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THE ACRYLIC SCAPHOID PROSTHESIS IN THE TREATMENT OF THE UNUNITED CARPAL SCAPHOID FRACTURE

By

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The numerous recommended methods of treatment of ununited fractures of the carpal scaphoid bone underline the problem of management of this condition and have been summarized by *Agner* (1963).

Having had promising results in the excision of the necrotic carpal lunate and its replacement with an acrylic prosthesis, (*Agerholm & Goodfellow* 1963), it was natural to consider a similar procedure for ununited fractures of the carpal scaphoid. There are two difficulties one has to remember.

First of all the shape of the scaphoid is far more complicated than that of the lunate. It is therefore far more difficult to find a suitable fitting prosthesis.

Secondly the position of the scaphoid in the carpal row is not as stable as that of the lunate. The latter is very well supported by the neighbouring bones and even during operation the lunate prosthesis is quite stable in the open wound. Furthermore, after lesions such as fractures and sprains, it is likely that the capsule and ligaments of the scaphoid which normally keep the bone in its proper place have suffered. However, one of us (J.C.A.) decided to try this procedure in patients with old ununited fractures of the scaphoid and marked osteoarthritic changes, giving so much trouble that the patients were prepared to accept arthrodesis of the wrist, and in more recent fractures, with avascular necrosis of the proximal fragment.

The purpose of this paper is to give an independent assessment (M.L.H.L.) of this method of treatment.

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TECHNIQUE

The Prosthesis

This is made in moulds taken from cadaveric bones. A number of different prosthesis are available.

The Operation

The scaphoid bone is excised through a lateral longitudinal incision between the long and short extensor tendons of the thumb. X-ray control (including oblique views) is used during the operation to ensure that the correct carpal bone is removed and that no fragments remain. The prosthesis that fits best is inserted. Post-operatively the wrist is immobilized in a plaster cast for between two and three weeks—average 17 days. Active movements and an early return to work are then encouraged.

MATERIAL

16 patients (17 wrists) were available for review. Of these, two patients had to have the prosthesis removed—one only four months after insertion because of its dislocation anteriorly: (this is the only example of dislocation of the prosthesis in a total of 22 wrists) the other because the prosthesis fractured after five years, though prior to this the wrist had been unsatisfactory, requiring several operations to remove osteophytes and the styloid process of the radius, and ending by arthrodesis.

One patient could not be traced, leaving 13 patients (14 wrists) available for review. These have all been examined personally by M.L.H.L. and X-rays taken.

The wrists of 12 men and 2 women were affected. In 9 cases the right hand was affected. The dominant wrist was affected in no less than 8 patients. In only two wrists (patients numbeer 2 and 4) was the fracture recent, treatment in a plaster cast until operation preventing a preoperative assessment of the range of movement.

Table 1 gives some particulars of the patients and the results of treatment.

RESULTS

Pain

Only 4 wrists were completely painless. The 10 painful wrists were evenly distributed between the various types of work, the dominant wrist being painful in 6 cases. This pain was not constant but was brought on by strains, jarring and if movements were forced to the limit. However, all patients said they were satisfied and that their symptoms had been improved by the operation. None had changed their occupation as a result of the operation.

Movement

There was no adequate record of the pre-operative range of movement in three of the wrists (Patients No. 2, 4, and 14) all of which had a good range of movement on review. Of the 11 wrists with good pre-operative

