Dorsal wrist synovectomy in rheumatoid arthritis—A long-term study

Dorsal wrist synovectomy, tenosynovectomy of the extensor tendons, excision of the distal ulna, ulnar-side stabilization of the wrist, and placement of the extensor retinaculum underneath the extensor tendons is an effective procedure in wrists with rheumatoid arthritis. Twenty-seven patients who had surgery on 38 wrists were followed for 5 to 14 years, with an average of 7.4 years. There were 25 female and two male patients with an average age of 54 years. Over 95% had excellent pain relief. There was significant reduction of wrist motion, but the arc of motion was within a functional range. Subsequent tendon rupture was minimal and even tendons found to be thinned out at the time of surgery remained intact. There was no recurrence of synovitis. Carpal measurements were done by using the pisiform bone as a reference point. The carpal height was maintained in 70% of the wrists. Carpal translocation occurred in 44% of the wrists. Three patients required wrist arthrodesis, and five, arthroplasty. Carpal collapse and translocation could not be predicted by preoperative x-rays. Progressive carpal collapse was associated with increasing ulnar deviation of fingers. Progression of carpal collapse and ulnar translocation occurred in a linear fashion with the years of follow-up. (J HAND SURG 8:848-86, 1983.)

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Dorsal wrist synovectomy, tenosynovectomy of the extensor tendons, excision of the distal ulna, and placement of the extensor retinaculum under the extensor tendons is generally considered to be a very effective procedure for relieving pain and prevent-
Dorsal wrist synovectomy in rheumatoid arthritis

Materials and methods

Forty-six patients underwent 69 procedures, of these, 27 patients with 38 wrists were available for review. The follow-up period averaged 7.4 years. Included are 25 female and two male patients with an average age of 54 years. Eleven of these patients underwent bilateral procedures and all patients demonstrated moderate to severe synovitis of the wrist. Ninety-five percent of the patients presented with significant pain. At the time of surgery, 22 associated tendon ruptures were found, involving mainly the extensor digitorum communis. Of these, seven involved the ring finger, six the small finger, and three the long finger. Other ruptures consisted of three of the extensor pollicis longus, one of the extensor indicis proprius, and two of the extensor digitii minimi.

Patients were evaluated for pain, motion, recurrence of synovitis, incidence of tendon rupture, and improved function. The total arc of wrist motion was measured and graded as follows:

- Poor: <45°
- Fair: 45°-75°
- Good: >75°

The immediate preoperative and latest postoperative x-rays were reviewed for carpal collapse, ulnar deviation of the fingers, and ulnar translocation of the carpus.

The pisiform bone was used as one of the major reference points to perform the radiographic measurements. The pisiform articulates with the triquetrum, forming a separate, flat diarthrodial type of joint. This is a separate joint, and in about 76% of wrists it communicates with the main radiocarpal joint. It is not commonly affected in the rheumatoid process and may be well preserved even in the advanced stages of the disease. To measure carpal height, a line is drawn along the long axis of the third metacarpal. The distal cortex of the capitate and the prominent proximal lunate are marked on this line. The distance between these points is defined as carpal height (Fig. 1). The difference between preoperative and postoperative carpal heights, as measured in each wrist, gives the extent of carpal collapse, which was graded as follows:

- Type I: 1-5 mm collapse
- Type II: 6-10 mm collapse
- Type III: >10 mm collapse

This method measures the actual height of the carpal bones in millimeters, as opposed to the measurement described by Youm et al., which is expressed as a ratio of the carpal height to the length of the third metacar-
Fig. 2. Diagrammatic representation of the method of ulnocarpal stabilization. The palmar wrist capsule is lifted up and sutured to the dorsal capsule and the extensor retinaculum. This prevents supination deformity of the wrist and also acts as a soft tissue filler.

By Youm's method the carpal height, which is measured from the base of the third metacarpal to the distal radial articular surface, can be altered by cartilage changes of those bones alone without any change in the carpal bones. In our method the carpal height is measured on the line drawn along the axis of the third metacarpal, which is a reproducible landmark even in ulnar or radial deviation of the hand. Moreover, surgical resection of the metacarpal bone for metacarpophalangeal arthroplasty does not alter the follow-up carpal measurements in this method.

