



# WRIST ARTHRODESIS IN RHEUMATOID ARTHRITIS

## A NEW TECHNIQUE USING INTERNAL FIXATION

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**A**rthrodesis of the wrist is a standard operation which is indicated for severe rheumatoid arthritis in which destruction is too advanced for more conservative procedures, or after failure of previous surgery. We have developed an L-shaped plate designed for this purpose. It provides rigid internal fixation with the wrist in the neutral position and utilises bone grafts obtained from the distal ulna and the carpal bones.

**We have carried out 29 successful fusions between 1992 and 1995. In all 29 patients synovectomy and resection of the head of the ulna were performed; 11 also had reconstruction of ruptured extensor tendons. All the patients obtained bony union, pain relief and improved function.**

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Arthrodesis of the wrist and carpus is a basic operation which aims to produce a strong, stable and painfree fusion in the correct axial position with retention of supination and pronation. Rheumatoid disease sometimes causes total collapse of the wrist with palmar subluxation and decreases in the carpal height index and the ulnar translocation index. Such deformity is a frequent indication for arthrodesis when there is pain and failure of conservative management or previous surgery. Other indications include severe post-traumatic arthritis, chronic spastic deformity and lesions of the radial nerve untreatable by other methods. Numerous methods of wrist arthrodesis have been described, but many require the use of bone autografts which may give problems at the donor site. We have developed a simple and reliable operation using an implant designed specifically for the purpose. We now describe the plate and method and report our early results.

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## Methods

**Plate and screws.** We designed an L-shaped plate with special screw openings to achieve a stable osteosynthesis and firm fixation. This was developed by the Meditech-Beznoska Company (Kladno, Czech Republic) and is now available in four sizes for both the right and left sides. Individual sizes range from 0 to 3; the narrowest plate allows screw diameters of 2.7 mm or 3.5 mm, but 4.5 mm screws are recommended for sizes 1 to 3 (Fig. 1). The axis of the fixation is the central pillar of the wrist from the distal portion of the radius over the lunate and capitate to the base of the third metacarpal. The two holes in the distal part of the main plate are designed for screws placed in the base and diaphysis of the third metacarpal. The opening in the L-extension is oval to facilitate optimal positioning of a screw in the second metacarpal. Proximal to this three-point distal fixation, there is a solid plate to bridge the fused area and then three or four other screw openings to allow proximal fixation to the radius. The oval openings on the plate allow for final adjustment before tightening. It is only 2.7 mm thick, with some transverse concavity to adapt to the natural shape of the bones; when necessary its shape can be adjusted by simple bending instruments.

**Technique.** The slightly curved, S-shaped dorsal skin incision starts distally at the base of the second metacarpal and curves radially over the centre of the wrist and the central axis of the forearm. The extensor retinaculum is divided and reflected radially so that after synovectomy of the extensor tendons and arthrodesis it can be transposed under the extensor tendons (Clayton 1965). These are then retracted, the dorsal articular capsule is incised and the joints exposed. The distal portion of the ulna is resected as described by Darrach and Dwight 1915, and the cancellous bone retained for use as graft. The articular surface of the radius is resected and the intercarpal and carpometacarpal joints are also cleared of their cartilaginous joint surfaces. In rheumatoid patients, areas of articular destruction and early spontaneous fusion will be revealed. The remaining bony fragments of the carpus are cut into small fragments with an oscillating saw and left in situ, taking great care to retain their blood supply from the palmar side. When the operative field has been fully prepared, the wrist is straightened and the plate applied (Fig. 2). The first screws are placed in the

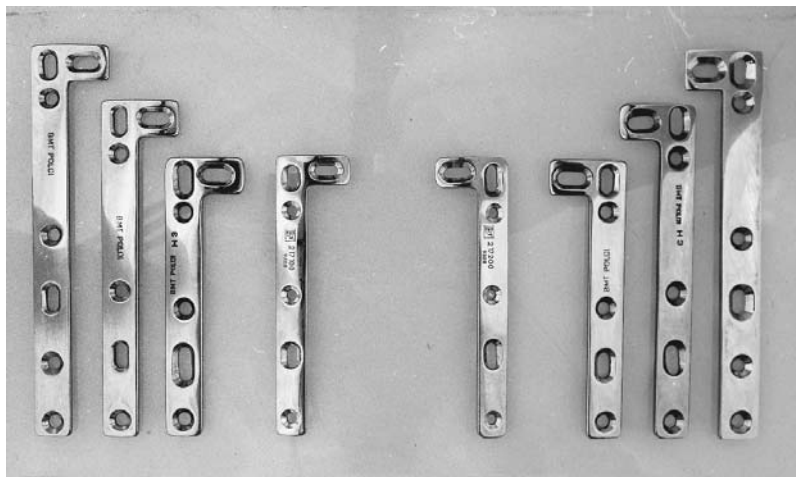


Fig. 1

A complete set of plates for the right and left wrists.