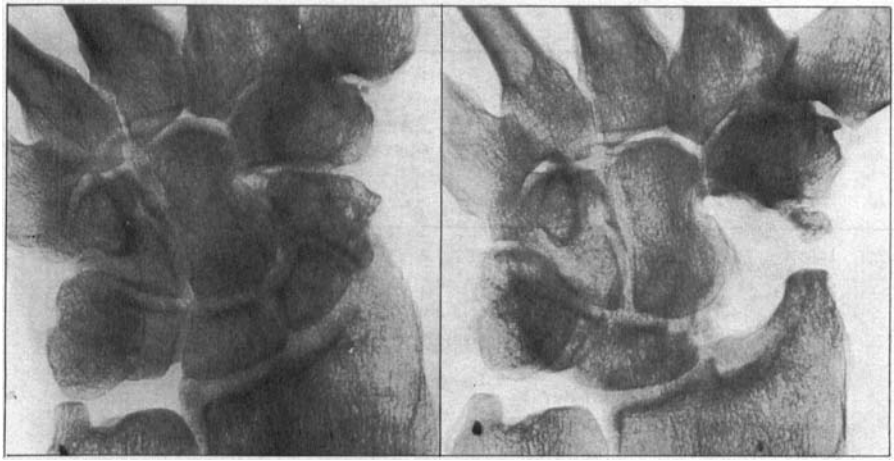

Figure 1. Patient No. 7 pre-operatively, and over 5 years following replacement of the scaphoid by an acrylic prosthesis. Note the post-operative subluxation of the capitate on the lunate and the residual bony fragments.

recoords, there was no significant change in movement except for Patient No. 7 who suffered a marked loss of movement perhaps due to the degree of carpal collapse (Fig. 1) following operation, though this does not seem to have affected the range of movement in Patients No. 1 and 14 who also suffered some post-operative carpal collapse.

It is striking how in several patients a remarkably good range of abduction and adduction was retained despite moderately severe restriction of flexion and extension.

There was no association between the range of movement and the presence of pain.

Power

By the use of a pinch gauge, the pinch between the thumb and finger, and that between the thumb and isolated index finger can be estimated with reasonable accuracy, and compared with the power in the normal hand.

This comparison could not be made in four wrists, as one patient (Nos. 5 and 11) had had the operation bilaterally, and two (Nos. 1 and 13—Fig. 2) had disabling conditions of the opposite wrist. Because of this the grip of the affected hand has been estimated as a percentage of the average grip of the normal hands of the patients under review (Table 1).

TABLE

Patient	Sex	Occupation	Age at operation	Years of symptoms operation before	Follow-up (years and months)	Some pain
1.	♂	Engineer	27	20+	8–1	Yes
2.	♀	Housewife	64	⅛	6–1	Yes
3.	♂	Labourer	55	20+	5–9	No
4.	♂	Medical Practioner	37	1	5–5	Yes
5.	♂	Joiner	43	10	5–3	Yes
6.	♂	Painter	54	20+	5–3	No
7.	♂	Bricklayer	59	20+	5–1	No
8.	♂	Labourer	44	20+	4–10	Yes
9,	♂	Chairmaker	49	3	3–10	Yes
10.	♂	Engineer	28	8	3–8	Yes
11.	♂	Joiner	45	10	3–4	Yes
12.	♀	Housewife	34	20+	3–4	Yes
13.	♂	Brewery hand	26	5	1–6	Yes
14.	♂	Publican	51	20+	1–6	No

Only the wrists of patients No. 2, 8, 11 and 12 were below 80 per cent of the average normal power, though the thumb/finger grip of patient No. 4 was reduced. Patients 2 (Fig. 3) and 12 were both women and may reasonably be expected to have a grip below the average power, in fact the grip of patient 2 was about equal to that of her normal hand, though in patient 12 it was significantly reduced without obvious cause other than marked osteoarthritic changes. Patients 8 and 11 also had marked degenerative changes; however, patients 5 and 6 had marked degenerative changes without severe loss of grip.

Durability

Deterioration with time was not apparent. No patient recalled any change of symptoms after the first year following operation. It is interesting that the first four patients in Table 1 have the best range of movement despite the length of time since insertion of the prosthesis, patients 2 (Fig. 3) and 4 showing no osteoarthritic changes 6 and 5½ years following operation.

