

# SILICONE ARTHROPLASTY FOR TRAPEZIOMETACARPAL ARTHRITIS

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**Twenty-three patients who had undergone trapeziectomy and Helal silicone rubber ball interposition for trapeziometacarpal arthritis were reviewed. The average age at operation was 63 (range 48–84) years and the mean follow-up was 59 (range 12–138) months. Of the 23 patients reviewed, two had pain at rest and four had some discomfort on exertion. Mean post-operative thumb extension was 37° whilst mean palmar abduction was 40°. Mean post-operative grip strength was 19 kg and thumb-pinch strength was 4.0 kg, 77% and 78% of the age- and sex-matched normal values. There were no cases of prosthetic dislocation, prosthetic fracture or silicone synovitis.**

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## INTRODUCTION

If conservative measures fail, basal thumb osteoarthritis usually requires trapeziectomy for long-term symptomatic relief. Trapeziectomy alone may result in pain relief but a longer term follow-up by Varley et al. (1994) reports decreased hand span and a reduction in grip and pinch strength. Iyer (1981) also reported shortening of the thumb with subsequent metacarpo-scaphoid degenerative change and carpal instability. In order to attempt to minimize these complications, trapeziectomy has been combined with ligamentous reconstruction, a tendinous “anchovy” or prosthetic implantation.

Considerable forces act at the trapeziometacarpal joint during thumb movements and any prosthesis must be able to withstand these forces without migration (Cooney and Chao, 1977). Eaton's (1979) reported a subluxation rate of silastic trapezoidal implants of 10% at 21 months, whilst Sollerman et al. (1988) reported a 56% rate of subluxation or dislocation in a series of Swanson's prostheses at 144 months. Similarly, Soterianos et al. (1993) reported a subluxation rate of 83% for the Niebauer prosthesis.

The Helal silicone rubber ball spacer, first reported by Grange and Helal in 1983, consists of a silicone elastomer ball with two stems reinforced by a Dacron core. These stems are inserted into the distal pole of the scaphoid and proximal pole of the first metacarpal, conferring intrinsic stability to the implant. A series of 40 implants, with 32 months follow-up, was reported by Helal and McPherson in 1989. Longer term follow-up is required to ensure the Helal prosthesis maintains its stability and to further detail the functional outcome.

In this study, all patients who had a Helal prosthesis inserted by the two senior authors (DHH/PJS) were reviewed and the clinical findings are reported.

## PATIENTS AND METHODS

Between 1984 and 1995, 44 patients had a Helal prosthesis inserted following trapeziectomy for trape-

ziometacarpal arthritis. Thirty-nine of these patients had at least 12 months post-operative follow-up. These patients were contacted and asked to attend for clinical and radiological assessment by a surgeon (SO) and hand therapist (NG). Of the 39 patients, three had died and ten were lost to follow-up. Two patients were unfit to travel and were assessed over the telephone, whilst one patient had recently been reviewed in the clinic. The remainder, 23 patients with 26 prostheses, were all examined and X-rayed.

Both surgeons (DHH/PJS) used a similar operative technique. A palmar–radial incision was made along the line of flexor carpi radialis, extending along the proximal aspect of the first metacarpal. The branches of the superficial radial nerve were identified and protected. The thenar muscles were dissected off the proximal aspect of the metacarpal and the capsule of the trapeziometacarpal joint was identified. A capsular incision was made on the ulnar aspect and the capsule was reflected off the trapezium. The trapezium was removed piecemeal with osteotomes and nibblers. A Paton bur (B. Braun Medical Ltd, Braintree, Essex) was used to establish channels into the distal scaphoid and proximal metacarpal (Fig. 1a) for the stems of the Helal prosthesis (Fig. 1b). On closure, the capsule was reinforced with a distally based slip of flexor carpi radialis. If an adduction deformity was present, an adductor release was performed.

Post-operatively, the thumb was held in abduction with a dressing of thick medical cotton wool and a crepe bandage. This was maintained for 3 weeks and then a post-operative X-ray was taken (Fig. 1c). There was no requirement for plaster or K-wire immobilization. The average operation time for the reported cases was 59 min.

