

Akimasa Kobayashi · Toshiro Futami · Yukio Tsukamoto

Flexor tendon rupture in the rheumatoid wrist caused by bony spurs in the carpal tunnel

Received: July 18, 2000 / Accepted: December 12, 2000

Abstract Five cases of flexor tendon rupture in surgically treated rheumatoid wrists were studied. The tendon ruptures occurred in the thumb and index finger, and the ruptures site was in the carpal tunnel in all five cases. The main cause of rupture was the formation of bony irregularities in the form of bony spurs in the carpal bones, mainly in the scaphoid, or at the volar aspect of the distal radius, as a result of rheumatoid erosion. In all five cases, tendon reconstruction and bony spur excision were conducted, and good recovery of phalangeal function was achieved. To clarify the causes of the rupture of the flexor pollicis longus in rheumatoid hands, we used three-dimensional computed tomography on 19 rheumatoid wrists without tendon rupture to investigate the presence or absence of bony spurs in the volar aspect of the scaphoid. The results showed a correlation between the frequency of scaphoid spurs and progression of bone changes as checked by radiography.

Key words Bony spur · Carpal tunnel · Flexor tendon rupture · Rheumatoid arthritis · Wrist joint

Introduction

Spontaneous tendon ruptures in the hand are occasionally observed in patients with rheumatoid arthritis. These ruptures are more commonly observed in the extensor tendons than in the flexor tendons. According to Mannerfelt and Norman,¹ spontaneous flexor tendon rupture in rheumatoid arthritis was first described by Laine in 1955. However, there are few case reports of flexor tendon rupture in rheumatoid hands.

We studied the characteristics of the clinical symptoms and causes of rupture in five cases of flexor tendon rupture

inside the carpal tunnel in the rheumatoid wrist. The causes of flexor tendon rupture were further studied in rheumatoid wrists without tendon rupture using three-dimensional computed tomography (3D-CT).

Patients and methods

Cases of flexor tendon rupture

Five cases of flexor tendon rupture were treated surgically in our unit between 1994 and 1999. Table 1 shows the clinical data of these cases. All five patients had been affected by rheumatoid arthritis for a long time (12 years on average) at the time of surgery. In all cases, the flexor tendon rupture was caused by minor trauma. All patients were inconvenienced by the loss of active movement in the thumb and/or index finger as a result of rupture of the flexor tendon. The tendons involved were the flexor pollicis longus (FPL) in two patients, the FPL and flexor digitorum profundus (FDP) of the index finger in two patients, and the FDP and flexor digitorum superficialis (FDS) of the index finger in one patient. Of the two patients with ruptures in the FPL and index finger FDP, both ruptures occurred simultaneously in one case (case 5), and the FPL rupture was followed by rupture in the index finger FDP 1 year later in the other case (case 4).

Before the operation, an X-ray examination was performed in all five cases, and a CT scan was obtained in three cases (cases 3, 4, and 5). The X-ray findings showed bone changes around the wrists caused by rheumatoid erosion in all cases. The three CT scans revealed bony spurs in the scaphoid and distal radius on the floor of the carpal tunnel.

Our cases underwent surgical treatment consisting of the excision of bony spurs and synovectomy combined with tendon reconstruction, including a tendon graft using the palmaris longus (PL) and a tendon transfer using the fourth finger FDS.

To investigate the causes of flexor tendon rupture in rheumatoid wrists, the degree of granulomatous rheuma-

A. Kobayashi (✉) · T. Futami · Y. Tsukamoto
Department of Orthopaedic Surgery, Kitasato University East
Hospital, 2-1-1 Asamizodai, Sagami-hara, Kanagawa 228-8520, Japan
Tel. +81-42-748-9111; Fax +81-42-748-5120