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on review Flexion	on review Extension	Abd/Add as fraction of normal	Pre- and post-operative degree of osteo-arthritis	Carpal Collapse Pre-op	Carpal Collapse Follow-up	Power as % of average normal power Pinch	Power as % of average normal power Thumb Index
60	40	½	+	No	Yes	112	160
60	60	1	No	No	No	76	75
70	40	½	+	No	No	107	94
65	65	¾	No	No	No	87	66
25	50	¾	++	No	No	82	85
—	10–30	¼	++	Yes	Yes	97	113
30	30	¾	+	No	Yes	112	105
30	30	¾	++	No	No	56	60
45	60	¾	+	No	No	92	71
25	25	½	+	No	No	82	94
45	25	¾	++	Yes	Yes	66	75
30	30	¾	++	No	No	61	38
45	50	¾	No	No	No	87	104
70	45	1	+	No	Yes	112	85

RADIOLOGICAL APPEARANCES

Osteoarthritis

This was assessed by the degree of 'spiking' of the styloid process of the radius and by the presence of osteophytes on the dorsal and palmar margins of the radius as seen on lateral radiographs.

It was considered to be marked in 5 wrists (Fig. 4), absent in 3 wrists (Figs. 2 and 3), and only slight in 6 wrists. In no patient did it appear to have altered in degree as a result of the operation.

TABLE 2

Severity of osteoarthritis	Average flexion plus extension movements
Marked	57°
Slight	90°
Absent	115°

A direct relation between the degree of osteoarthritis and the range of flexion and extension was found, as is shown in Table 2. It did not

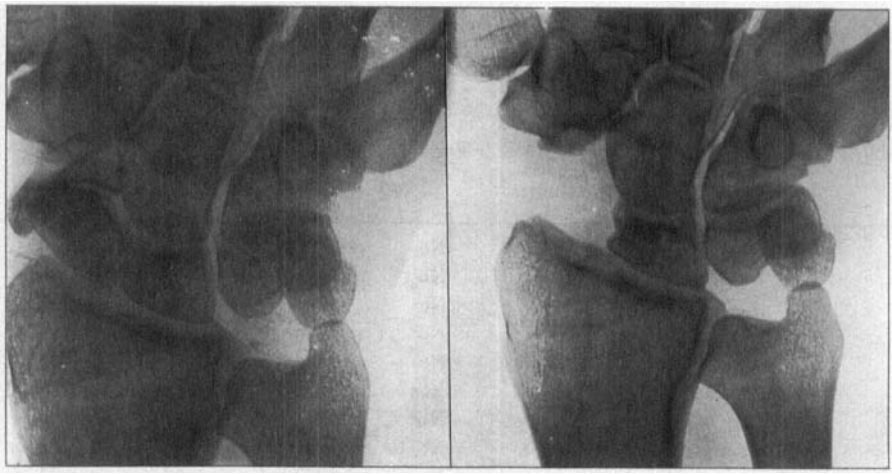

Figure 2. Patient No. 13 pre-operatively, and 18 months following operation. Note the lack of arthritic changes, and the maintenance of the normal carpal relations.

seem to be related to carpal collapse (Table 1). The degree of osteoarthritis was largely related to the duration of symptoms prior to operation (Table 1).

Carpal Collapse

This was considered to have taken place if there was either incongruity of the articulation between the capitate and the lunate, or if the distance of the proximal pole of the capitate from the radius had diminished, or else a combination of these two factors was present (Fig. 1). Collapse was present in 5 wrists on review, but was present before operation in 2 of these. These 5 wrists were not found clinically different from the wrists that showed no collapse.

New Bone Formation

Despite care taken during operation to try and ensure removal of the whole of the scaphoid, in 8 cases some bone fragments were visible on post-operative X-rays, usually lying in an antero-lateral position (Fig. 1). In a further case the actual proximal pole of the fractured scaphoid was, in error, not removed (indicating the need for careful radiographic control), a prosthesis being none the less inserted. The satisfactory result here is perhaps due to the marked restriction of movement, which was present even before operation (Patient No. 6).