The center of the ulnar border of the pisiform and distalmost point of the radial styloid are connected to form a horizontal line (H). These two landmarks are well preserved even in advanced stages of rheumatoid arthritis. Another line is drawn along the ulnar-side cortex of the radius. This is a reproducible reference line, and this line does not change with translocation of the carpus or distal radioulnar dislocation. Its junction with the H line is marked, and the distance from this point to the ulnar border of the pisiform is the ulnocarpal distance (UCD). The difference between the pre and postoperative ulnocarpal distance is the amount of carpal translocation (CT).

Carpal translocation was divided into three grades:

- Grade A: 1-5 mm
- Grade B: 6-10 mm
- Grade C: >10 mm

Youm et al. used the axis of the ulna as a reference line. This landmark often is altered after the common spontaneous resorption of the distal ulna, its surgical excision, and dislocation of the distal radioulnar joint. The radius is not spontaneously absorbed and is not excised as part of the treatment, so its ulnar border acts as a reproducible reference line even after different surgical procedures.

Ulnar deviation (UD) was measured by the angles formed by the lines drawn along the long axis of the third metacarpal and its proximal phalanx.

Operative technique. A straight, dorsal incision was utilized in most of these patients, although in some cases the incision was more to one side, depending on the site of synovitis. The incision was carried straight down to the level of the retinaculum. Care was taken to avoid undermining the skin flaps from the subcutaneous fat. The sensory branches of the radial and ulnar nerves along with the venous network were preserved. The retinaculum was divided and reflected to the radial side and the tenosynovium of the tendons was removed by sharp dissection and by rongeurs. All the tendons were retracted to the radial side and the wrist capsule was opened along the distal ulna. Invariably the distal ulna

### Table I. Total arc of wrist motion

<table>
<thead>
<tr>
<th>Total arc of motion (No. of wrists)</th>
<th>&lt;45° (poor)</th>
<th>45°-75° (fair)</th>
<th>&gt;75° (good)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>3</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Postoperative</td>
<td>9</td>
<td>18</td>
<td>11</td>
</tr>
</tbody>
</table>

### Table II. Preoperative tendon ruptures

<table>
<thead>
<tr>
<th>Tendons</th>
<th>Ruptures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensor digitorum</td>
<td>3</td>
</tr>
<tr>
<td>Long finger</td>
<td>7</td>
</tr>
<tr>
<td>Ring finger</td>
<td>6</td>
</tr>
<tr>
<td>Small finger</td>
<td>3</td>
</tr>
<tr>
<td>Extensor pollicis longus</td>
<td>2</td>
</tr>
<tr>
<td>Extensor digitii minimi</td>
<td>1</td>
</tr>
<tr>
<td>Extensor indicis proprius</td>
<td>1</td>
</tr>
</tbody>
</table>
was subluxed dorsally with marked arthritic involvement of the distal radioulnar complex. The distal 1 cm of the ulna was excised and the margins smoothed, along with Lister's tubercle and spurs on the dorsal radius. Synovectomies of the wrist, the distal radioulnar joint, and the midcarpal joints were performed. The palmar capsule on the ulnar side was lifted up and secured to the dorsal capsule and the extensor retinaculum to prevent the hand from going into supination and also to act as a soft tissue arthroplasty between the distal ulna and the radius (Fig. 2). The extensor retinaculum was passed beneath the extensor tendons and sutured to the ulnar side. A flap of retinaculum was passed around the extensor carpi ulnaris to keep it stabilized on the dorsum of the wrist. Tendon repairs, if necessary, were done at this stage. In patients who lacked the ability to actively deviate the wrist ulnaward, the extensor carpi radialis longus was transferred to the extensor carpi ulnaris tendon. The wound was drained, the skin and subcutaneous layers were closed, and a bulky dressing with a palmar splint was applied.

Immobilization in a splint or cast was continued for 4 to 6 weeks, at which time active and assisted exercises were begun.

Results

Pain was the main presenting symptom in all the patients and it was classified into mild, moderate, and severe types. Preoperatively, 17 patients had mild, 13 moderate, and four severe pain. After a 5- to 14-year follow-up period, three had mild pain and only one had moderate pain.

Wrist motion was analyzed by allotting one point for each degree of wrist motion in the flexion-extension arc. A significant amount of motion loss was noted postoperatively and the preoperative and postoperative arcs of wrist motion are recorded in Table I. Patients with ruptured tendons before synovectomy (Table II) did equally well as patients without preoperative tendon rupture in the total arc of wrist motion. There was no recurrence of wrist tenosynovitis.

The postoperative complications included one superficial wound infected by *Staphylococcus aureus*, which responded well to oxacillin. There were no deep wound infections.

