AVASCULAR NECROSIS OF THE LUNATE BONE TREATED BY EXCISION AND PROSTHETIC REPLACEMENT

J. C. AGERHOLM and J. W. GOODFELLOW, OXFORD, ENGLAND

From the Nuffield Orthopaedic Centre, Oxford

Kienböck's avascular necrosis of the lunate bone still poses problems both in its etiology and management. Excision of the bone has received little support in the past. Thus Stählin (1947) in an extensive review of the condition concluded that the operation should be abandoned. Therkelsen and Andersen (1949) reviewed 109 cases and found that the worst results followed excision. Dornan (1949) recorded that of sixteen patients operated on eleven were able to return to heavy work, though four of these suffered pain after prolonged use. More recently, however, Gillespie (1961) has reviewed the late results of operation in twenty-four patients. He rated 88 per cent as excellent, but noted that excision after prolonged symptoms gave disappointing results.

Stählin (1947) found that prolonged immobilisation gave definitely better results than excision. Many months of immobilisation in plaster are required and the outcome is uncertain, being least favourable in those patients in whom collapse and fragmentation of the bone have occurred.

Dissatisfaction with the results both of excision and immobilisation led one of us (J. C. A.) to attempt excision and replacement of the damaged bone by an acrylic prosthesis. It was hoped in this way to avoid the collapse and distortion of the carpus consequent upon simple excision and so to avoid osteoarthritis in the radio-carpal joint. We have since found in the literature one report of a patient treated in a similar way (Danis 1951).

It is the purpose of this paper to describe the method applied (by J. C. A.) and to give an independent assessment (by J. W. G.) of the results achieved.

TECHNIQUE

The prosthesis—The prostheses were made in acrylic from moulds taken from a number of lunate bones of varying size and shape excised from cadavers. A range of prostheses was thus available at each operation, and the one that fitted best as determined by trial and error was used. The method may appear somewhat inexact but in practice it was almost always possible to get a good fit from the range available.

The lunate bone is particularly suitable for prosthetic replacement. Almost its entire surface is articular and its shape ensures good stability in the absence of all ligamentous attachments.

The operation—The lunate bone was excised through a small transverse incision on the dorsum of the wrist. Radiographs were taken in the theatre at every operation, first to ensure that the bone exposed was in fact the lunate and later to demonstrate the completeness of its removal. This precaution is essential if the disaster of removing the wrong bone is to be avoided. It is surprisingly easy to leave quite large portions of the bone if radiographic control is omitted. Frequently the bone is found to be fragmented, and even if it is whole it usually breaks during the excision and has to be removed piecemeal.

Once inserted a well-fitting prosthesis is remarkably stable even with the posterior capsule open; in most cases no attempt was made to repair this structure, the skin and subcutaneous layers only being closed.
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In the early cases in this series a plaster was applied to immobilise the wrist for three weeks after operation. More recently we have simply used a compression bandage, because immobilisation appears to be unnecessary and may delay rehabilitation.

After operation early mobilisation and a quick return to work has been encouraged. Most patients have returned to light work within a month of the operation and to heavy work within two months.

MATERIAL

Of the first seventeen patients treated, one died from coronary artery occlusion a few months after operation and one could not be traced. The remaining fifteen patients are reviewed. All save one have been personally examined and assessed. The exception (Case 4) lived too far away to attend the hospital but answered a questionnaire and was examined by his family doctor.

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<th>TABLE I</th>
<th>CLINICAL DETAILS IN FIFTEEN CASES</th>
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There were eleven men and four women. All the men save one were manual workers. The exception, a university lecturer (Case 6), was a keen amateur handyman who subjected his wrist to severe strain in his leisure time. All those in whom the right hand was affected were right handed. Two patients in whom the left hand was affected were left handed (Cases 2 and 5) (Table 1).

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Symptomatology—Pain in the wrist was the symptom of which all the patients initially complained. Most of them had also noticed weakness of grip and stiffness of the wrist. In general the pain was brought on by use and relieved by rest, though four patients specifically noted pain at rest relieved by use.