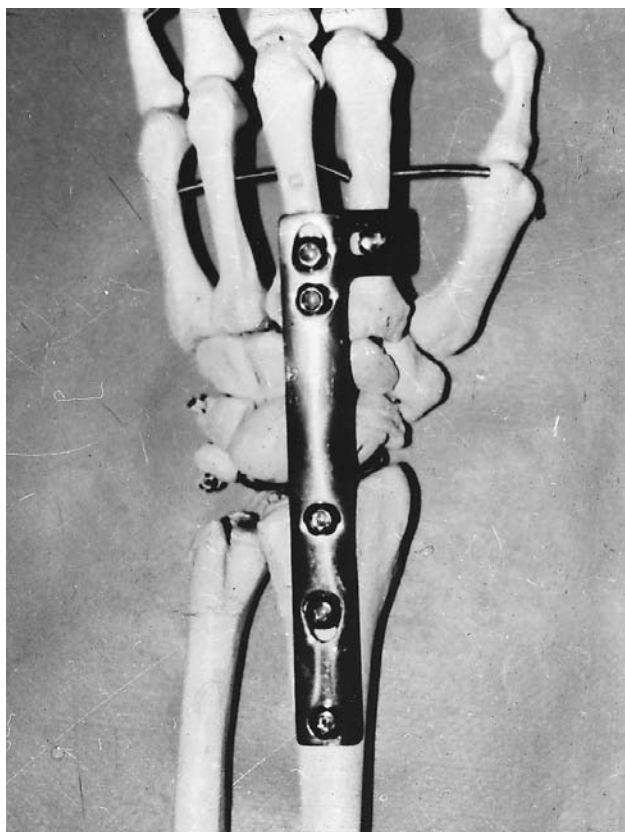


Fig. 2

To show the position of the plate.

oval openings of the plate to allow slight compression before tightening and the remainder positioned in optional order. Fusion is performed in the neutral position (Clayton 1965; Straub and Ranawat 1969). In a bilateral case the dominant hand is fused straight and the other wrist in slight flexion. Slight ulnar deviation of  $10^{\circ}$  to  $15^{\circ}$  is acceptable (Pahle and Raunio 1969) (Figs 3a and 3b). Bone graft from the resected ulna is placed in position under the plate. Any

ruptures of extensor tendons are repaired. The reflected extensor retinaculum is then replaced deep to the extensor tendons, spread widely and sutured to provide a fibrous layer between the tendons and the plate and screws. Suction drainage is used and the subcutaneous layers and the skin are carefully sutured. A palmar plaster slab is left in place until removal of the sutures. When tendon repair has been needed, the palmar splint remains in place for four weeks to support the fingers in extension. The implant can be removed after 10 to 12 months if necessary (Figs 3c and 3d), but only when there is consolidation of the fusion. Earlier removal may be required if there are any problems with skin healing or infection.

## Patients

From 1992 to 1995, we performed 29 arthrodeses on 26 patients (three bilateral), including 22 women and four men. All 29 wrists had severe rheumatoid arthritis with collapse and subluxation of the carpus. The average age of the patients was 49.5 years (19 to 68), and the average duration of disease 15.3 years. The average postoperative follow-up was for 19.8 months (4.5 to 35). Standard anteroposterior and lateral radiographs were taken preoperatively, immediately after operation, and at one, three, four, six and 12 months later. In the AP view, we measured the carpal height index (CHI) and the ulnar translocation index (UTI) by the method of Youm et al (1978). The CHI is the ratio of the distance between the third metacarpal base and the articular surface of the radius to the length of the third metacarpal. The normal value is  $0.54 \pm 0.03$ . The UTI is the ratio of the distance between the axis of the ulna and the centre of the carpus at the head of the capitate to the length of the third metacarpal. The normal value is  $0.3 \pm 0.03$ . We evaluated articular damage by the classification of Larsen, Dale and Eek 1977. Most of the wrists which were arthrodesed showed severe changes of grade IV or V. The decision for arthrodesis was made on radiological, clinical and functional findings as well as on the views of the patient after



Fig. 3a



Fig. 3b



Fig. 3c



Fig. 3d

AP (a) and lateral views (b) of a 66-year-old patient postoperatively, with a size 0 plate in position. The straightening of previously severe palmar carpal subluxation can be seen. There is solid bony fusion (c,d) at 11 months after removal of the plate, and an axial position of the stabilisation.

the expected outcome of the fusion had been fully explained.