Preoperative and postoperative carpal heights were compared in each patient. Preoperative carpal height averaged 27.9 mm and the average postoperative height was 23.4 mm (average 30 to 35 mm in normal adults).

Carpal collapse, which is the difference between preoperative and postoperative carpal heights, was found to be as follows:

<table>
<thead>
<tr>
<th>Type (mm)</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I (1-5 mm)</td>
<td>20</td>
</tr>
<tr>
<td>Type II (6-10 mm)</td>
<td>8</td>
</tr>
<tr>
<td>Type III (&gt;10 mm)</td>
<td>1</td>
</tr>
</tbody>
</table>

Nine patients showed no change in carpal height (Table III). The rate of carpal collapse of those nine wrists with over 5 mm collapse showed a gradual linear relationship during the years of follow up (Fig. 3).

The normal average value of ulnocarpal distance is 20 mm. The mean preoperative and postoperative val-
Fig. 4. Rate of carpal translocation in 17 wrists. There was a slowly progressing ulnocarpal distance as the follow-up period increased.

Table IV. Incidence of finger deviation

<table>
<thead>
<tr>
<th></th>
<th>No. of wrists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperatively</td>
<td></td>
</tr>
<tr>
<td>Neutrally aligned</td>
<td>11</td>
</tr>
<tr>
<td>Radially deviated</td>
<td>1</td>
</tr>
<tr>
<td>Ulnar deviated</td>
<td>26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 wrists with ulnar deviated</td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td></td>
</tr>
<tr>
<td>0-10° more than preop</td>
<td>10</td>
</tr>
<tr>
<td>10°-20° more than preop</td>
<td>2</td>
</tr>
<tr>
<td>&gt;20° more than preop</td>
<td>1</td>
</tr>
<tr>
<td>Improvement</td>
<td></td>
</tr>
<tr>
<td>0-10° less than preop</td>
<td>9</td>
</tr>
<tr>
<td>10°-20° less than preop</td>
<td>3</td>
</tr>
<tr>
<td>&gt;20° less than preop</td>
<td>1</td>
</tr>
</tbody>
</table>

Values in these 38 wrists were 21.2 and 26.2 mm, respectively. The progression of the distance, carpal translocation, were as follows:

- Grade A (1-5 mm) 20
- Grade B (6-10 mm) 14
- Grade C (>10 mm) 3

One patient showed no change in the follow-up. Seventeen wrists, with progression of the carpal distance over 5 mm, revealed that this occurred in a linear relationship to the duration of time after surgery (Fig. 4). Preoperative and postoperative ulnar deviations were compared in each patient. Preoperatively, the fingers of 26 hands had ulnar deviation; one, radial deviation; and 11, neutral alignment. On follow-up, the fingers of 30 wrists had ulnar deviation; one, radial deviation; and seven, neutral alignment. Eleven patients had neutrally aligned fingers, one radial-deviated, and 26 ulnar-deviated. Of the 11 neutrally aligned fingers, three developed ulnar deviation up to 7°, one up to 10°, and the remaining seven stayed in neutral. The patient with 20° radially deviated fingers remained at 15° radial deviation 13½ years after surgery. Ulnar deviation progressed in 13 patients, with an increase of 10° in 10 patients, 10° to 20° in two, and 25° in one. Improvement was seen in 13 patients; nine showed reduction up to 10°, three up to 20°, and one by 25° (Table IV).

Subsequent wrist operations were performed in 10 patients. Three patients needed wrist arthrodeses, one after 8 years, one after 10 years. Total Volz wrist arthroplasty was performed in three patients, and Swanson Silastic implants in two patients. One patient experienced a catching of the ulna with persistent painful dorsal subluxation. The ulna was stabilized by passing the palmaris longus tendon through drilled holes in the radius and looping it to the ulna. The wrist remained...
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able in the last follow-up at 3 years after this proce-

dure. One patient required repair of the extensor tendons 
to the ring and small fingers. In this patient the ten-
dons appeared normal during the original surgery but 
were subsequently ruptured by the sharp end of the distal 
ulna.

Discussion

Synovial proliferation is the prime manifestation of 
the rheumatoid wrist. It erodes through the tendons, 
causing them to rupture.5–8 The tightness under the unyielding retinaculum contributes to the rupture, as do 
the dorsal dislocation of the distal ulna and friction 
against the roughened Lister's tubercle or the bony 
prominences in the wrist. The synovium erodes the 
cartilage, leading to painful bone-to-bone articulation, 
loosening and stretching of the ligaments, and subluxa-
tion of the joints. The bulkiness of the synovium results 
in swelling and pain in the wrist.