The onset of symptoms was related to a specific injury by only eight of the patients. Symptoms had been present for periods varying between thirteen years and three months before operation. Those patients who had had symptoms for years had usually suffered only intermittently, and it was often as the result of some minor injury that the condition had worsened sufficiently for them to demand treatment.

Most of the patients had had a period of conservative treatment by immobilisation in plaster before operation—indeed at the beginning of this series failure of conservative measures was the usual indication for operation. More recently, however, operation has been advised as soon as the diagnosis has been made.

RESULTS

Pain—Because in every case pain was the symptom from which relief was sought, the presence or absence of pain after operation is of overriding importance in assessing the value of the procedure. The patients fell into three groups in respect of this symptom.

Group 1—The eight patients in Group 1 denied any pain in the affected wrist. All returned to their heavy manual jobs after the operation. Many of these patients subject their wrists to a severe test daily. On the day of examination the patient in Case 15 had shovelled several tons of coal without any discomfort, and the patient in Case 9 keeps goal in a football team and can punch away a fast ball without pain.

Group 2—The four patients in Group 2 suffer occasional pain in the affected wrist. Thus one patient (Case 4) complains of pain in cold weather but he continues in his heavy job as a coalman. Another (Case 5) has pain after the use of a hammer but at no other time and continues as a professional gardener without difficulty. A third (Case 6) has pain in cold weather after vigorous screwing movements with the wrist. The fourth patient (Case 10) never has pain with “ordinary use” which involves four hours’ hammering a day as an upholsterer, but he has learned to avoid certain movements of the wrist and gets pain if he wrenches it.

These four patients were all satisfied with their results and all considered their wrists much less painful than before operation.

Group 3—Group 3 consists of three patients in whom pain has persisted despite operation.

The first (Case 12) had pain in the wrist when she did heavy work. She did not at the time of the review think that her discomfort warranted any further action and had decided to put up with it.

The second (Case 14) had pain after ironing or washing, but made little of her disability and was satisfied with her result.

The last (Case 13), a mother of small children, required to wash large numbers of clothes, complained of pain in the wrist as severe as before the operation. She considered the operation a failure.

Range of movement—The average range in all the patients was 55 degrees of dorsiflexion and 35 degrees of palmar flexion (Table I). There was no absolute correlation between the range of movement and presence or absence of pain. Thus the patient in Case 1 exhibited a poor range with no pain at all whereas that in Case 13 had persistent pain despite an average range of movement.

Power—Five of the patients in Group 1 retained a grip equal in power to that of the healthy side. In all the other patients there was demonstrable weakness of grip, but in no case was this a cause of complaint despite the heavy nature of the work that most were doing. Most patients thought the wrist stronger than it had been before the operation.
Durability—The average duration of follow-up for Groups 1 and 2 is over five years (Table I). A study of the notes revealed that gradual improvement could occur for many months after operation and that a patient who complained of occasional pain a year after operation might have a completely pain-free joint a year later. The numbers are too small for firm conclusions to be drawn, but it may be significant that in Group 3 the follow-up periods are much shorter than the average for the other groups. No patient, having attained a painless wrist, has experienced a recurrence of symptoms.

Antero-posterior radiographs of the wrists of six patients showing the extent to which the prosthesis was successful in maintaining carpal architecture after excision of the lunate bone. Figure 1—Case 1. Eight years and five months after operation. Figure 2—Case 3. Seven years and three months after operation. Figure 3—Case 6. Six years and seven months after operation. Figure 4—Case 7. Six years after operation. Figure 5—Case 8. Four years and five months after operation. Figure 6—Case 11. Three years and eight months after operation.

Radiological Appearances

Antero-posterior and lateral radiographs of the operated wrist were taken at the follow-up examination of all the patients. The points specially looked for were: 1) collapse of the carpus—shown by pressure changes between the tip of the styloid process of the radius and the triquetral bone and closing of the gap between the articular surface of the radius and the head of the capitate; 2) new bone formation; and 3) osteoarthritis.