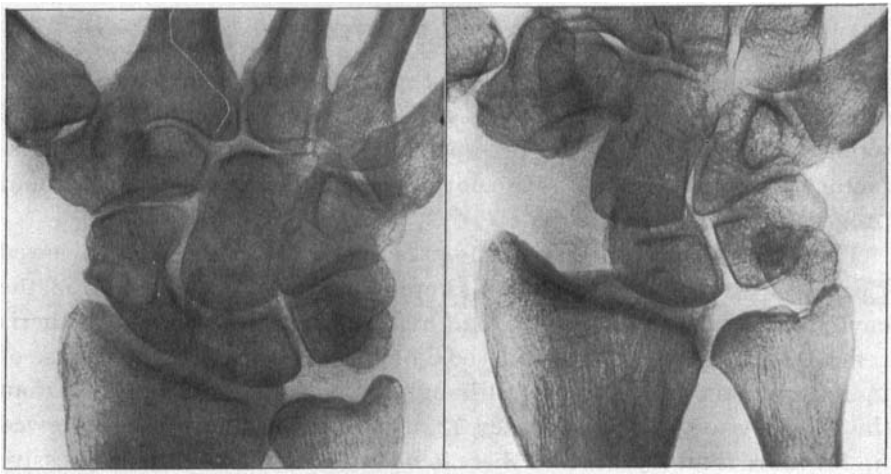

Figure 3. Patient No. 2 pre-operatively, and over 6 years following operation. Note the lack of arthritic changes, and the congruity of the articulation between the capitate and the lunate.

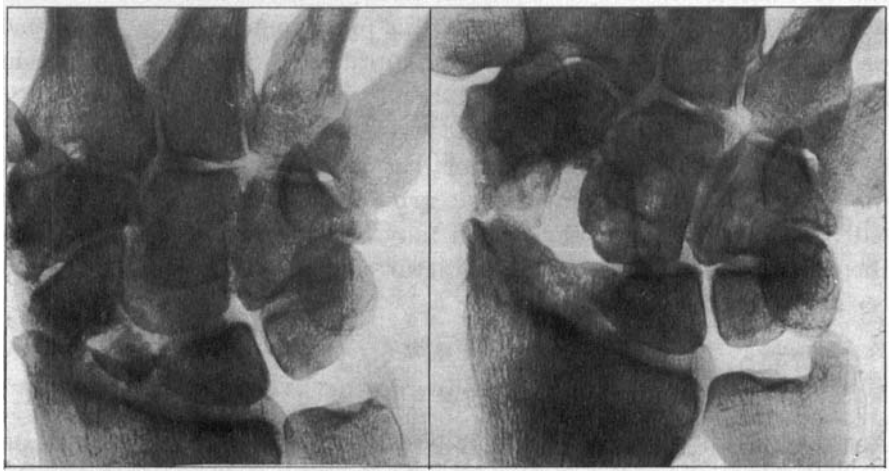

Figure 4. Patient No. 5 pre-operatively, and over 5 years following operation. Note the equally marked arthritic changes before and after operation, and the post-operative mass of bone fused to the proximal part of the trapezium.

The X-rays, on review in all these cases showed consolidation of these post-operative bony fragments.

These were not large or of apparent significance except for patients No. 5, 8 and 10 where they had fused with the trapezium and may have been a factor in the limitation of the wrist movement (Fig. 4).

CONCLUSIONS

In our experience, replacement of the ununited fracture of the scaphoid by an acrylic prosthesis gave satisfactory results in 14 of 16 wrists with retention of the pre-operative range of movement, a satisfactory grip, maintenance of the normal carpal relationship and without progression of osteoarthritis.