Table 1. Patient data

Patient No.	Sex	Age (years)	Affected finger	Duration of RA (years)	X-ray findings (Larsen's classification)	Rupture site	Treatment	Follow-up (months)	Range of motion (°) (extension/flexion)
1	F	63	R index	20	3	Carpal tunnel	Tendon graft (PL → 2FDP)	12	MP -10/70 PIP 0/45 DIP -20/70
2	F	67	L thumb	7	3	Carpal tunnel	Tendon transfer (4FDS → FPL)	44	IP 0/50
3	F	46	L thumb	15	4	Carpal tunnel	Tendon graft (PL → FPL)	36	IP 0/50
4	F	54	L thumb	7	4	Carpal tunnel	Tendon graft (PL → FPL) End to side (2FDP → 3FDP)	14	Thumb IP -10/45 Index DIP -15/50
5	F	66	R thumb index	6	3	Carpal tunnel	Tendon graft (PL → 2FDP) Tendon transfer (4FDS → FPL)	6	Thumb IP -10/40 Index DIP -15/50

RA, rheumatoid arthritis; PL, palmaris longus; FDP, flexor digitorum profundus; FDS, flexor digitorum superficialis; FPL, flexor pollicis longus; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint

toid tissue, and the spatial relationship between the site of the tendon rupture and the bony spur were observed during surgery. The patients were followed for an average of 22 months after surgery.

3D-CT study in wrists without tendon rupture

In a separate study, we used 3D-CT to examine the status of spurs at the volar aspect of the scaphoid (scaphoid spur) in rheumatoid wrists without flexor tendon rupture. Eleven female patients (19 hands), with an average age of 53 years (range 37–64 years) and an average duration of rheumatoid arthritis of 8 years (range 2–17 years), were studied. CT scanning was performed using a High-Speed Advantage SG machine (GE Medical Systems). The slice thickness was set at 1 mm. X-ray findings of the wrists were classified according to Larsen et al.,² and we found five wrists in grade I, one wrist in grade II, nine wrists in grade III, and four wrists in grade IV. The frequency of scaphoid spurs according to Larsen's grade was analyzed.

Results

Intraoperative findings of cases of flexor tendon rupture

Intraoperative observations revealed bony spurs in the carpal bones or at the volar aspect of the distal radius in all five cases. Furthermore, all the rupture sites were in the vicinity of bony spurs in the scaphoid or at the volar aspect of the distal radius. In other words, the index finger flexor tendons were ruptured above the distal end of the radius (Fig. 1), and the FPL was ruptured above the scaphoid (Fig. 2). These bony spurs were confirmed by CT findings (Fig. 3). On the other hands, while marked proliferation of the synovium is commonly observed intraoperatively in cases of extensor tendon rupture, this condition was not observed in the present cases. At follow-up, none of the patients had complications, and all were satisfied with a good range of movement in the digital joints (Table 1).

Findings in rheumatoid wrists without tendon rupture

In the 3D-CT study of rheumatoid wrists without flexor tendon rupture, the frequency of scaphoid spurs increased with a progression in Larsen's grade (Table 2). No scaphoid spurs were found in any of the cases in grades I and II, while all four wrists in grade IV showed spurs (Fig. 4).

Discussion

Chronic synovitis is commonly observed in rheumatoid arthritis. Granulomatous rheumatoid tissue may invade tendons, and consequently cause tendon rupture. In rheumatoid wrists, tendon rupture most commonly occurs