Thirty-four of the 38 patients had excellent pain re-

lief. Although there was generally a reduction in mo-
motion, synovectomy resulted in an acceptable arc of wrist 
motion. Final stabilization was achieved by bringing 
the palmar capsule over dorsally on the ulnar side. This 
also contributed soft tissue bulk to take up some of 
the space previously occupied by the distal ulna. The 
carpal height was well preserved in 29 of the 38 wrists. 
Of the nine collapsed wrists, eight were moderate (less 
than 10 mm) and only one had 16 mm collapse. This 
group of patients experienced a greater degree of ulnar 
development than the others.

The carpal translocation may have been aggravated 
by the loss of the distal ulna, but we have also seen 
ulnar translocation even in patients who have not un-
dergone surgery. If progressive deformity is seen in the 
follow-up x-rays, stabilizing procedures such as ar-
thodesis or arthroplasty are indicated. The same x-ray 
views were taken preoperatively and postoperatively 
for the purpose of comparison, thus obliterating the 
possibility that hand position would affect measure-
ment of ulnar deviation. There was no significant rela-
tionship between carpal translocation and ulnar devi-
ation of the fingers, and carpal collapse or carpal 
translocation could not be predicted by utilization of 
preoperative x-ray films. Patients with preoperative 
ulnar deviation improved and deteriorated in equal num-
Fig. 6. Left hand of a 63-year-old female with rheumatoid disease. A, Preoperatively, 20° radial deviation. B, Four years after dorsal synovectomy. Note the well-maintained carpal height and 4° correction of radial deviation. C, Well-preserved carpal position at 6½-year follow-up period. D, Carpal collapse (10 mm, type III) and 6 mm ulnar translocation of the carpus (grade II) at 13½-year follow-up period.
bers. Seventy percent of the patients with neutrally aligned fingers remained neutrally aligned after surgery. Only one patient had extensor tendon ruptures after the dorsal wrist surgery. This was due to the sharp edge of the distal ulna, which ruptured the extensor tendons of the ring and small fingers. Three patients had transfer of the extensor carpi radialis longus to the extensor carpi ulnaris tendon to prevent radial deviation of the wrist. They all maintained good ulnar deviation and balance of the wrist.

Case reports

Case 1. A 61-year-old white female with rheumatoid arthritis had been treated with various anti-inflammatory medications for synovitis of the right wrist. Synovial swelling was persistent and progressive in spite of adequate medical treatment. The thumb metacarpophalangeal joint was collapsed and unstable. The extensor pollicis longus was ruptured. She had dorsal wrist synovectomy, transposition of the extensor retinaculum beneath the tendons, arthodesis of the metacarpophalangeal joint of the thumb, and transfer of the extensor indicis proprius to the extensor pollicis longus in October 1967.

The initial radiograph revealed the soft tissue swelling over the distal ulna (Fig. 5, A). The carpal height was 26 mm and ulnocarpal distance 27 mm, with 10° of ulnar deviation. The patient remained free of swelling and pain in the wrist after surgery.

Radiographs taken October 1973, at 6 years after surgery, revealed progressive ulnar translocation of the carpus with increasing ulnar deviation of the fingers. The carpal height remained the same (26 mm). The ulnocarpal distance measured 36 mm, resulting in an ulnar translocation of the carpus by 9 mm. The ulnar deviation progressed to 15° (Fig. 5, B). The hand function was satisfactory to the patient.

A radiograph 8 years after surgery (Fig. 5, C) showed progressive ulnar translocation of the carpus. The ulnocarpal distance progressed to 42 mm, resulting in 15 mm ulnar translocation of the carpal bones (grade C). The carpal height and the finger ulnar deviation remained unchanged. The hand functions were limited at this time. Wrist stabilization and metacarpophalangeal arthroplasties were recommended, but the patient was not willing to undergo any additional surgical procedures.

Case 2. A 63-year-old right-handed female with rheumatoid arthritis presented with persistent dorsal synovitis of the left wrist, which did not improve with anti-inflammatory medication. Clinical examination revealed marked dorsal synovitis and radial deviation of the fingers. The initial preoperative radiograph (Fig. 6, A) revealed soft tissue swelling. Carpal measurements showed carpal height at 30 mm, ulnocarpal distance 24 mm, and finger radial deviation 20°.