## Results

Solid fusion was achieved in all 26 patients within an average of 2.5 months. The mean preoperative CHI was 0.24 (0.22 to 0.29), and at six months after operation was 0.42 (0.34 to 0.46). This improvement was achieved mainly by the straightening of angulated or subluxated wrists. The mean preoperative UTI was 0.23 (0.19 to 0.28) and the mean postoperative UTI 0.29 (0.27 to 0.30). The improvement of both indices indicates the improved axial position of the fusion with correction of subluxation and lateral

translocation. Adequate gripping function of the hand was retained in all patients, and the performance of everyday tasks was improved because of the elimination of pain, swelling and instability of the wrist (Fig. 4). A neutral position of the wrist was achieved in 26 arthrodeses with the planned 10° of flexion and 5° of ulnar deviation for the non-dominant wrist in bilateral cases provided by slight bending of the implant. In the 11 patients who required reconstruction of extensor tendon lesions, there was always some deficiency in finger extension at the metacarpophalangeal joints, with an average loss of extension of 18°. Despite this the functional improvement was always substantial. In one woman who had early treatment of extensor tendon rupture by end-to-end suture, the result was excellent.

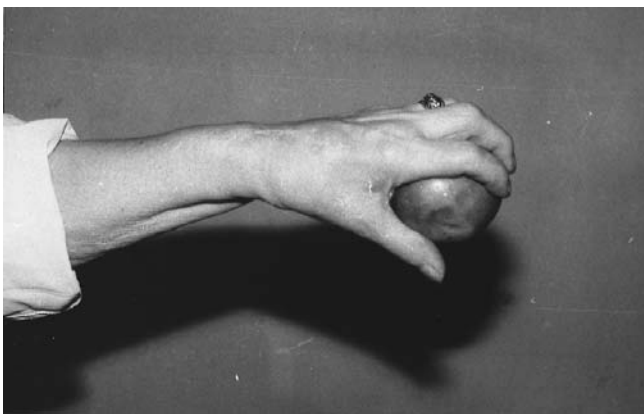


Fig. 4a



Fig. 4b

To show the gripping ability of the same patient one month after implant removal and the range of pronation and supination.

**Complications.** There was one case of deep soft-tissue infection which resolved after removal of the implant and flow lavage. After remission the infection, plaster fixation was used and spontaneous fusion of the carpus was achieved.

## Discussion

A resected portion of the ulna has previously been used to bridge the carpus for an arthrodesis held in position by a plaster; the use of a substantial graft from the ulna was the method of Smith-Petersen 1940. Various modifications of the bridging graft have been described. Mittal and Jain 1990 reported 28 arthrodeses using a graft obtained by an oblique osteotomy in the longitudinal axis of the ulna; this long graft was laid into the distal radius and the proximal third metacarpal. Lisfranc and Tubiana 1985 used graft from the iliac crest or the proximal tibia, with single screw fixation to the radius and the third metacarpal. Müller et al 1991 used a combination graft from the iliac crest and proximal tibia, with a straight narrow AO plate fixed to the radius and the second metacarpal. Souquet and Mansat 1980 performed carpectomy of the proximal line and impacted the capitate bone into the radius, fixed by a tension-band wire technique. Fernandez-Palazzi and Bendahan 1992 described a cerclage method with a bridging graft in 22 arthrodeses in an attempt to prevent any increase in the CHI deformity. A number of authors have described the use of intramedullary fixation using a Steinmann or Rush pin and an accessory graft (Clayton 1965; Mannerfelt and Malmsten 1971; Mannerfelt 1973; Millender and Nalebuf 1975). Most of the methods of fixation mentioned above require additional support from a cast for several weeks to several months. Our method is a simple technique which seems to be reliable, does not need a second operation to obtain the graft, and allows the reconstruction of ruptured extensor tendons at the same procedure. It does not require long-term plaster immobilisation and facilitates the early rehabilitation of the finger joints.

Despite the encouraging early results of new methods of wrist arthroplasty, arthrodesis of the wrist and carpus still has an important place in the range of orthopaedic rheumatological operations. The provision of a stable painfree wrist reduces the suffering of the patient and considerably improves the function of the hand.

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