Mod Rheumatol (2006) 16:404–409
DOI 10.1007/s10165-006-0519-x

CASE REPORT

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Carpal tunnel syndrome caused by volar dislocation of the lunate in a patient with rheumatoid arthritis

Received: April 19, 2006 / Accepted: August 18, 2006

Abstract We report a case of carpal tunnel syndrome caused by volar dislocation of the lunate in a patient with rheumatoid arthritis. A 74-year-old woman complained of numbness in her fingers. Carpal tunnel syndrome was diagnosed, and carpal tunnel release was performed. However, the symptoms recurred. Three-dimensional computed tomography and magnetic resonance imaging revealed volar dislocation of the lunate and synovitis around the distal radioulnar joint, respectively. Resection of the lunate and the Sauvé–Kapandji procedure were effective.

Key words Carpal instability · Carpal tunnel syndrome · Lunate · Rheumatoid arthritis · Volar dislocation

Introduction

It is known that various changes occur in the wrist joints of patients with rheumatoid arthritis (RA). The common changes that occur in RA wrists are as follows: radiocarpal/intercarpal joint space narrowing, decrease in carpal height, ulnar and volar carpal shifts, often associated with synovitis around the extensor tendons and dorsal carpal ligaments, and instability of the distal radioulnar joint. This report describes a case of carpal tunnel syndrome caused by volar dislocation of the lunate in an RA patient.

Case report

A 74-year-old woman consulted the neurologist with complaints of numbness in the thumb, index, and middle fingers of the left hand, and ring and little fingers of the right hand. She was diagnosed with left carpal tunnel syndrome and right cubital tunnel syndrome, and was referred to the orthopedist. Subsequently, RA was diagnosed. The status of RA, which was classified according to the Steinbrocker classification, was stage IV and class II. Although the patient had polyarthritis involving the knee and ankle joints, she was diagnosed with RA for the first time. The laboratory findings revealed that the inflammation was not severe, and the level of C-reactive protein was 0.1 mg/dl. The clinical examination for detecting sensory disturbance revealed that the two-point discrimination and tactile sensation were compromised. X-ray examinations revealed scapholunate dissociation and volar subluxation of the lunate (Fig. 1, upper panel). Magnetic resonance imaging (MRI) revealed severe synovitis around the carpal bones and flexor tendons. The electrophysiological examination of the left median nerve failed to detect any motor and sensory action potentials. Therefore, the patient was diagnosed with left carpal tunnel syndrome secondary to RA synovitis. The administration of a nonsteroidal anti-inflammatory drug and minocycline kept the inflammation well under control. However, the pain in the left fingers continued to increase and the thenar muscle power decreased. Since the patient did not complain of any pain in the left distal radioulnar joint (DRUJ) or the wrist joint, only release of the left carpal tunnel with synovectomy was performed.

Postoperatively, the pain and sensory disturbances in her left hand were relieved. However, there was a gradual relapse after approximately 6 months, and a swelling was observed on the volar side of the wrist joint. X-ray examination revealed volar dislocation of the lunate. Sclerotic changes were observed between the scaphoid and the radius, and the carpal height ratio had decreased to 0.38. The ulnar carpal shift ratio was 0.05, and the palmar carpal subluxation ratio was 0.2 (Fig. 1, lower panel). Volar dislocation of the lunate into the carpal tunnel was observed on three-dimensional computed tomography (3D-CT) (Fig. 2). Bone erosion, sclerosis, spur formation, and cyst formation were observed in the DRUJ and in the wrist joint. Reconstruction CT clearly demonstrated volar dislocation of the

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Fig. 1. *Upper panel*, X-ray film of the left wrist at the first consultation. The lunate was subluxated to volar side. *Lower panel*, the X-ray film of the left wrist before the second operation. The lunate was dislocated to the volar side and the capitate shifted proximally

lunate and contact between the capitate and the radius (Fig. 3). On fat-suppressed gadolinium (gadolinium diethylenetriamine penta-acetic acid: Gd-DTPA)-enhanced T1 image, a high signal intensity area was observed around the flexor tendons, which we suspected was caused by an outgrowth of the synovium and fluid accumulation. Maximum intensity projection image revealed another high signal intensity area, observed around the DRUJ and the wrist joint (Fig. 4).

