OPEN AND CLOSED ARTHRODESIS OF THE RHEUMATOID WRIST USING A MODIFIED (STANLEY) STEINMANN PIN

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In a series of 21 patients (22 wrists) with rheumatoid arthritis, arthrodesis of the wrist was done using a modified Steinmann pin (Stanley) either by an open or closed technique. The open technique, which included fragmenting the carpal bones (12 cases), was mainly used when additional procedures were needed simultaneously. The closed technique simply required insertion of the Stanley pin under fluoroscan control through a small incision over the metacarpal head. Nine out of 12 wrists treated with the open technique and nine out of ten of those treated by the closed technique were successfully fused. Complications were few. A single patient was dissatisfied due to continuing pain. Two out of the four pins that migrated (both involving the open technique) have been removed.

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Rheumatoid arthritis (RA) affects the wrist joint in many patients causing pain and stiffness limiting hand function. The indications for arthrodesis of the rheumatoid wrist are painful movement not controlled by anti-inflammatory agents, instability or marked deformity.

Internal fixation of the wrist with an intramedullary nail has the advantage of simplicity, speed, and safety in osteopenic bone. Clayton (1965) used an intramedullary Steinmann pin and subsequently Mannerfelt and Malmsten (1971) and Vahvanen and Tallroth (1984) popularized the use of the Rush pin. Stanley et al. (1986) introduced a modified pin for wrist fusion and the technique was adopted in our centre. Intramedullary pin fixation was preferred as a minimal intervention in patients with polyarticular disease, particularly if vascularity of the skin was precarious. Closed arthrodesis of the wrist through a 2 cm incision over the metacarpal head offers great benefits to the patient if spontaneous fusion around the pin is the predictable outcome.

We have reviewed our experience with wrist arthrodesis using the modified Steinmann pin described by Stanley et al. (1986) inserted by either the closed or open technique.

PATIENTS AND METHODS

This study consists of 21 patients (22 wrists) available for review, who underwent wrist arthrodesis between 1985 and 1997 for rheumatoid arthritis fixed with a Stanley pin. This was not a consecutive series of patients treated prospectively, rather a group of cases available for assessment. The ratio of men to women was 2:19 and right to left wrists 12:10. The age of patients at operation ranged from 42 to 78 years with a mean of 63 years. Postoperative review ranged from 6 months to 12 years with a mean 31 months.

Operative technique

The length of the pin may be chosen preoperatively but frequently the final choice is dictated by the degree of ulnar translocation and the ability to use the index or middle metacarpal. There should be sufficient length to allow pin to bone contact in the distal 7 cm of the radius and the proximal two-thirds of the metacarpal. The pins come in two diameters; the thicker is preferred on all occasions if metacarpal dimensions permit.

In the closed technique, the index or middle metacarpophalangeal joint is approached through a short longitudinal dorsal incision. The extensor mechanism and the capsule are incised longitudinally and the metacarpal head is exposed after flexion of the proximal phalanx (Fig 1). The metacarpal shaft can be hand drilled to a somewhat smaller diameter than the pin if the canal is narrow with good bone stock. This still permits firm grip without the risk of metacarpal fracture. Alternatively the Stanley pin can be used as a drill bit and is loaded on to the hand drill and introduced through the centre of the metacarpal head into the metacarpal canal. The hand drill is then removed and the pin advanced under fluoroscan control. An introducer is applied to the end of the nail and the pin hammered forward through the carpus and into the medullary canal of the radius (Fig 2). The distal end of the pin is advanced 2 to 3 cm into the metacarpal using the countersink (which is the same diameter as the pin). It is prudent to advance the pin sufficiently far to allow space for a metacarpophalangeal joint replacement in case one should be required in the future. The split in the extensor tendon is then repaired with non-absorbable sutures and the skin is closed.

Postoperatively, the wrist is immobilized on a palmar slab for a period of 2 weeks for comfort. The metacarpophalangeal joints remain free with early mobilization of the fingers and the other joints of the upper extremity.

