Resection of the proximal row of the carpus. A review of 45 cases

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Summary. *The authors present a review of 45 proximal carpectomies performed for various reasons between 1986 and 1995. The pre- and postoperative assessment was clinical and radiological, and the intra-operative analysis was based on the status of the cartilage of the radio-lunate joint, and of the head of the capitate. Postoperative assessment was based on the bio-mechanical behaviour of the wrist after surgery. At the final follow-up, the authors noted that pain was improved in 90% and functional movement was preserved in 70% of patients. There was approximately 20% loss of strength when compared to the opposite hand.*

Résumé. *Les auteurs présentent une série de 45 cas de résection de la première rangée des os du carpe, opérés de 1986 à 1995, pour des étiologies diverses. L'analyse pré- et post-opératoire, clinique et radiologique, est corrélée à une analyse pré-opératoire du cartilage de la fossette lunarienne du radius et de la tête du grand os et enfin une étude biomécanique avec les changements qui se produisent au niveau du poignet après que la résection de la première rangée ait été effectuée. Les auteurs ont obtenu une amélioration de la douleur de 90% et une conservation de la mobilité utile pour 73% des personnes opérées tout en notant une perte de force de 20% en moyenne par rapport au côté sain.*

Introduction

Resection of the proximal row of the carpus, with removal of the scaphoid, lunate and triquetrum is an operation which has been used since the start of the 19th century. Although it has not been accepted by all surgeons it is practised from time to time, particularly as a salvage procedure. It is useful for painful wrists with arthritis, or with bone or ligamentous instability, but it can be difficult to decide the exact timing of the operation in order to secure the best long-term results.

Watson's classification [32] is used to define the stages of carpal instability associated with degenerative arthritis. He considered the scapho-lunate advanced collapse (SLAC) wrist to have three stages:

- Grade I Degenerative arthritis between the scaphoid and the radial styloid;
- Grade II Degenerative radio-scaphoid arthritis;
- Grade III Degenerative radio-scaphoid arthritis with osteoarthritic lesions between the head of the capitate and the lunate.

Pre-operative examination including MRI scanning, arthro-scanning and arthroscopy, together with intra-operative observations of chondromalacia or of arthritic lesions at the radio-lunate joint, has resulted in the need to enlarge Watson's classification so as to define more clearly the best time to excise the proximal row of the carpus. Grade IIIA corresponds to Watson's Grade III, but Grade IIIB has the addition of chondromalacia between the radius and the lunate. In Grade IV there is a degenerative arthritis at the radio-carpal and the inter-carpal joints.

Table 1. Permanent post-traumatic instability of ligamentous origin in 23 cases

Confirmed posterior lunate dislocation	1
SLAC wrist Grade I	1
SLAC wrist Grade II	13
SLAC wrist Grade III (III A = 5, III B = 3)	8
<i>Total</i>	<i>23</i>

Table 2. Permanent instability of osseous origin in 22 cases

<i>Semi-lunar origin</i>		10
Kienbock's disease:		
SLAC wrist Grade I	4	
SLAC wrist Grade III A	3	
SLAC wrist Grade III B	2	
Post excision of lunate:		
SLAC wrist Grade IV	1	
<i>Scaphoid origin</i>		12
Preiser's disease:		
SLAC wrist Grade I	1	
SLAC wrist Grade II	2	
Pseudoarthrosis:		
SLAC wrist Grade II	6	(III A)
SLAC wrist Grade III A	2	(III B)
SLAC wrist Grade III B	1	(IV)
<i>Total</i>		<i>22</i>

Materials and methods

There were 45 cases in our series who were operated upon between 1986 and 1995, with 33 men and 11 women. The average age was 45 years (from 23–71 years). Average follow-up was 30 months (from 1 to 7 years), and 20 were heavy labourers who had been injured at work.

Pain with loss of movement and loss of grip resulting from secondary osteoarthritis with bone or ligamentous instability was the indication for excision of the proximal row of the carpus (Tables 1 and 2). All the patients experienced significant disturbance in their activities (Table 3), and 10 suffered severe disabling pain. All the patients had limitation of flexion and extension, with loss of radial and ulnar deviation. On average there was 31° of extension and 37° of flexion (i. e. an arc of 68°), and 15° of radial and 25° of ulnar deviation. Pronation and supination were normal. There was an average of 40% loss of power measured with the Jamar apparatus when compared to the normal side. Investigations included static and dynamic radiography and more recently we used MRI or an arthro-scanner.

