First metacarpal osteotomy for trapeziometacarpal osteoarthritis

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We report a long-term follow-up of abduction-extension osteotomy of the first metacarpal, performed for painful trapeziometacarpal osteoarthritis. Of a consecutive series of 50 operations, 41 thumbs (82%) were reviewed at a mean follow-up of 6.8 years. Good or excellent pain relief was achieved in 80%, and 93% considered that surgery had improved hand function, while 82% had normal grip and pinch strength, with restoration of thumb abduction. Metacarpal osteotomy was equally successful in relieving symptoms of those with early (grade 2) and moderate (grade 3) degenerative changes. This simple procedure provides lasting pain relief, corrects adduction contracture and restores grip and pinch strength, giving good results with few complications.

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Osteoarthritis of the trapeziometacarpal joint is common,¹ causing pain and an adduction deformity of the thumb. A wide variety of operations has been advocated including arthrodesis,² excision arthroplasty,^{3,4} interposition arthroplasty with silastic,⁵ interposition arthroplasty with soft tissue,⁶ trapeziectomy with a stabilising tendon sling⁷ and total joint replacement.⁸ Osteotomy of the first metacarpal is a simple technique which has been largely overlooked.⁹

Trapeziometacarpal osteoarthritis is associated with degeneration of the palmar beak ligament¹⁰ and articular degeneration starts on the joint surfaces adjacent to it. The cartilage of the dorsoradial joint surface is spared until late in the disease process.¹⁰ A recent cadaver study has shown

that extension osteotomy of the first metacarpal shifts the area of joint contact from the worn palmar cartilage to the normal dorsal surface.¹¹ We describe our experience of osteotomy in a large series of patients over a period of 12 years.

Patients and Methods

We carried out 50 operations in 42 patients; 41 thumbs (82%) in 33 patients were available for review at a mean of 6.8 years (2 to 12) from operation. The average age at operation was 57 years (20 to 73). Nine of the operations were in men and 32 in women, and the dominant hand was involved in 20 patients. Nine patients were lost to follow-up. Three had died, one had moved and could not be contacted, and three very elderly patients could not be traced. Another elderly man was too confused to co-operate. One patient was contacted by telephone but did not wish to be reviewed. When last seen she had complete relief of pain, full abduction and a strong grip.

The patients were reviewed by a surgeon who had not been involved in the operation. Pain and hand function were assessed by the patient, using a self-administered questionnaire. Grip strength was measured with a Jamar dynamometer (Asimov Engineering Company, Los Angeles, California), and pulp to pulp (pinch) and lateral pinch (key-grip) with a B & L hydraulic pinch meter (B&L Engineering, Santa Fe Springs, California). The mean of three readings was compared with normal ranges matched for age and sex.¹² The range of movement and maximum abduction were measured clinically with a goniometer. Thumb opposition and the ability to flatten the palm were assessed and recorded.

Indications for operation. Surgery was carried out when pain which interfered with everyday activities had not responded to conservative treatment with a splint, non-steroidal anti-inflammatory drugs or injection with lignocaine and hydrocortisone. Osteotomy was only considered for mild and moderate degenerative changes confined to the trapeziometacarpal joint, scaphotrapezial wear being a contraindication. The preoperative radiographs were graded as described by Eaton and Littler¹³: grade 1, no radiological changes; grade 2, osteophytes or intra-articular fragments of <2 mm with no narrowing of

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Fig. 1

Basal osteotomy corrects adduction contracture, restoring the first web space and reducing the tendency for the action of flexor and extensor pollicis longus to sublux the carpo-metacarpal joint.

the joint space; grade 3, osteophytes or fragments of >2 mm with slight narrowing of the joint space; and grade 4, marked narrowing of the joint space with erosion of the

dorsoradial facet of the trapezium (Fig. 1).

