



## Complications of volar plating of distal radius fractures

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Open reduction and internal fixation has been shown to be effective in the treatment of unstable distal radius fractures. When a dorsal approach is used, extensor tendons rupture or irritation are frequent and well known complications. Complications associated with volar plate fixation have not been studied to the same extent.

In this study a homogenous series of 90 patients treated by volar plate fixation were retrospectively evaluated, focusing on the complications observed. The overall rate of complications was 8% (7 cases). Tendon rupture or irritation of extensor (3 cases) and flexor tendons (2 cases) were the complications most frequently seen. All but one were clearly related to direct attritional damage of the tendon caused by the prominent edge of the plate or by protruding screw tips. Loss of reduction requiring repeat internal fixation was observed in one marginal shear fracture involving the lunate facet fragment. One patient had a carpal tunnel release owing to median nerve irritation.

In this study, volar plate fixation appeared as a safe procedure in the management of unstable distal radius fractures, with a low rate of complications. Accurate placement of the plate and exact measurement of the screws may further minimize the incidence of complications. When radiographs reveal conditions that may predispose to tendon attritional lesions (prominent edge of the plate, dorsal protrusion of the screw tips) we strongly recommend early removal of the fixation device.

**Keywords** : distal radius fractures ; volar plate fixation ; complications.

## INTRODUCTION

Restoration of normal alignment and articular congruity after a distal radius fracture has proved to be essential to achieve good functional results (4,15) and for prevention of late osteoarthritis (14). Open reduction and internal fixation with plates and screws has recently become more popular ; it allows restoration of normal anatomy, stable fixation, early mobilisation and early return to previous activity.

Distal radius plating can be performed using a dorsal, a volar or a combined volar and dorsal approach. When a dorsal approach is used, extensor tendon rupture and irritation caused by implants or operative trauma are serious and frequent complications that have frequently discouraged surgeons from internally fixing distal radius fractures. To avoid these problems, even dorsally displaced fractures have been treated using a palmar

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approach (13,16,17) ; this seems to reduce complications and minimizes the necessity for secondary plate removal. Although many studies demonstrated that volar plating is a safe and effective technique, reports of problems and complications have appeared in literature following its increasing use.

In this study we retrospectively reviewed 90 consecutive cases of volar plating for distal radius fractures and focused on the complications observed. The aim of this study was to identify possible problems and pitfalls that may generate complications, in order to reduce their incidence and severity.

### MATERIAL AND METHODS

From May 2002 to October 2005, 90 displaced intra-articular fractures of the distal radius were treated by volar plating in our Department. Patients' ages ranged from 21 to 86 years, with a mean age of 44 years ; 41 patients were male and 49 female. Fractures were classified according to the AO classification system. The main represented groups of fractures were A3 (28 cases), C1 (31 cases) and C2 (24cases) ; 3 fractures were classified as B3 and 4 as C3.

Eighty-four patients underwent primary surgery ; the time between initial injury and operation ranged from 1 to 9 days (mean, 2.3 days). Six patients were operated after an initial treatment had failed (5 with a cast and one with the EpiBloc device).

### Operative technique

Regional anaesthesia, upper arm tourniquet and pre-operative antibiotic prophylaxis were used in all cases. A standard Henry's volar approach was performed in all patients. Operations were done by three senior surgeons experienced in hand and trauma surgery. A low profile titanium fixed angle palmar T-shaped plate (Synthes Ltd) was used in all cases ; the first generation of implant was used in the first 34 cases while the second generation plate was used in the remaining 66. In 15 cases K-wire pinning was associated to enhance stability, especially when a highly comminuted and unstable radial styloid fragment was present. Temporary external fixation as described by others (18) was not used.

A below-elbow volar plaster slab was worn for a minimum of twelve days, in young adults and simple stable fractures, to a maximum of 4 weeks in fractures with a greater degree of comminution and with poor quality

bone. A removable volar splint was used in most of the cases at the time of cast removal. Early active and passive motion of the wrist was initiated under physio-therapist supervision at that time.

Patients were followed for at least one year.

### RESULTS

Complications were observed in 7 cases (8%). Tendon complications were the most frequent.

– *Extensor tendons lesions* were observed in three cases. A closed rupture of the Extensor Pollicis Longus (EPL) tendon occurred without previous symptoms, 5 months after operation, in a young adult male. He underwent surgical tendon reconstruction by transfer of the Extensor Indicis Proprius (EIP) with good functional results. Gross degeneration of the ruptured tendon was evident intraoperatively.