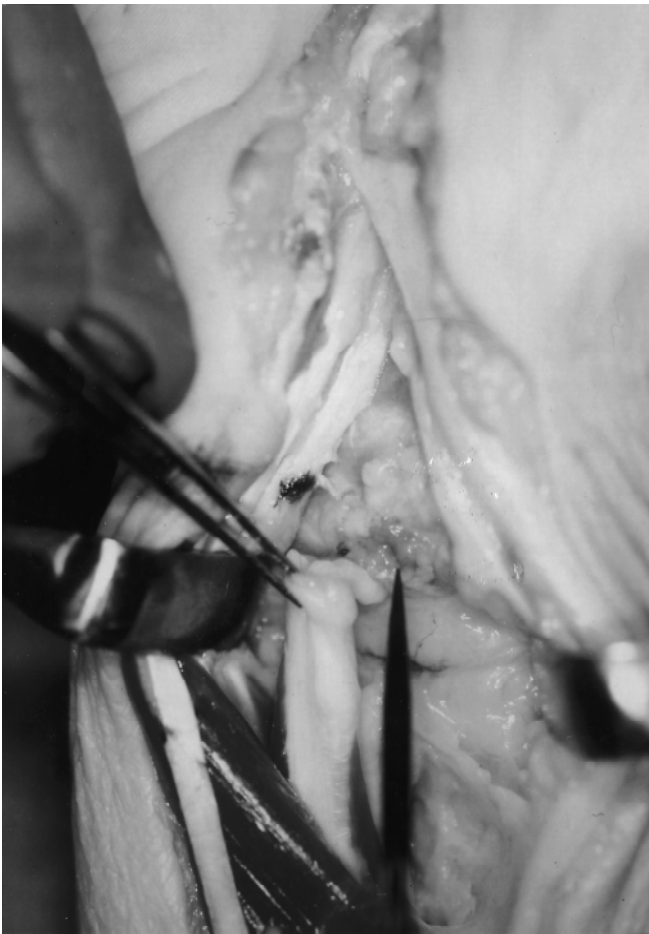


Fig. 1. Intraoperative findings in case 1. Corresponding to the site of the rupture of the flexor digitorum profundus of the index finger, bony spurs are seen at the volar aspect of the distal radius



Fig. 2. Intraoperative findings in case 2. A bony spur is seen which corresponds to the site of the rupture of the flexor pollicis longus. To confirm the position of the bony spur, a pin was placed on the bone and an X-ray picture was taken. The site of the pin is shown to be the distal scaphoid

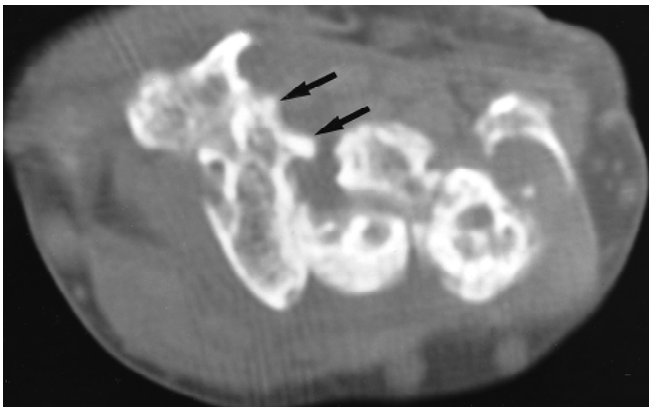


Fig. 3. Computed tomographic (CT) findings in case 5 show bony spurs at the volar aspect of the scaphoid (arrows)

in the extensor tendons. There are many reports of extensor tendon ruptures in rheumatoid wrists.³⁻⁵ Extensor tendon ruptures, which are especially common in tendons at the ulnar side such as the extensor digitorum communis and the extensor digiti minimi, frequently affect several digits.

Table 2. Frequency of scaphoid spurs

Larsen's classification	No. of wrists	Frequency of scaphoid spurs
I	5	0
II	1	0
III	9	7
IV	4	4

These ruptures must have occurred as the result of marked proliferation of rheumatoid tissue and mechanical stress caused by the ulnar head.

On the other hand, flexor tendon ruptures in rheumatoid wrists are relatively rare. In Japan, several authors have reported spontaneous flexor tendon ruptures in these conditions in a total of 32 cases (34 hands, 42 digits).⁴⁻⁷ According to these reports, flexor tendon ruptures were involved in 10% of all tendon ruptures, and the most common sites of rupture were in the FPL (24 digits) and the flexor tendons of the index finger (10 digits). Furthermore, 28 of 34 hands had a single rupture. The rupture site was in the carpal tunnel in 24 hands (73%).

