 left) in 26 patients (17 women and 9 men) were available for review; 6 patients (6 thumbs) could not be traced, and one very elderly patient declined to participate. All these patients reported satisfactory results at their last assessment. The mean age of the 26 patients at operation was 54 years (range, 30–69 years). 13 cases were of the dominant hand and 15 cases the non-dominant. 16 patients developed symptoms in the opposite thumb, and 10 patients had other joints affected. Four thumbs were classified as stage II, 21 as stage III, and 3 as stage IV according to preoperative radiographs. One patient also had erosive changes consistent with an inflammatory arthritis. The New Zealand Accident Compensation Corporation covered

all or part of the treatment costs in 10 patients (11 thumbs).

Three thumbs in 3 patients required revision and were classified as failures. The mean follow-up of the 25 thumbs (24 patients) not requiring revision was 34 months (range, 12–73 months). 22 (21 patients) were categorised as good or excellent, 2 as fair, one as poor. The mean time to full recovery was 10 months (range, 2–30 months). Four patients felt some deterioration as time went by; 23 patients would choose to undergo the procedure again for the same problem, including the 2 who required revision at 6 months and 22 months, respectively.

Clinical examination

Both the mean extension and abduction of the thumb metacarpal were 47° (range, 30°–65° and 30°–60°, respectively). Six patients were unable to fully flatten the palm to the table. Two patients were unable to oppose the thumb to the tip of the little finger and 5 could not oppose to the base of the little finger. This composite movement required metacarpophalangeal and interphalangeal joint mobility. All carpometacarpal joints were stable. Crepitus was palpable on axial grinding in 4 thumbs with mild crepitus in further 6 thumbs. There was tenderness to deep palpation in 6 thumbs and mild discomfort in further 10 thumbs.

Strength testing

Grip and pinch strengths vary between sexes, ages, and hands.²¹ The results were therefore expressed as a percentage of normative data for comparison. There was no significant difference in mean grip strength. Strength of key pinch, pulp pinch, and tripod pinch of our patients were significantly lower than the normative values by 22% to 32% (Table 1). There was no correlation between the range of movement of the thumb and the strength of grip and pinch.

Michigan Hand Outcomes Questionnaire scores

The total MHQ score and all fields except aesthetics increased significantly. The greatest improvements were in pain (+44), ADL scores, especially for one-handed tasks (+41) and satisfaction (+35). The mean overall score improvement in the 24 patients who did not require revision was 28 (range, 1–56) points [Table 2].

The MHQ score has not been converted into adjectival grades such as excellent, good, fair, and poor by its originators. The preoperative pain score of 27

Table 1
Mean strength values and comparison with normative data²¹

	Mean strength (kg)			Comparison with normative data	p value
	All, n=26	Male, n=9	Female, n=17		
Grip	30.6	44.3	24.0	-2%	0.73
Key pinch	6.3	7.2	5.9	-23%	0.002
Pulp pinch	4.5	4.9	4.3	-22%	0.003
Tripod pinch	5.7	7.6	4.7	-32%	<0.0001

Table 2
Mean Michigan Hand Outcomes Questionnaire (MHQ) scores

Field	Mean MHQ scores			p value
	Preoperative	Postoperative	Change	
Overall function	47	73	26	<0.0001
Activities of daily living				
One hand	33	74	41	<0.0001
Two hands	48	78	30	<0.0001
Overall	40	76	36	<0.0001
Work performance	47	70	23	0.0002
Pain	27	71	44	0.0001
Aesthetics	73	81	8	0.14
Satisfaction	36	71	35	<0.0001
Total	43.9	74.3	30.4	<0.0001

equates to regular and severe pain often affecting sleep and ADL. This agrees with the chart reviews and the indications for surgery. The postoperative pain score of 71 equates to rare mild pain. Similarly the preoperative ADL (one-handed) score of 33 equates to moderate difficulty, and a postoperative score of 74 equates to little difficulty in performing 5 tasks using one hand (Table 2). One patient was poor (25 points) and 2 were fair (41 and 50 points).

Of the 24 patients who did not require revision, those covered by the Accident Compensation Corporation had significantly greater improvement ($p=0.01$) and higher final MHQ score ($p=0.006$) than those not covered. One of the revision patients was covered by compensation. There was no significant correlation between duration of follow-up and MHQ score, clinical findings, or strength testing. The pain score correlated poorly with other field scores and all measurements of grip and pinch strengths. The measurements of pinch strength correlated well with the other MHQ field scores and the total MHQ score (correlation coefficient [r]=0.57, $p<0.005$), but the grip strength correlated less well to total MHQ score ($r=0.41$, $p<0.05$).

Radiological grade did not correlate significantly with postoperative MHQ, pain or strength

measurements. However, there were only small numbers of thumbs with grade II or IV osteoarthritis.