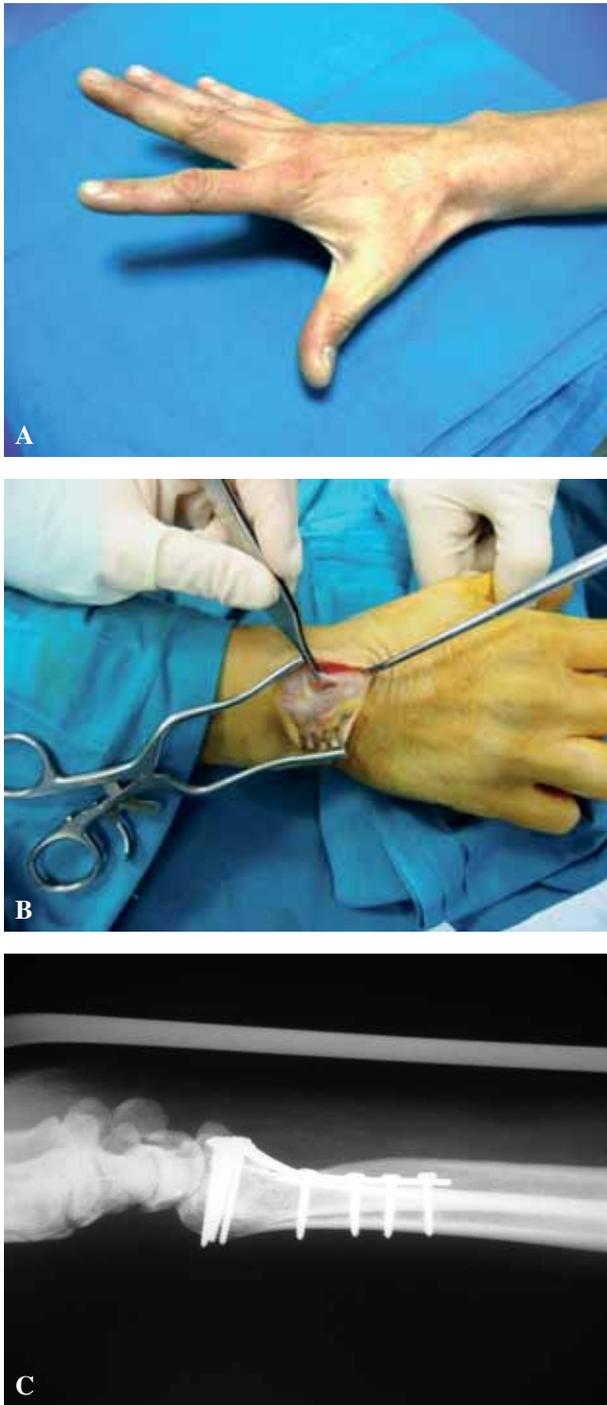
Rupture of both Extensor Indicis tendons (EIP and EIC) was observed in a 42-year-old male, 6 months after operation (fig 1). At that time, the patient started complaining of a weak and incomplete extension of his index finger, which developed several days after swelling appeared on the dorsal aspect of the wrist. At surgery an extended tenosynovitis of the fourth dorsal compartment was noted, with degenerative changes and rupture of EIC and EIP ; tenodesis of the ruptured tendons on the Extensor Communis Tendon of the 3<sup>rd</sup> finger was done after tenosynovectomy.

The third patient was treated 6 months after operation for a diffuse tenosynovitis of the Extensor Communis tendons, with swelling, tenderness and crepitus on the dorsal aspect of the wrist. At operation, marked hypertrophy of the synovial sheaths of the tendons was present with fibrillar degeneration of the tendon but without rupture.

In all these three cases, radiographs demonstrated an excessive length of one or more screws of the distal branch of the plate, with dorsal protrusion of their tips ; the plate was removed in all three cases.

– *Flexor tendon lesions* were observed in two patients.

Rupture of the Flexor Pollicis Longus tendon (FLP) occurred in a 48-year-old male patient,



**Fig. 1.** — Rupture of both Extensor Indicis tendons in a 42-year-old male. Clinical (A) and surgical (B) evidence. Lateral radiographs shows dorsal protrusion of the tips of the screws (C).