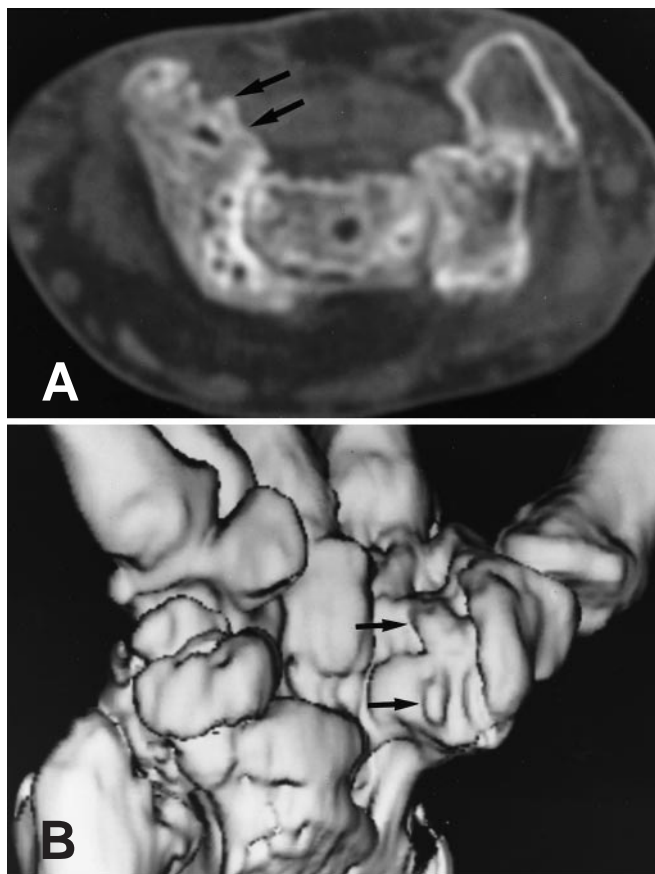


Fig. 4. **A** CT and **B** 3D-CT of a rheumatoid wrist classified as Larsen's grade IV, showing bony spurs at the volar aspect of the scaphoid (arrows)

Therefore, the clinical characteristics of flexor tendon ruptures in rheumatoid wrists are (1) that the ruptures commonly occur in the thumb and index finger, (2) that the ruptures usually affect a single digit, and (3) that the site of the rupture is usually inside the carpal tunnel.

Mannerfelt and Norman¹ described five factors in the pathomechanics of spontaneous tendon rupture in rheumatoid arthritis: granulomatous rheumatoid tissue, occlusion by rheumatoid tissue, bony spurs, pressure from the carpal ligament, and local steroid injections. In the five cases reported here, we observed no marked growth of granulomatous rheumatoid tissue around the rupture sites. The flexor tendons were ruptured in the vicinity of bony spurs formed in the scaphoid or the distal radius. From these findings, we hypothesize that flexor tendon rupture inside the carpal tunnel is caused mainly by bony spurs which are formed as a result of bone erosion by rheumatoid tissue. The tendon is subjected to mechanical stress from the bony spurs, resulting in attrition. Ultimately, tendon rupture occurs spontaneously.

Ertel et al.^{8,9} have reported that flexor tendon ruptures inside the carpal tunnel most commonly occur on the scaphoid. According to Mannerfelt and Norman,¹ one of

the reasons for the frequent formation of a scaphoid spur is the passage of nutrient vessels in the distal volar part of the scaphoid. Anatomically, the FPL goes round the distal volar ulnar part of the scaphoid. For this reason, when scaphoid spurs are formed, the FPL is prone to rupture at this site, which Mannerfelt and Norman called the critical corner. One of the reasons why flexor tendon rupture in rheumatoid wrists frequently occurs on the radial side, and mainly in the FPL, may be associated with the anatomical orientation of the FPL.

To detect the status of scaphoid spurs in rheumatoid wrists, we used 3D-CT to investigate the wrists of patients with rheumatoid arthritis who had no tendon rupture. Our study indicates that 3D-CT is an effective tool for detecting the presence of scaphoid spurs which are associated with FPL rupture. A progression in Larsen's grades of the wrist, shown by X-ray film, was associated with increased frequencies of a scaphoid spur, which corresponds to the site of the passage of the FPL. The presence of a scaphoid spur, as detected by 3D-CT, predicts a high probability of FPL rupture.

In the five cases reported here, surgical treatment consisted not only of tendon reconstruction, including cases where the tendon of the flexor tendon rupture required a tendon graft using the PL or a tendon transfer using the fourth-finger FDS, but also excision of the bony spurs to achieve a smooth surface. Since these five patients were satisfied with the results of surgery, we conclude that tendon reconstruction combined with the excision of bony spurs is an effective treatment for flexor tendon ruptures in rheumatoid wrists.

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