Dorsal wrist synovectomy and transposition of the extensor retinaculum beneath the tendons and excision of the distal ulna were performed in June 1968. The unstable metacarpo- phalangeal joint of the thumb was arthrodesed. Hand function markedly improved and there was no pain or recurrent swelling over the wrist. Follow-up radiograph in 1972 (Fig. 6, B) revealed no change in the carpal height or ulnocarpal distance. Radial deviation measured 16°. There was also a palmar subluxation of the metacarpophalangeal joint of the index finger and the interphalangeal joint of the small finger.

A radiograph of the hand taken in October 1974 (Fig. 6, C) revealed the carpal height had remained unchanged at 30 mm, with ulnocarpal distance to 28 mm and resultant 4 mm carpal translocation. Finger radial deviation measured 15°. The stumps of the distal ulna showed spontaneous resorption that progressed significantly, as seen in the radiograph done in December 1981 (Fig. 6, D). There was narrowing of the first webspace. Carpal height measured 20 mm, resulting in a 10 mm collapse. Ulnocarpal distance measured 30 mm, increasing the carpal translocation to 6 mm. Finger deviation remained unchanged. The patient subsequently had many reconstructive procedures to other major joints but was reluctant to undergo any further hand surgery.

Conclusion

Dorsal wrist synovectomy is an effective procedure with good long-term results. In our study of 38 wrists with an average follow-up of 7.4 years, over 95% of the wrists obtained pain relief with good adequate motion. The carpal height in 70% of the cases was preserved, but carpal translocation in 44% of the cases deteriorated over a 5- to 14-year follow-up period. The incidence of postoperative extensor tendon rupture was minimal. Patients with tendon ruptures and repair did as well as those without tendon rupture in gaining the total arc of motion. There was no significant correlation between ulnar deviation and carpal translocation. Those wrists with severe carpal collapse developed marked ulnar deviation of the fingers. Carpal collapse and carpal ulnar translocation occurred in a direct relationship to the period of follow-up. Prediction of ulnar translocation or carpal collapse from preoperative x-ray was not possible, and those few patients with continued collapse are candidates for arthrodesis or arthroplasty.

REFERENCES

5. Clayton ML, Ferlic DC: Tendon transfer for the radial
Hand and wrist involvement in calcium pyrophosphate dihydrate crystal deposition disease

The clinical records and hand and wrist radiographs of 51 patients with calcium pyrophosphate dihydrate crystal deposition disease have been analyzed, and symptomatology and radiologic abnormalities have been correlated. Characteristic roentgenographic features included cartilage and synovial calcification and arthropathy of the metacarpophalangeal joints and the radiocarpal compartment of the wrist, including scapholunate dissociation. Clinical-radiologic correlation revealed many asymptomatic patients with calcification and arthropathy and many symptomatic patients with normal radiographs. Thorough radiologic evaluation may reveal many patients with this disorder before the onset of clinical symptoms. (J HAND SURG 8:856-63, 1983.)

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Calcium pyrophosphate dihydrate (CPPD) crystal deposition disease is a commonly recognized inflammatory joint disorder of the elderly. The hand and wrist are commonly involved areas, second in incidence only to the knee. This study describes the characteristic roentgenographic findings of CPPD crystal deposition disease in the hand and wrist and correlates the clinical and roentgenographic presentations at these sites.

Material and methods

The radiologic records of all patients with a diagnosis of CPPD crystal deposition disease at University Hospital and the Veterans Administration Medical Center, San Diego, Calif., from 1972 to 1981 were reviewed. From an initial group of 120 patients, adequate clinical data were available in 79 of the patients which allowed assessment of the presence of this disease according to the criteria developed by Mccarty. These criteria separate cases of CPPD crystal deposition disease into “definite,” “probable,” or “possible” categories. The disease is considered definitely present if CPPD crystals are identified in tissue biopsy or fluid aspiration utilizing x-ray diffraction or chemical analysis. The same is true if typical weakly positive birefringent crystals are identified by polarized light microscopy and characteristic calcifications are present radiologically. If only one of these latter conditions is met, a probable diagnosis can be made. A possible diagnosis is suggested by the presence of acute or chronic arthritis occurring in common “target” areas, showing typical radiologic features including subchondral cyst formation, severe degeneration, variable osteophyte formation, or tendon calcification. “Possible” cases were not included in this study.

Of the 79 records evaluated, 51 patients fulfilled