The overall assessment was that predisposing arthritis of radiocarpal joint, especially scapholunate joint, the release of the flexor retinaculum, and the progression of synovitis primarily from the DRUJ into the carpal tunnel led to carpal instability and accompanying volar dislocation of the lunate. It also resulted in relapse of the carpal tunnel syndrome. Therefore, another operation was planned.

The median nerve was compressed from the dorsal aspect at the same area, as noted during the first surgical procedure, due to the volar dislocation of the lunate and dorsal subluxation of the distal carpal row. Mucinous effusion accumulated under the fascia surrounding the flexor tendons. Further, an outgrowth of the synovium of the flexor tendons was observed. In the DRUJ, severe joint destruction and instability of the distal ulna were observed. The Sauvé–Kapandji procedure was performed to treat the DRUJ disorder. The volar carpal ligaments were remarkably lax, the lunate had dislocated volar and beneath the flexor tendons, and hence it could not be reduced manually. After making a longitudinal incision in the volar capsule, the lunate was removed. Thus, the compression of the median nerve was reduced. Subsequently, the capsule was sutured tightly using dissolvable stitches (Fig. 5).

Fig. 2. Three-dimensional computed tomography (3D-CT) scan of the left wrist. *Upper panel*, coronal view. *Lower panel*, axial view. The lunate is in the carpal tunnel

Fig. 3. Reconstructed 3D-CT of the wrist: sagittal plane. The distal carpal row is subluxated dorsally and the lunate is dislocated volarly

Active motion of the fingers was permitted immediately after the surgery. After immobilization for 2 weeks, an active range of motion exercises for the wrist joint was permitted under application of soft support device. Pain and numbness had reduced 15 months after the second surgery. Numbness of the thumb, index, and middle fingers of the left hand had improved. The range of motion of the left wrist joint was 25° in dorsiflexion and 45° in palmar flexion, whereas the preoperative range of motion was 50° in dorsiflexion and 45° in palmar flexion; the range of motion of the left forearm was 90° in pronation and 90° in supination. X-ray examination revealed that the movement of the radiocarpal joint was smooth, and compatibility of the capitate and radius was excellent at the midcarpal joint (Fig. 6). On electrophysiological examination, it was possible to detect the motor and sensory action potentials; however, severe difficulty persisted with the motor conduction velocity. No relapse of the synovitis in the wrist joint has been observed so far.

Discussion

In general, wrist joint involvement occurs in over 90% of the RA cases. Patients develop deformity in the wrist joint and advancing instability of the carpal bones. Unstable wrist joint often manifests as dorsal subluxation of the ulnar head, radial rotation and ulnar translocation of the carpus, supination, and palmar dislocation at the radiocarpal joint.[1] Due to the alignment of the carpus, the volar intercalated segment instability (VISI) deformity occurs frequently, whereas the dorsal intercalated segment instability (DISI) deformity rarely occurs.[2,3] Instability of the RA wrist has been described in various classifications. In 1965, Clayton[4] classified the instability of the wrist by using the terms "stiff type" and "loose type". In 1992, Simmen and Huber[5] put forth the following classification: type I, ankylosis (stable type); type II, osteoarthrosis (stable type); and type III,