The wrist is approached by a dorsal and median "bayonet" approach extending along the third ray. The dorsal annular ligament is divided in relation to the extensor to the ring finger, and the posterior interosseous nerve is divided just proximal to the articular branch of the inferior radio-ulnar joint. This allows exposure of part of the radio-carpal joint, including the radio-lunate articulation and the head of the capitate. In our series we found 11 cases with partial cartilaginous lesions of the head of the capitate, 3 with such lesions on the radial surface of the radio-lunate joint, and 3 with similar abnormalities of the head of the capitate and of the radial surface of the radiolunate joint. In all of these there was also radiological degenerative arthritis of the radioscapoid joint.

Table 3. Pre-operative pain

Painless	0
Minimal (+/- occasional when stressed)	0
Intermittent (everyday movements)	19
Important	16
Permanently disabling	10
<i>Total no. cases</i>	<i>45</i>

Table 4. Post-operative pain

Painless	22
Minimal (+/- occasional when stressed)	12
Intermittent (everyday movements)	7
Important	1
Disabling and permanent	0
<i>Total no. cases</i>	<i>42</i>

Table 5. Long-term mobility

0°–30°	3
30°–50°	8
50°–70°	20
70°–90°	4
above 90°	7
<i>Total no. cases</i>	<i>42</i>

The articular capsule is incised in a "T" fashion, and the scaphoid, lunate and triquetrum are removed. The capsule and annular ligament are then sutured after ensuring that the capitate is positioned in the lunar "socket" of the radius. The wrist is immobilised with an anterior plaster splint for 3–4 weeks, but movement is allowed from day 15.

Results

There were 3 failures with sufficient residual disabling and permanent pain to justify further surgery such as a radio-carpal arthrodesis. One patient had a post-traumatic osteoarthritis of SLAC IIIB type secondary to a scapho-lunate instability which had been treated by a scapho-lunate arthrodesis. Another had non-union of the scaphoid with osteoarthritis and necrosis, classified as SLAC IIIB. The third was an old posterior-lunate dislocation with necrosis of the lunate which had been treated elsewhere by excision and which was classified as a Grade IV.

At operation in all these three cases cartilaginous lesions were found both on the head of the capitate and on the radial surface of the radio-lunate joint. These three patients had relief from pain for 6–12 months, but it then returned and it was necessary to perform wrist fusion some 12–24 months later.

Fig. 1 a. SLAC wrist Grade II associated with an old non-union of the scaphoid. **b–e** Results of the resection of the proximal carpus after 4 years. The wrist is painless with good motion correlated to the dynamic stereotype

Our medium term results (average of 30 months) have been analysed as follows:

Pain

Thirty-four patients reported that their pain had improved by about 90%. Intermittent pain was still experienced by 7 patients when the wrist was stressed, and 1 suffered permanent pain following a period of improvement.

Mobility

A reasonable and useful range of movement was preserved in the majority of patients, with an average of 30° of extension, 31° of flexion, and 10° and 20° of radial and ulnar deviation. Overall there was a loss of 7° of flexion-extension, but 7 patients had either a total range of more than 90°, or a gain of 30° when compared to the pre-operative movement. A flexion-extension range of 50° with 25° of flexion and of extension is considered useful, and this was present in 31 of our patients. A combined range (30°–50°) occurred in 8 patients.

Fig. 2 a. Immediately after operation in plaster. **b, c** Six months and 2 years after operation. **d** Variations of the dimension of the capitate corresponding to the relation C/C' in 7 cases with a follow-up of over 3 years

Strength

Grip strength measured with the Jamar apparatus improved on average by 30% after operation, to about 80° of the opposite normal side. This may take 3 or 4 years to appear after surgery, but only 2 patients regained a similar grip in both hands.

Radiology

No alteration of the radio-capitate joint space was noted in 32 wrists (Fig. 1). In 9 there was an isolated decrease of 50% in the joint space. Only 1 patient developed painful osteoarthritis of SLAC Grade IIIB, secondary to a scapho-lunate instability, with cartilaginous lesions on the head of the capitate and the radial surface of the lunate. In the 11 cases with cartilaginous lesions at the level of the head of the capitate, there were no bad clinical results despite radiological narrowing of up to 50% of the joint space. On the other hand, in the 6 cases where there were lesions of the radial side of the radio-lunate joint the prognosis was poor in 4, and average in 2, because of pain during normal movement and less than 30° mobility.