This is in direct contrast to the experience of *Agner*, who reviewed 7 cases in whom the scaphoid was replaced by an acrylic mould of the cavity in a two stage procedure. 5 of his cases had to have the prosthesis removed and the wristt arthrodesed 6 months to 3 years later because of increasing pain and stiffness. Although the period of review is less than the 9 to 11 years of *Agner*'s cases, 12 of our patients have been followed up for more than 3 years and there is no indication that any progressive deterioration is taking place. It is not easy to account for these different results, but it is possible that a cause of the marked periarticular fibrosis found by *Agner* is due to the double operative procedure rather than to the acrylic material itself, which can suffer minimal wearing forces in this non-weightbearing joint. In addition, a preformed prosthesis of normal anatomical configuration is more likely to retain normal carpal relationships and therefore better functional results.

Our findings indicate that acrylic replacement of the carpal scaphoid is a useful procedure and may well be recommended if retention of mobility is desired and arthrodesis avoided. It is worth a trial even if osteoarthritis is established, and it may also be considered suitable in the early treatment of scaphoid fractures of the elderly as the period of immobilisation is short.

SUMMARY

An anatomically modelled acrylic prosthesis was used to replace an ununited fracture of the scaphoid in 16 wrists injured between 3 months and 20 years previously. Two wrists required arthrodesis—one after 4 months through dislocation of the prosthesis, and one after 5 years because of pain and stiffness of the wrist and fracture of the prosthesis. 14 wrists were reviewed between 1½ and 8 years after operation (7 were seen over 5 years after operation). 4 wrists were painless, and the other 10 suffered only minor pain after heavy stress. The 14 patients retained their pre-operative movements, had a good grip, and osteoarthritis did not progress. 11 wrists maintained their carpal relation-

ships. The procedure is considered valuable in late cases of non-union and in more recent injuries of the elderly.

RESUME

Une prothèse acrylique modelée anatomiquement a été utilisée pour remplacer une fracture non soudée du scaphoïde dans 16 lésions du poignet intervenues entre 3 mois eet 20 ans auparavant. Deux poignets ont demandé l'arthrodèse – l'un après 4 mois par suite de la dislocation de la prothèse et l'autre après 5 ans par suite de douleurs, de rigidité du poignet et de fracture de la prothèse. 14 poignets ont été soumis à un nouvel examen entre 1½ et 8 ans après l'opération (7 avaient été opérés depuis plus de 5 ans). 4 poignets ne présentaient pas de douleurs et les autres souffraient seulement de douleurs légères après un grand effort. Les 14 malades ont regagné leurs mouvements pré-opératoires, avec une bonne faculté de saisir et l'ostéoarthrite ne fit pas de progrès. 11 poignets ont maintenu leurs contacts carpiens. La procédure est considérée avoir de la valeur dans les cas tardifs de non-soudure et dans les lésions plus récentes chez les personnes âgées.

ZUSAMMENFASSUNG

Eine anatomisch modellierte Akrylprothese wurde verwendet, um nichtgeheilte Navikularebrüche bei 16 Handgelenken, die zwischen 3 Monaten und 20 Jahren vorher geschädigt worden waren, zu ersetzen. Zwei Handgelenke erforderten Arthrodese – eines nach 4 Monaten wegen Luxation der Prothese und ein anderes nach 5 Jahren wegen Schmerzen und Steifheit des Handgelenkes und Bruch der Prothese. 14 Handgelenke wurden von 1½ bis 8 Jahren nach der Operation nachuntersucht (7 waren 5 Jahre nach der Operation). 4 Handgelenke waren schmerzlos und die anderen 10 hatten nu geringe Schmerzen nach starker Anstrengung. Die 14 Patienten behielten ihre voroperative Beweglichkeit, hatten einen guten Griff und die Osteoarthritis schritt nicht fort. 11 Handgelenke behielten ihre carpale normale Lage bei. Das Vorgehen wird in späten Fällen von Nichtheilung und bei neueren Verletzungen von älteren Patienten als wertvoll angesehen.

ACKNOWLEDGEMENTS

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