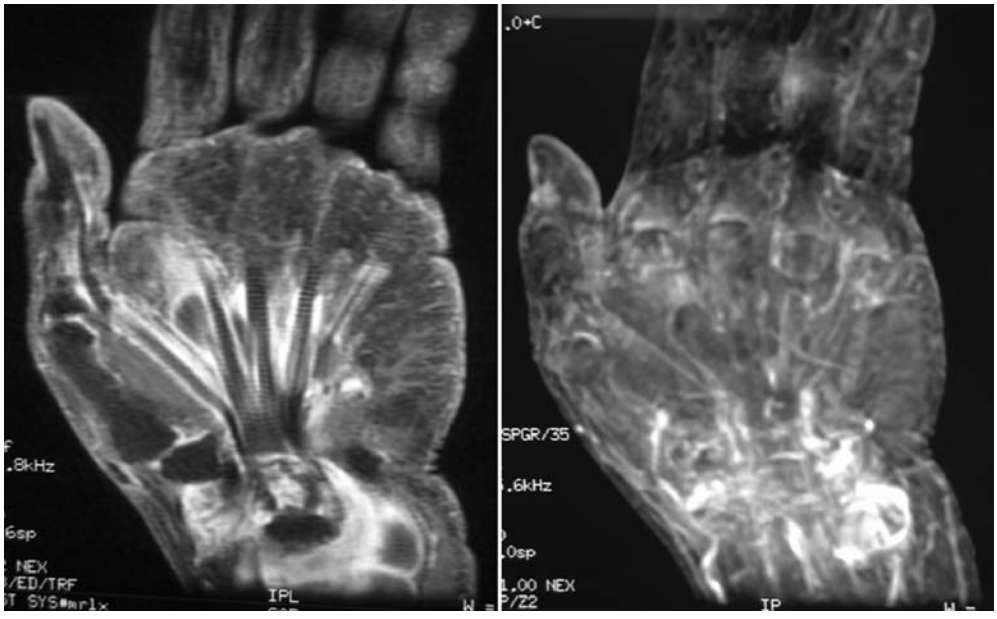

Fig. 4. Magnetic resonance images of the wrist before the second operation: Severe synovitis around the distal radioulnar joint and flexor tendons are apparent. Fat-suppressed gadolinium-enhanced T1 image (*right*); maximum intensity projection image (*left*)

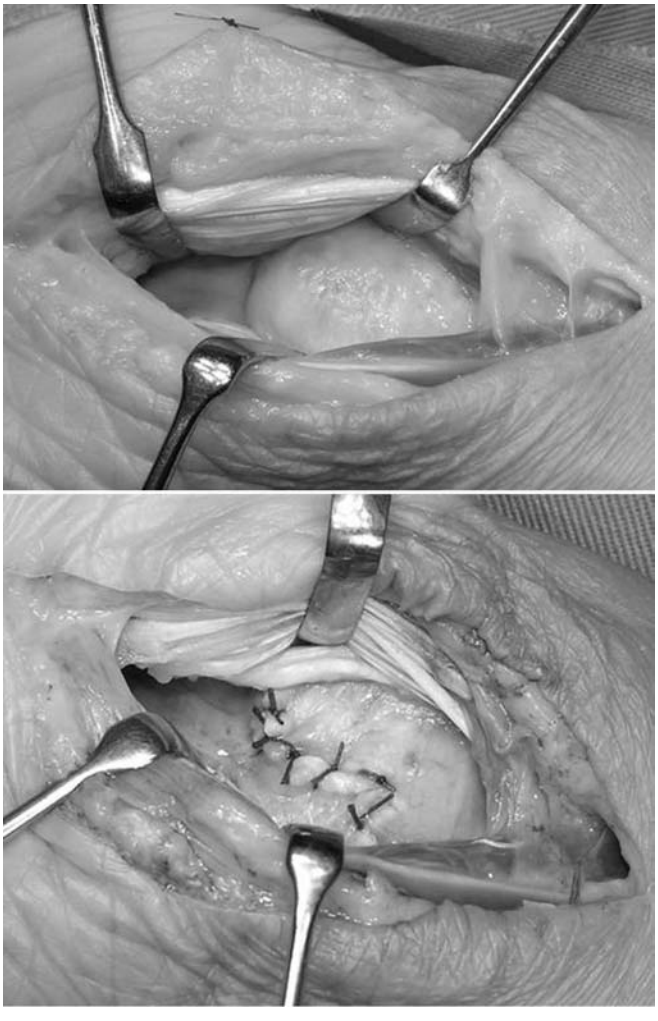

Fig. 5. Intraoperative findings. The lunate was dislocated to the volar side (*upper*) and after the removal of the lunate, the capsule was stitched tightly (*lower*)

destabilization (unstable type). Zangger et al.[1] suggested that this classification could be applied to 50% of RA patients. Flury et al.[6] examined the natural course of instability of the RA wrist and concluded that the carpal height ratio, ulnar translation, and scapholunate dissociation could predict the future course of wrist instability in RA patients. Ishikawa et al.[7] stated that the ulnar translocation and volar subluxation of the carpus, and scapholunate dissociation were indicative of instability at the radiocarpal joint.