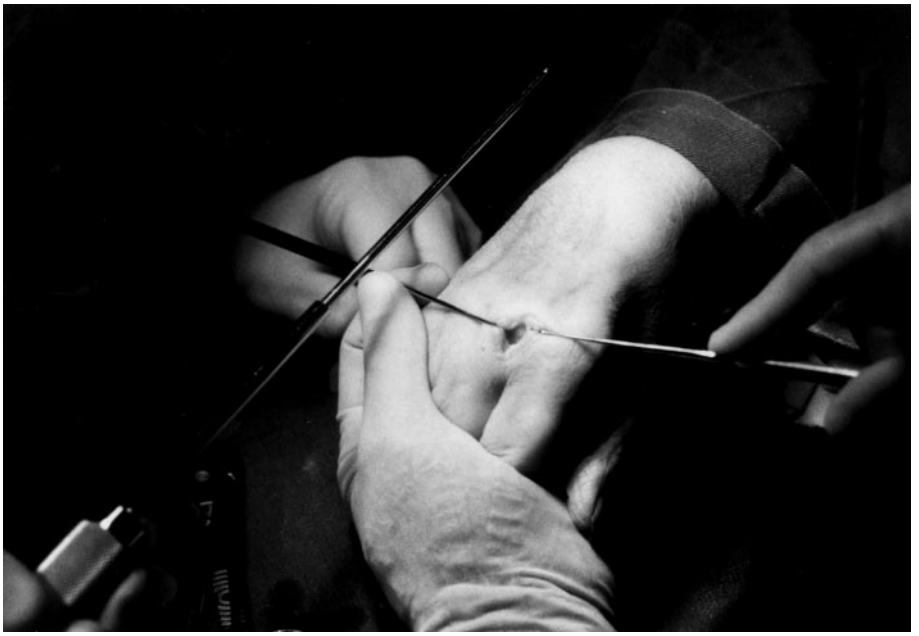

Fig 1 The Stanley pin is inserted into the metacarpal head through a split in the extensor mechanism.

Fig 2 Intraoperative radiograph of the pin in process of being advanced.

The open technique involved disruption of the articular surface of the radius and carpal bones to promote union. On occasion extensor tendon reconstructive surgery was required or a Darrach procedure.

In nine cases, the pin was introduced into the index or middle metacarpal through the carpus. The pin was then advanced through the metacarpal and across the carpus into the radius in direct vision using the technique described above. Bone grafting was not used in any of the open technique cases.

RESULTS

Twenty-one patients (22 wrists) attended for review with previous records and radiographs. We separated the patients into two groups (open and closed) depending on the technique used. Fresh X-rays were taken at the review. Fusion was achieved in 18 wrists (Table 1).

All patients were questioned about pain relief, satisfaction with the procedure, stability, increase in strength and postoperative dexterity. Pain was quantified using a four point scale (Table 2). Alleviation of pain was the most obvious benefit from the operation in 20 out of 21 patients. The ten patients with a closed wrist fusion had the least pain with a mean pain score of 1.8, compared with the group of open wrist fusion (mean pain score, 2.1). The patients considered the wrist to be stable and strength was increased in 19 out of 21 patients. This facilitated such activities as pouring from a jug or using a knife and fork. Instability occurred in two cases with a pseudarthrosis (both performed by the open technique). Seventeen patients (18 wrists) had

Fig 3 Lateral radiograph of pin crossing dorsum of the carpus.

Table 1—Radiographic results of Stanley pin wrist fusion

	n	*Fusion*	*Site of pin*			
			Index metacarpal	*Middle metacarpal*	*Through carpus*	*Dorsal to carpus*
Open	12	9	7	5	5	7
Closed	10	9	8	2	4	6

increased dexterity in activities of daily living, (getting dressed, making a bed, holding a kettle).

Satisfaction with the procedure was quantified using a 3 point scale (Table 2). Eighteen patients (19 wrists) were completely satisfied (16 of the 18 fused wrists and three of the four pseudarthroses) and two patients were partially satisfied. A single patient with a pseudarthrosis was dissatisfied due to severe pain at the radiocarpal joint (in addition there was distal migration of the pin).

On clinical examination, all but one patient had no pain during attempted radiocarpal flexion. In seven cases there was dorsal subluxation of the distal ulna with moderate pain on the ulnar side of the wrist.

Twelve patients had additional operative procedures to the hand and wrist. Eight patients had extensor tendon repairs, two a PIP joint fusion, one a Darrach procedure and one an extensor tendon repair with a Darrach procedure. There was an extension lag of 10 to 15° in nine patients at the metacarpophalangeal joint involved in the arthrodesis (index or middle ray). Eight of the nine cases with an extension lag had the arthrodesis done using the open technique.

Table 2—Postoperative quantification of patient's pain and satisfaction with procedure

Pain score	*Satisfied with procedure*
1. No pain	1. Completely satisfied
2. Slight/occasional	2. Partial satisfaction
3. Moderate pain	3. Dissatisfaction
4. Severe pain	
– Regular analgesics	

Radiological assessment

In the lateral projection seven wrists were found to be in a neutral position, ten in palmar flexion (mean 5°) and five in extension (mean 6°). In the anteroposterior projection the position was neutral in six cases and in ulnar deviation in 16 cases (mean 7°). The radiographs showed a 5 to 10 mm wide osteolytic zone (halo) around the pin in ten wrists, which in five cases was in the distal radius, one in the distal metacarpal and in four in both the radius and metacarpal. All these wrists had fused with occasional local pain. Four had been treated with the closed technique and six with the open.