Operative technique. This was as described by Wilson in 1973.⁹ Under general anaesthesia and using an above-elbow tourniquet, the joint line is identified with a percutaneous hypodermic needle and a 4 cm longitudinal incision is made over the radial border of the first metacarpal. The tendon of extensor pollicis longus is retracted and the thenar muscles are elevated. A radially based wedge of 20 to 30° is removed from the metaphyseal bone, within 2 cm of the joint line, using a reciprocating saw. The wedge is shaped to combine extension (the plane of the thumb nail) and abduction (radial border of the metacarpal) to restore the first web space as shown in Figure 1. The far cortex is divided incompletely to retain stability and the osteotomy closed by osteoclasis and held with two percutaneous Kirschner wires (Fig. 2). Wilson's original method⁹ used an intraosseous wire loop, and we tried a staple in our early cases but found it unsatisfactory. After wound closure, a Bennett-type cast is applied for four weeks. The patient is then examined clinically and radiologically. If the osteotomy is uniting the wires are removed and mobilisation is started.

Results

Before operation all patients complained of pain in the thumb which interfered with hand function. At latest

Fig. 2a

Fig. 2b

Radiographs after operation showing the fixation with Kirschner wires.

Table I. Pain in the 41 thumbs of 33 patients at follow-up

	Number	Percentage
No pain	21	51
Discomfort only with heavy use	12	29
Discomfort which limits activity	6	15
Pain unchanged from preop	1	2.5
Revised for persistent pain	1	2.5

Table II. Mean grip strength after 31 operations in women and eight in men

	Power grip (kg)	Key grip (kg)	Pinch (kg)
Women	24	5.9	4.3
Men	38	8.3	5.3

Table III. Results for 19 hands followed up for over six years

Results	Number of patients (%)	
Excellent	11	58
Good	3	16
Poor	5	26

Table IV. Results in 39 hands according to severity of preoperative degenerative change

	Excellent	Good	Poor
Grade 1	1	0	0
2	8	6	4
3	7	6	5
4	0	0	2

review, 82% considered that pain did not interfere with hand function and 51% were completely free from pain (Table I). Most patients (95%) felt that surgery had produced worthwhile pain relief. Hand function had improved in 93% of patients and 44% had no limitation. Two patients were unchanged and one had needed revision to a trapeziometacarpal fusion.

Grip strength was assessed in 39 hands (Table II), but one patient was unable to co-operate and another had had a surgical revision. The measurements were compared with a normal range matched for age and sex assessed in 260 asymptomatic individuals from the Cambridge area.¹² Results within two standard deviations of the mean were considered to be normal. The grip strength was within the normal range in 36 hands (93%) and the pinch grip was normal in 35 (90%). The grip and the pinch strengths did not differ significantly between the right and left hands, or with hand dominance.

All patients were able to oppose the thumb to the tip of the little finger. In 34 hands (85%), the thumb could be opposed to the fifth metacarpal head, and in 38 (95%) the palm could be completely flattened. The mean maximum abduction was 45° (20 to 60). Only one patient had less than 30° of abduction; she had malunion of the osteotomy due to failure of staple fixation and deep infection. There was more than 35° of abduction in 35 of 40 hands (87%).

Complications. Only two patients had complications which affected the result: one had loosening of a staple leading to infection and malunion and the other had a deep infection and loosening of the Kirschner wires. Four hands (10%) had minor complications which responded to conservative measures and did not affect their long-term results. One with delayed union required seven weeks in plaster, one had a superficial wound infection, one had transient neurapraxia of a digital nerve and the fourth showed mild reflex sympathetic dystrophy which completely resolved after physiotherapy.

Overall assessment. There was an excellent result (no pain, no limitation of function, normal grip strength and >30° abduction) in 18 hands. A good result (discomfort on heavy use, improved function, normal grip strength and >30° abduction) was achieved in 12 hands. The result was poor (pain causing limited activity, no improvement in function, weak grip and <30° abduction) in 11 hands. One patient, with advanced arthritic changes, had persistent pain after osteotomy and needed a trapeziometacarpal arthrodesis, which was classified as a poor result.