Complications

There were no intra-operative complications and no supplementary fixation was required. Five thumbs developed dysaesthesia in the superficial radial nerve distribution caused by retraction of the nerve branches: 4 were temporary and one developed a mild algodystrophy that took 4 months to resolve. Three patients required revision: a 65-year-old man with erosive-type arthritis had good pain relief for 18 months but required revision for an interposition arthroplasty at 22 months due to pain. A 69-year-old woman who underwent bilateral osteotomies had fair results on the right thumb but had coexistent metacarpophalangeal joint arthritis on the left thumb and remained irritable at the carpometacarpal joint. She underwent interposition arthroplasty and metacarpophalangeal joint arthrodesis 6 months later. A 41-year-old alcoholic labourer and heavy smoker had delayed union and no improvement in pain. He underwent arthrodesis of the trapeziometacarpal joint 6 months later. The arthrodesis failed to fuse despite revision 12 months

later. He eventually required trapezium excision and interposition arthroplasty due to nonunion. One failure case of a 51-year-old woman had a poor postoperative MHQ total score of 25 and grip and pinch strengths that were 13% to 22% of normal. She had coexistent scaphotrapezial arthritis (stage IV) that was not revised.

DISCUSSION

Wilson¹⁰ in 1973 first described the basal metacarpal osteotomy for trapeziometacarpal osteoarthritis. Wilson and Bossley¹¹ subsequently reported substantial and lasting pain relief after surgery on 23 thumbs in 21 patients with a mean follow-up of 12 years. Hobby et al.¹⁶ reported good or excellent results in 30 of 41 thumbs and poor results in the remaining 11 thumbs, including one revision, in a mean follow-up of 6.8 years.

It is unclear why the basal thumb metacarpal osteotomy works. Intramedullary decompression may palliate the pain as seen in other juxta-articular osteotomies. Biomechanical factors may also contribute to the long-term success as seen in high tibial osteotomy. The efficacy of the procedure in unloading palmar contact areas of normal or moderately arthritic joints and in transferring the load to the dorsoradial cartilage was demonstrated in a cadaveric study; however, no biomechanical rationale for the procedure was found in the advanced stage.¹⁷ It was concluded that correction of the adduction deformity of the metacarpal was important for pain relief.¹¹ If the volar plate of the metacarpophalangeal joint is lax, osteotomy does not worsen the hyperextension. However, the laxity may drive the metacarpal back to persistent flexion or adduction position following either osteotomy or interposition arthroplasty. Therefore, it is our practice to treat any metacarpophalangeal joint volar plate laxity at the time of surgery.

The present series is a consecutive single-surgeon series. It is difficult to compare our series with previous series because of variation in subjective assessment and differing criteria for categorising results. The MHQ score was used because it is a validated patient-derived outcome measure sensitive to change.^{19,20} Measuring preoperative scores based on patients' memory was a weakness of this study. Nonetheless, the responses and scores correlated well with the chart reviews and indications for surgery.

Good intercorrelation was found within the fields and the total score of the MHQ. Pain correlated

least with the other fields. Trapeziometacarpal osteoarthritis is predominantly a painful condition and this suggests that pain is inadequately weighted in the calculation of the total MHQ score.

Results of grip and pinch strength were compared with normative data for sex, age, and hand, as most patients were affected bilaterally. Although our female patients were younger than those of Hobby et al.,¹⁶ the mean grip and pinch strengths of both series were similar. Pinch strength correlated well with all MHQ field scores except pain.

The mean recovery time of the present series was 10 months (range, 2–30 months). In some cases, recovery was prolonged and this has also been noted in other series of osteotomy¹¹ or interposition arthroplasty.⁹ Poor patient selection contributed to the cases of 2 revisions and one failure. Contraindications to this procedure include ipsilateral thumb metacarpophalangeal joint disease, erosive inflammatory arthritis, and scaphotrapezial disease.

Comparison of basal thumb metacarpal osteotomy with other procedures was not found in the literature. Many have reported good and excellent results with interposition arthroplasty using a variety of techniques.^{5–9,18} Nonetheless, it is technically demanding and may have greater morbidity because the dissection involves trapezium excision and tendon harvest.⁶ Hollevoet et al.²² compared results of simple trapezium excision with interposition arthroplasty and found no significant subjective or clinical differences. Trapeziometacarpal arthrodesis has a mean nonunion rate of 13%,¹⁵ but may cause stiffness and loss of dexterity,^{14,15} as well as scaphotrapezial degeneration in long term.¹⁴

Basal thumb metacarpal osteotomy is a straightforward, conservative procedure that should be considered for grades II and III (moderate and advanced) carpometacarpal arthritis that has no scaphotrapezial changes. It does not compromise subsequent procedures should revision be required. Kirschner wire or interosseous wiring is not needed if osteoclasia of the apex of the osteotomy is carefully performed. Correction of the adduction deformity helps prevent hyperextension of the metacarpophalangeal joint. Both subjective and objective results are good and comparable with other procedures.

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