Intraoperative difficulties

In a single case the anterior cortex of the radius was penetrated by the pin, which had to be repositioned during the operation (closed technique). In another case

the posterior cortex was penetrated due to malposition of the pin (closed technique). A small incision was made to exclude impingement on the first compartment or superficial radial nerve. No impingement was found and the pin was not repositioned. In another case, the insertion of the pin was difficult (by the closed technique) due to a stiff and flexed wrist. Stabilization in slight wrist flexion was considered acceptable and bone union was achieved.

Postoperative complications

Pseudarthrosis occurred in four cases, three of which were treated by the open technique. Migration occurred in three cases of pseudarthrosis after the open technique. The pin was removed in two cases (at 3 weeks and 3 months after operation, respectively). At review neither of these patients had pain at the wrist on attempted motion, with an average range of 30° flexion and 20° extension. One patient mentioned occasional pain at the index MCP joint with restriction of full flexion. The pin had been inserted at this site using the closed technique. In one patient the extensors tendons to the little finger ruptured immediately after the operation.

DISCUSSION

The open and closed arthrodesis groups were not directly comparable, since those who had the open fusion tended to have additional procedures and perhaps had more severe disease. This is confirmed by radiographic evaluation of the wrists, using the Larsen classification (Larsen et al., 1977), which showed grade IV and V arthritis in 11 out of 12 patients in the open group compared with five out ten in the closed group.

Stanley pin fixation is technically easy and quick to perform in patients with RA (Stanley et al., 1986; Stanley and Hullin, 1986). The middle metacarpal is preferred but the choice will depend on clinical and radiological assessment of carpal translocation. The metacarpal shaft must align with the longitudinal axis of the radius. The final decision is made intraoperatively under fluoroscan control.

The average operative time was 1 hour for the open technique and 35 minutes for the closed technique. Millender and Nalebuff (1973) stress the benefit of short operative time with intramedullary fixation but preferred the open carpal approach.

There is no way of knowing if the different results obtained were due to variations in surgical technique or in the severity of the disease being treated. The overall results were satisfactory in both groups and were better for the closed fusion group. All the patients (in the closed group) felt completely satisfied with the operative results, having a stable wrist, increased strength with less pain when compared with the open fusion group.

We did not seek a specific position for the wrist during the operation. The ultimate position depended on a variety of factors, particularly in the closed technique. Wrist flexion or radioulnar deviation deformities preoperatively affected the postoperative position. Carpal translocation in an ulnar direction was also an important factor. All these factors affect the point on the radius that is penetrated by the advancing pin. Thereafter, the pin is constrained by the progressive narrowing of the radius. In 13 cases the pin entered the intramedullary canal of the radius without passing through the carpus (Table 1) (Fig 3). Eleven out of these 13 cases had successfully fused. Reduction of a palmar subluxated carpus during the operation is clearly not a prerequisite for successful arthrodesis. Postoperatively, none of the patients with anterior subluxation of the carpus complained of carpal tunnel syndrome. Although we prefer wrist fusion in a position of slight extension and ulnar deviation, we did not find any particular functional differences between the final wrist positions.

Pseudarthrosis occurred in four cases out of 22 (three with the open and one with the closed technique). The pin migrated in three of these cases. All but one of these patients were satisfied with the operative result. A single patient who developed pseudarthrosis after the open technique with distal migration of the pin was dissatisfied. During the wrist operation he also had a Darrach procedure and repair of extensors to the middle, ring and little fingers. He complained of pain on radiocarpal motion and also at the distal ulna, with swelling to the ulnar side of the wrist.

Two pins were removed (for migration and malposition) before the fusion had consolidated because of significant pain in the wrist and hand due to migration. Osteolysis around the pin was seen in the radiographs of ten patients at review (six treated by the closed technique). This emphasizes that the pin simply acts as a stabilizer of the wrist while fusion occurs. The fusions had united in all patients with evidence of osteolysis. All were completely satisfied and had a mean pin score of 1.9.

The above results and complications are comparable with previous authors. Clayton (1965) had two pseudarthroses out of 12 wrist fusions. Millender and Nalebuff (1973) reported pseudarthrosis in two out of 70 cases, distal migration in 12 cases, skin problems in three patients and an infection in a single patient. Barbier et al. (1999) had one patient with limited skin necrosis in a series of 18 cases. Although we did not encounter the problem, compression of the median nerve was reported by Mannerfelt and Malmstem (1971) and later by Vahvanen and Tallroth (1984). In both these papers intraoperative reduction of the anterior subluxation of the wrist was advocated.

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