Although several reports are available on traumatic dislocation of the lunate,[8,9] there are only a few reports on nontraumatic cases such as that in RA. Arner et al.[10] reported complete dislocation of the lunate in RA. Zangger and Simmen[11] reported the rupture of the flexor tendons secondary to extreme DISI deformity of the lunate in a rheumatoid wrist. When the underlying mechanism of the deformity in these reports was examined, the deformity in the case report by Arner et al. was assumed to have occurred due to the weakness of the ligament that had occurred due to steroidal administration. This led to severe instability of the carpus and dislocation of the lunate. Zangger and Simmen explained that the extreme DISI deformity secondary to partial or complete failure of the ligaments between the radius and scaphoid had resulted in volar dislocation of the lunate.[11]

The case presented here is considered to involve instability of the carpus that led to the volar dislocation of the lunate from the proximal carpal row to the carpal tunnel. In general, the volar ligament structure of the wrist joint is tougher than the dorsal ligament structure,[12] and hence it probably does not show DISI deformity. The ligaments that connect the carpus, radius, and ulna on the volar side are radiocapitate ligament, radiotriquetral ligament (RTL), and radioscaphoid ligament. On the dorsal side, the ligament that chiefly connects the radius and carpus is the dorsal radiocarpal ligament (DRC).

Fig. 6. Postoperative X-ray film of the left wrist. Compatibility of the capitate and radius is good

In this case, volar subluxation of the lunate and scapholunate dissociation was observed before the carpal tunnel release. With respect to the DRUJ, although swelling due to synovitis and instability were observed preoperatively, the patient did not complain of pain and the radiological changes were slight. During the first surgery, only carpal tunnel release and synovectomy were performed because synovitis around the flexor tendons was considered to have caused the compression of the median nerve. The volar carpal ligament had already become lax by this time, and additional release of the flexor retinaculum had increased the ligament instability.[13] Moreover, synovectomy of the DRUJ was not performed during the first surgery. This could be the underlying reason for the relapse and progression of the synovitis into the carpus, thereby resulting in the fragility of the strong volar ligaments. In particular, the RTL, which is located on the volar side of the wrist and which constrains the volar displacement of the lunate during wrist extension, plays an important role in the maintenance of stability of the lunate.[12,14,15] When the volar carpal ligaments became obviously lax, the dorsal DRC caused a relative DISI deformity. Additionally, the carpal tunnel release and progression of synovitis from the DRUJ worsened the volar carpal instability, which resulted in an extreme DISI deformity, proximal shift of the capitate, and volar dislocation of the lunate. Therefore, RA patients with severe volar synovitis and instability around DRUJ should be assessed carefully.

It was hypothesized that the major causes of carpal tunnel syndrome are the volar dislocation of the lunate and the synovitis around the flexor tendons. These factors were surgically corrected by excision of the lunate and the Sauvé–Kapandji procedure. Further decompression of the median nerve provided long-term relief of the symptoms and no relapse of synovitis occurred.[16] With respect to proximal row carpectomy, Ferlic et al.[17] compared RA and non-RA patients and concluded that the proximal row carpectomy has a very limited indication for RA patients. Moreover, a multicenter study by Culp et al.[18] concluded that the clinical outcome of proximal row carpectomy in RA patients was poor. Hence, in the present case, only the lunate was excised and proximal row carpectomy was not performed. Since the blood supply to the dislocated lunate through the ligaments was disrupted, occurrence of necrosis was expected. Therefore, partial wrist arthrodesis was not performed and removal of the lunate was selected. With regard to the symptoms, no complaint of the ulnar side of the wrist was observed. X-ray examination revealed bone union between the distal radius and ulna. Although the mobility of the radiocarpal joint and midcarpal joint between the capitate and radius persisted, the mobility between the radius and the scaphoid decreased. Long-term follow-up of the patient will be required to detect any volar and ulnar translocations of the carpus.

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