The same hand therapist (NG) administered all the assessment tests in a standardized order. Each patient was asked about pain at the base of the thumb and, if present, the specific activities which would be painful. The range of extension and palmar abduction were measured with a goniometer, using the angle between

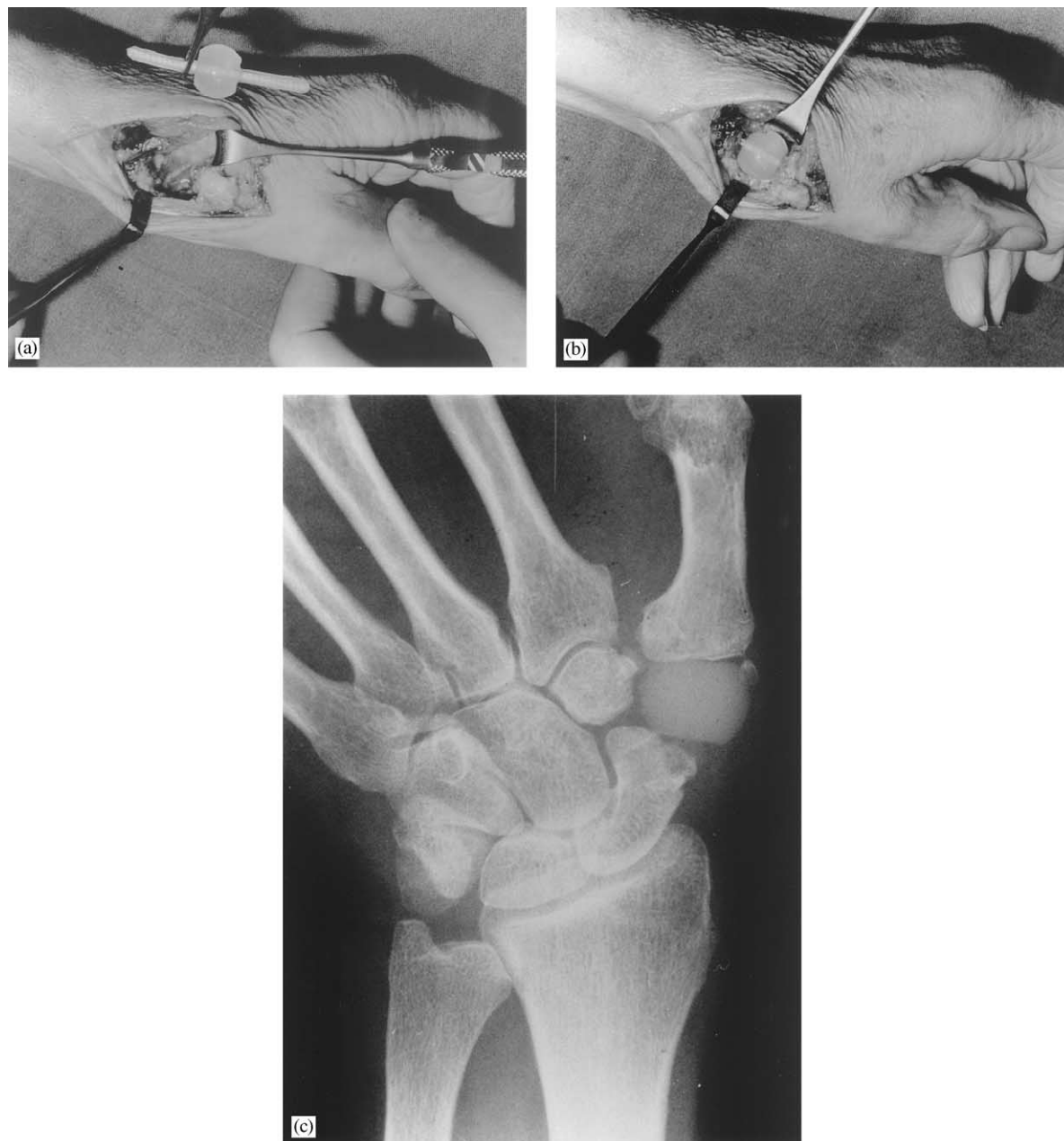


Fig 1 (a) The trapezium excised, the Helal prosthesis is ready for insertion. (b) The Helal prosthesis in situ. (c) Post-operative X-ray.

the first and second metacarpals. Opposition was measured by observing the thumb attempting to touch ten anatomical landmarks (Kapandji, 1986). A Jamar hand dynamometer (Sammons Preston, Bolingbrook, IL, USA) was used for grip strength and the B&L Engineering Pinch Gauge (Pinsco Inc., Santafe Springs, CA, USA) was used to test pure pinch (tip-to-tip) and lateral pinch (key) strength (Gilbertson and Barber-Lomax, 1994). All three measurements were performed using recommendations from the American Society of

Hand Therapists. For comparison, all measurements were repeated for the opposite, non-operated hand. In addition, all strength results were compared to an age- and sex-matched normal population.