Five patients with good early results had the return of symptoms with time. Nineteen hands were followed up for more than six years (mean 9.4) and of these 74% had good or excellent results (Table III). We also assessed the results according to the severity of the preoperative degenerative changes, graded as described by Eaton and Littler¹³ (Table IV), excluding two for which there were no preoperative radiographs. We found no difference between those with early and moderate degenerative changes, but the only two hands with advanced preoperative degeneration both had poor results.

Discussion

Our findings confirm those of previous reports.^{14,15} There was long-lasting symptomatic relief after metacarpal osteotomy as assessed by similar methods to those in recent reports of other techniques. We compared grip strength with a normal range because 25% of our patients had bilateral surgery, and others had some pain and weakness in their unoperated hand, making a contralateral comparison misleading. Normal grip and pinch strengths are 60% higher in men than in women, and decline gradually after 50 years of age.¹² This should be taken into account when comparing average values from groups of patients with different age and sex distributions. We could not assess improvement in grip strength after surgery because pre-operative measurements were not available, but absolute grip and pinch strengths after this procedure compare favourably with the results published for other techniques in similar groups of patients (Table V).

Many other operations provide satisfactory pain relief but all have certain disadvantages. Simple trapeziectomy is effective,¹⁶⁻²⁶ but results in weakness and instability of the thumb,⁴ with some late failures because of pain from the

Table V. Mean grip strength after operation for trapeziometacarpal arthritis

Series	Technique*	Grip strength (kg)			Gender (%)	Age (yr)
		Power	Key	Pinch		
Varley et al ¹⁶	Trapeziectomy	16.9	3.5	3.7	F	63
Hollevoet et al ¹⁷	Trapeziectomy	18.5	5.6		94 F	62
Dell et al ¹⁸	PL interposition	22.0	4.7		F	63
Menon ¹⁹	FCR interposition	17.7	4.8		91 F	63
Damen et al ²⁰	FCR interposition	22.0	4.4	3.2	91 F	63
Uriburu et al ²¹	FCR ligamentplasty	24.0	5.3		F	63
Tomiano et al ²²	FCR ligamentplasty	24.6	4.9	3.8	83 F	65
Kleinman and Eckenrode ²³	FCR ligamentplasty	18.5	5.1		82 F	62
Swanson et al ²⁴	Silastic interposition	13.6	5.0	3.6	F	60
Cooney et al ²⁵	Total joint replacement	10.7	4.9	2.6	90 F	62
Hobby et al (this series)	Osteotomy	24.0	5.9	4.3	F	63

* PL, pollicis longus; FCR, flexor carpi radialis

scaphometacarpal pseudarthrosis.²⁷ It has been suggested that strength and stability may be improved by soft-tissue interposition⁶ or reconstruction with a stabilising tendon sling,⁷ but these operations have an increased postoperative morbidity^{28,29} and comparative studies have not shown significant advantages over simple trapeziectomy.²⁸⁻³⁰ Trapeziometacarpal arthrodesis provides a stable thumb, but reduces manual dexterity.³¹⁻³³ It requires prolonged immobilisation, the average rate of nonunion is 13%,³⁴ and pain may recur because of degenerative changes in the overloaded scaphotrapezial joint.²⁷

Total joint replacements may become infected and the components may wear. Aseptic loosening may occur, and in the two largest published series^{25,35} fewer than 50% of the prostheses were soundly fixed when reviewed at three and five years. Heterotopic ossification may cause reduced mobility or ankylosis and is seen in over one-third of cases.^{25,36} Silastic implants provide satisfactory relief of pain and grip strength but instability or subluxation of the implant was seen in 25% of Swanson's own series.²⁴ There may be implant fracture and fragmentation^{28,37} and there is progressive wear of the prosthesis,^{37,38} with the risk of a destructive silicone synovitis.³⁷⁻³⁹ Long-term studies report the need for revision in 10% to 35% of patients.^{28,37,38} Such prostheses have no advantage over trapeziectomy with or without a tendon sling.^{7,28,40}

Metacarpal osteotomy provides satisfactory symptomatic relief and restores hand function. It is successful in early and moderate osteoarthritis of the trapeziometacarpal joint but is unsuitable for severe disease or pantrapezial osteoarthritis.

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