Further interesting radiological findings were noted. For example, Youm and MacMurty's measurement of the "height" of the carpus is reduced after resection; the head of the capitate is displaced a little anteriorly and lies in the shelter of the lower end of the radius. The long-term slight modification of the shape of the capitate, with an enlargement of the head, and decrease in its "height" results from the new forces to which it is subjected (Fig. 2). There is radial displacement of the pisiform, and a verticalisation with rotation of between 4–6° of the base of the 4th and 5th metacarpals. These last two points are of considerable interest and have not been previously reported.

In general, at an average of 30 months after excision of the proximal row of the carpus, 39 of the 40 patients (41 wrists) were either satisfied or very satisfied, although 3 had required a further operation for fusion of their wrist.

The average time off work was two and a half months, with a spread from 2 weeks to 2 years, and

depended on the occupation of the patient. Thirty patients were able to return to their original activities but of 12 manual labourers, 6 were re-graded and 6 had retired.

Discussion

Resection of the proximal row of the carpus decreases pain, preserves movement and results in a useful and reasonably strong wrist. There are several series in the literature [2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 20, 21, 22, 24, 28, 30], but these often lack important information, and may not be strictly comparable. These authors note a 70% improvement in pain, flexion-extension of 60–70°, and strength of between 30–40% of the opposite side. However, the operation had been performed for a variety of reasons, including rheumatoid arthritis, a condition generally considered to be a contra-indication to this procedure [1, 8, 16, 17, 18, 19, 27, 31].

We have found an improvement in pain of about 90%, a loss of 7° flexion-extension, and a loss of about 20% power when compared to the opposite side. We have found that 73% of the patients have more than 50° of movement and 19% between 30°–50°.

After resection of the proximal row it is rare to find more than 60° of extension, as the capitate is in contact with the dorsal surface of the radius. Flexion is limited to 70° as the trapezium strikes the anterior margin of the radius [15, 20, 25, 29]. Similarly, radial deviation is limited to 10° as movement of the trapezium is blocked by the radial styloid. Ulnar deviation is also reduced by 50%.

Decrease in strength follows reduction in the “height” of the carpus and the relative lengthening of the long tendons.

In the 4 cases with severe loss of joint space and osteoarthritis, there were cartilaginous lesions on the head of the capitate, and especially on the radial surface of the lunate.

The long-term modifications of the length at its head (C') and width (C) of the capitate have been studied, and found to accord to Wolf's law which appeared in 1870 and states that bones which are compressed will change their shape.

The average value of C/C' was 0.54 pre-operatively, and 0.65 after operation in the 7 patients with a follow-up greater than 3 years (Fig. 2). This is a result of the different forces which act on the capitate in its new position, reducing its length and increasing its width. At the same time the range of flexion-extension improves. The normal elasticity

of bone allows some adaptation of shape within certain limits (Hooke's law), but if these are exceeded then the bone structure will suffer. The new contact surface is about 10 times smaller than normal, and this will result in a 10-fold increase in the longitudinal force which in turn increases 10-fold the likelihood of damage to the cartilage. Therefore, it is important to advise patients to spare their wrists, as otherwise they will wear out faster than normal. Pre-existing cartilaginous lesions of the radial side of the radio-lunate joint, particularly when associated with injuries of the head of the capitate, lead rapidly to osteoarthritis. This combination was found in 6 of our patients and gave a bad functional result in 4. Thus we believe that wrists in SLAC Grade IIIB, or in Grade IV, should not be treated by resection of the proximal row of the carpus.

Problems arising from capsulo-ligamentous structures are also important, and from anatomical dissection studies we have confirmed the importance of the palmar ulna-carpal ligament which passes between the pisiform and the ulna, the transverse carpal ligament, passing between the bones of the proximal row of the carpus and in the second row the hamato-pisiform ligament and the pisi-metacarpal ligament to the 4th and 5th metacarpals.

Our anatomical studies have also shown us that the part of this ligament attaching to the 4th metacarpal is also stronger and more important than that of the 5th, and this has not been previously described [22, 33, 48].

By comparing pre- and post-operative radiographs, we have observed that there is a radial and proximal displacement of the pisiform, resulting from the action of the flexor carpi ulnaris. At the same time there is a verticalisation and a rotation of about 4°–6° of the base of both the 4th and 5th metacarpals.

When operating it is important to respect and possibly to repair the anterior capsular ligament, as well as to perform a careful repair of the posterior capsular ligament and the dorsal retinaculum.

Post-operative immobilisation of about 3 weeks is adequate to allow the ligaments and capsule to heal.

Resection of the proximal row of the carpus results in hypertrophy of the capitate, as well as a modification in shape of the pisiform. Alterations in the mechanics of the 4th and 5th carpo-metacarpal joints also help to produce a good functional result.

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