The Moberg pick-up test (1958) was used to measure dexterity and a key turning task was used to assess grip style. Five standardized resistance pegs, with resistances between 0.45 kg and 3.6 kg, were also used to observe patients' grip style when removing and replacing pegs from a rail.

## RESULTS

The 23 patients consisted of 20 women and three men with an average age 63 (range 48–84) years and an average follow-up of 59 (range 12–138) months. Four patients had undergone bilateral surgical procedures, one within the last 12 months. In the 19 patients who had had unilateral surgery, ten had had this performed on the dominant hand.

Although not in the assessed group, one patient had the prosthesis removed within 6 months of insertion for uncontrollable pain. This was not relieved by removal of the prosthesis. Of the 23 patients, six (26%) complained of significant post-operative pain. Two were generally tender and painful at rest, but not functionally limited. Two complained of pain on grip testing and two on pinch testing. We specifically enquired about pain at the basal region of the thumb and it was often found that the pain experienced was outside this area, for example at the thumb interphalangeal joint or wrist.

Radiographs revealed no evidence of any prosthetic dislocation, fracture or cold-flow and there was no evidence of any osteolysis developing around the prosthetic stems. Fig. 2 shows a follow-up X-ray taken at 138 months. The Helal prosthesis appears a little subluxed but was clinically stable, emphasizing the importance of the Dacron core stems. There are no records of any prosthetic abnormality in the one implant removed after 6 months.

Unfortunately, there were no comparative pre-operative assessment values – the main limitation of this retrospective study. However, the ranges of movement for opposition, extension and abduction were all similar to the non-operated hand and compare favourably to previous reports (Tables 1 and 2). Mean grip strength was 19 kg (95% CI, 16–22 kg) in the operated hand, 77% of the “normal” value and 20 kg (95% CI, 16–24 kg) in the non-operated hand (82%). Mean tip-pinch strengths were 4.0 kg (95% CI, 3.5–4.5 kg) (78%) and 5.0 kg (95% CI, 3.7–5.5 kg) (88%) whilst mean lateral pinch was 5.0 kg (95% CI, 4.0–5.4 kg) (76%) and 6.0 kg (95% CI, 4.8–6.6 kg) (82%), respectively.



Fig 2 Follow-up X-ray at 138 months. There is some subluxation at the proximal end of both prostheses but the intra-osseous stem of the implant maintains stability. Note the length of the first ray is maintained and there are no peri-prosthetic radiological changes.

The results for the Moberg test showed little difference between the operated and non-operated hands (Table 1). All but two patients were able to remove all of the resistance pegs from the rail. If present, compromised styles were usually consistent between the sides.

## DISCUSSION

Trapeziometacarpal arthritis is a common disease, mostly affecting the post-menopausal female. Treatment using a “ball-and-socket” surface arthroplasty remains popular. The most commonly reported is the De la Caffinière prosthesis which provides reasonable range of movement and strength. However in Boeckstyns et al.’s (1989) series, 23% required revision for loosening by 48 months. Due to a failure to reproduce the physiological axis, Wachtl et al. (1998) concluded that designs based

Table 1—Post-operative findings

	Opposition (mean) (/10)	Extension (deg)	Palmar abduction (deg)	Grip strength <sup>3</sup> (kg) (%)	Tip-pinch <sup>3</sup> (kg) (%)	Lateral pinch <sup>3</sup> (kg) (%)	Moberg pick-up (s)
Operated <sup>1</sup> (23)	8.5 <sup>2</sup>	37°	40°	19 (16–22) 77%	4.0 (3.5–4.5) 78%	5.0 (4.0–5.4) 76%	11.9
Control <sup>1</sup> (19)	8.5 <sup>2</sup>	37°	41°	20 (16–24) 82%	5.0 (3.7–5.5) 88%	6.0 (4.8–6.6) 82%	12.0

<sup>1</sup>The operated group includes four patients with bilateral prostheses, one of whom had had a procedure less than 12 months prior to assessment. This left 23 patients with 26 “operated” hands. There were 19 “control” hands.

<sup>2</sup>Between the PIP crease and proximal crease of the little finger.