Collapse—All the wrists examined revealed some degree of collapse though it was frequently slight and shown only by an apparent foreshortening of the scaphoid in the antero-posterior projection, caused by forward inclination of that bone. This deformity has been seen to occur after simple excision of the lunate bone (Gillespie 1961). The prosthesis usually proved successful in maintaining a more or less normal structure of the carpus over many years. Figures 1 to 6 demonstrate degrees of carpal shift much less than would be expected after simple excision.
In some patients there was already marked collapse of the carpus before operation. Figure 7 shows gross fragmentation and collapse of the lunate bone. At review nineteen months after operation the carpal architecture was good (Fig. 8) and the patient's wrist free from pain.

In one patient (Case 12) an ill-fitting prosthesis subluxated medially. At a second operation six months later the prosthesis was removed and a new one inserted. The second was, however,

![Fig. 7](image1)

**Fig. 7**—State before operation. Note the severe changes in the lunate bone.

![Fig. 8](image2)

**Fig. 8**—Eighteen months after operation. Good maintenance of the carpal architecture in a pain-free wrist.

![Fig. 9](image3)

**Fig. 9**—Case 12. Three and a half years after operation. The prosthesis has worn a new facet on the inferior margin of the radius. Devoid of support from the prosthesis, the carpus has collapsed so that the head of the capitate bone now articulates with the radius.

**New bone formation**—All patients showed evidence of new bone formation. Its degree bore no relation to the symptoms. Thus in one patient masses of new bone were seen in anterior and posterior capsular ligaments, but the patient had a good result with an average range of movement in the wrist (Fig. 10).
Osteoarthritis—Four patients showed minimal signs of osteoarthritis in their wrists at the time of operation. In one of these (Case 12), whose prosthesis was subluxated, there had been some progress of the degenerative changes eighteen months after operation (Fig. 9). In the other three no progress of the osteoarthritis had occurred at the time of review.

One wrist (Case 5) showed no osteoarthritic changes before operation, but at follow-up six years later osteoarthritic changes had occurred and there was some collapse of the carpus (Fig. 11). The radiographs are suggestive of subluxation of the prosthesis medially as in Case 12 (Fig. 9).

In the remaining ten patients no osteoarthritic changes were visible at follow-up examination. Osteoarthritis has therefore progressed or developed only in the two wrists in which the prosthesis failed to support the carpus. When the operation has been technically successful the wrist has been able to withstand heavy use over many years without developing osteoarthritis. In one patient (Case 2) the left wrist showed little degenerative change as long
as eight years after operation, even though an ununited fracture of the right scaphoid bone had forced him to use the left hand predominantly in his work as a lorry driver’s mate (Figs. 12 and 13).

SUMMARY AND CONCLUSIONS

Of fifteen patients treated by excision of the lunate bone and prosthetic replacement twelve had no pain at all or slight discomfort after exceptionally heavy work. All these were able to return to and continue at heavy manual jobs. Two patients continued to experience pain with vigorous use of the wrist but were none the less satisfied with their improvement. In one patient the operation failed and pain persisted unrelieved.

We believe that the radiographs show that the prosthesis greatly minimises the distortion of the carpus after excision of the lunate bone and that the maintenance of a normal carpal architecture is important in the avoidance of osteoarthritis of the remaining joints. The results suggest that when the operation is technically successful degenerative changes do not occur despite prolonged and heavy use. The presence of osteoarthritis in the wrist before operation is not a contra-indication to prosthetic replacement because the degenerative process may remain stationary for several years after removal of the damaged lunate bone.

The prosthesis has proved durable over many years and none of our patients having attained a good wrist has suffered a relapse. The operation entails a month off work for a heavy labourer and as little as a fortnight for those who do lighter jobs. These considerations prompt us to suggest its wider use in the treatment of Kienböck’s disease.

The acrylic prostheses were made by Mr Alan J. Anderson, Senior Dental Technician (Surgical) in Charge, Oral and Maxillo-facial Department, the Churchill Hospital, Oxford, whose assistance is gratefully acknowledged.

REFERENCES