<sup>3</sup>All strength measurements are represented by the mean figure obtained on testing (with 95% confidence intervals) and a percentage value compared to the age- and sex-matched normal value.

**Table 2—Summary of reported results for trapeziectomy and insertion of a Helal rubber ball spacer**

<i>Implant</i>	<i>Author (year)</i>	<i>Patients/implants (nos.)</i>	<i>Follow-up (months)</i>	<i>Revised (%)</i>	<i>Extension (deg)</i>	<i>Abduction (deg)</i>	<i>Pinch strength (kg)</i>	<i>Grip strength (kg)</i>
Excision	Iyer (1981)	18/26				75%	27%	23%
	Varley et al. (1994)	30/34	60		45	Normal <sup>1</sup> 40	Normal <sup>1</sup> 3.8 – tip 3.7 – key	Normal <sup>1</sup> 18.3
Helal	Grange and Helal (1983)	22/25	14	28		52%	88%	84%
	Helal and McPherson (1989)	31/40	32	12.5		Normal <sup>1</sup>	Normal <sup>1</sup> 85%	Normal <sup>1</sup> 87%
	Present study (2002)	23/26	59	0	37	40	Normal <sup>1</sup> 4.0 – tip (3.5–4.5) (78%) 5.0 – key (4.0–5.4) (76%) <sup>2</sup>	Normal <sup>1</sup> 19 (15.6–22) (77%) <sup>2</sup>

<sup>1</sup>Compared to the opposite thumb.

<sup>2</sup>All mean strength measurements for the current study are also given as a percentage of the value for an age- and sex-matched population.

on a ball-and-socket principle are not suitable for replacement of the trapeziometacarpal joint.

There are reports of metacarpal osteotomy, carpo-metacarpal joint arthrodesis and silicone interposition arthroplasty. However, the nature of the multi-articular trapezium and the high rates of synchronous scapho-trapezial arthritis seem to suggest that excision of the whole trapezium should be recommended for long-term symptomatic relief.

In a review of isolated trapeziectomy, Varley et al. (1994) highlighted that this particular procedure did not have the complications associated with more complicated surgery, such as silicone synovitis or implant loosening. However the results still show that, even at 60 months, 53% of patients still had some degree of discomfort. In addition, key and pinch strengths were lowered by 23% and 17% in comparison to the unoperated side and uncertainty remains over the long-term incidence of degenerative change at the scaphotrapezial pseudarthrosis.

All prosthetic implants will have their own particular complications, and prosthetic instability may be secondary to implant design or inadequate soft-tissue constraints. Both the Eaton and the Niebauer “tie-in” silastic prostheses were attempted to improve stability but their longer term rates of subluxation and instability are disappointing. It is now almost routine for a capsular reinforcement procedure to be performed at most operations. The inherent stability of the Helal prosthesis is demonstrated by this study and the range of motion achieved compares favourably with other prostheses. Longer follow-up may reveal subluxation of the prostheses but, due to the presence of the stems, this should be stable. In our study, which had a follow-up of 59 months, there were no clinical or radiological signs of silicone synovitis.

Following insertion of a Helal prosthesis, grip strength is 77% of a normal age- and sex-matched population. The results for tip and lateral pinch were 78% and 76%, respectively. Similar results for the non-operated hands probably reflect asymptomatic involvement of the contra-lateral thumb. These results are very similar to those presented by Helal in 1989 (Table 2). When compared to the results for trapeziectomy presented by Varley et al. (1994) the grip and tip pinch strengths were similar with a small improvement in the key pinch strength. However, comparison to earlier reports and other prostheses is hindered by the use of different assessment criteria and techniques.

Trapeziectomy and insertion of a Helal spacer results in good post-operative strength and ranges of motion in a relatively low-demand, aging population. There have been no reports of silicone synovitis and, in our series, only one prosthesis required removal. Twenty-six per cent of patients had some degree of post-operative pain, mostly on exertion. The incidence of post-operative pain has been variably reported and makes comparison between studies difficult.

The advantages of the Helal prosthesis are its ability to maintain the length of the thumb, with its theoretical beneficial effect on strength, and provide greater stability without any compromise on the range of movement. The prosthesis itself is inserted with a simple operative technique, which does not require any additional post-operative splintage. We believe that the Helal silicone rubber ball spacer is a safe and reliable prosthesis for use in advanced trapeziometacarpal arthritis.

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