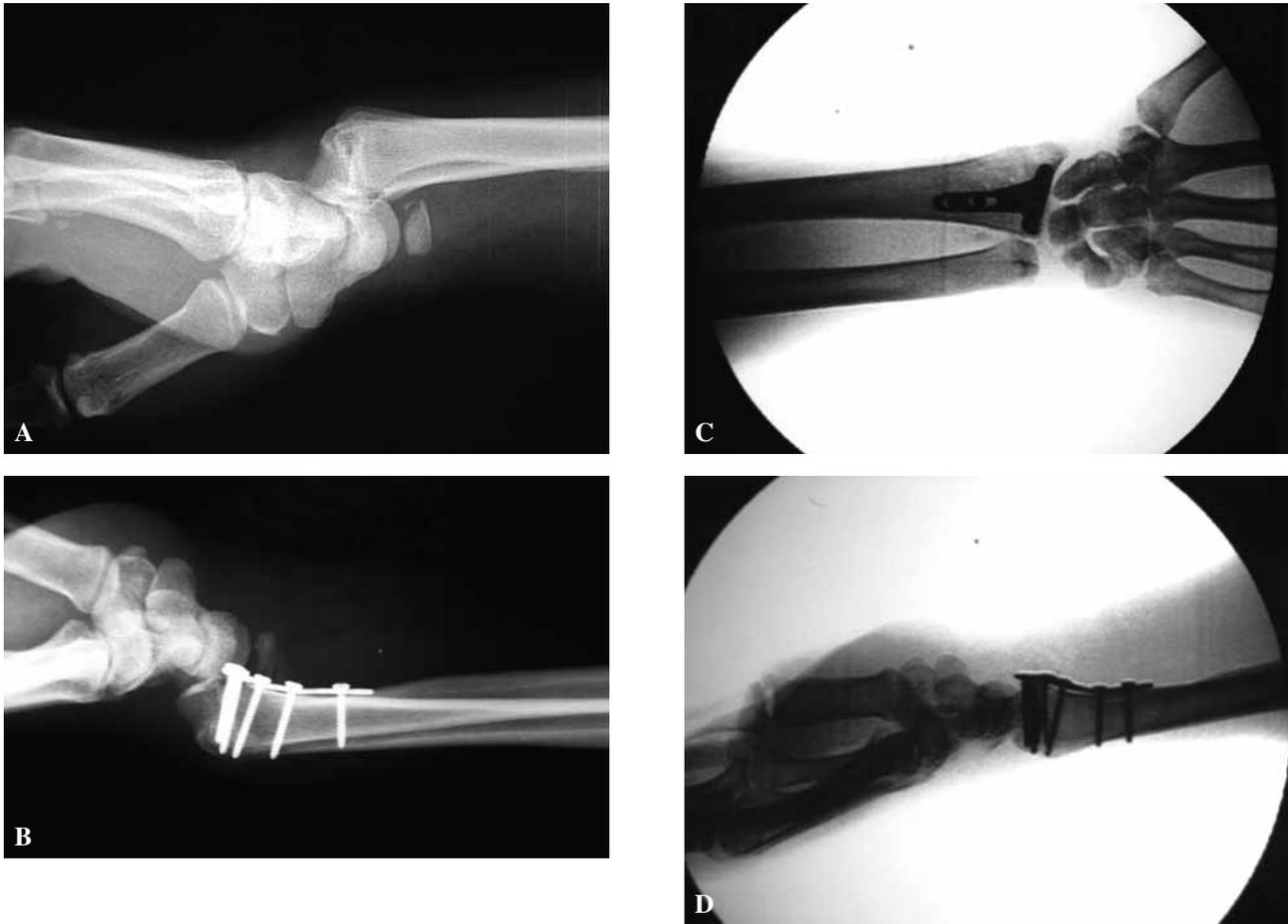


**Fig. 2.** — Rupture of the Flexor Pollicis Longus tendon in a 48-year-old male ; operative appearance of the lesion and its relationship to the plate.

8 months after plate fixation. He presented with inability to flex the interphalangeal joint of the thumb ; no pain and warning symptoms were associated. At operation, an attritional rupture of the FPL was found, associated with a dense mass of scar tissue overlying the plate (fig 2). Primary repair of the tendon was not possible and the FPL was reconstructed with a transfer of the Flexor Superficialis tendon of the ring finger. Radiographs showed the distal edge of the plate being prominent and not in close contact with the distal radius.

The second patient – a 60-year-old male who sustained a high-energy trauma with fracture-dislocation of the wrist – came to us one month after operation, claiming he was unable to actively flex the distal interphalangeal joint of the index finger. On clinical evaluation he could actively flex the DIP joint only when the PIP joint of the finger was fixed in extension by the examiner's hand and jointly with the other fingers but he was unable to do so if the PIP was left free. After 5 months the plate was removed and the tendons were explored. The Flexor Profundus tendon of the index finger was found intact but elongated and with degenerative changes ; scar adhesions were present with the plate. In this case also, the plate was not in close contact with the bone in its distal branch.

– *Loss of reduction* after plate fixation was observed in one case (fig 3). The patient was



**Fig. 3.** — Volar shearing fracture of the distal radius with carpal dislocation (A). Radiograph 14 days after volar plate fixation showed loss of fixation and recurrence of the carpal displacement (B). Repeat open reduction and internal fixation provided good reduction and restoration of radio-carpal alignment (C, D).

operated for a marginal fracture of the volar lunate facet associated with volar dislocation of the carpus. Immediate post-operative radiographs showed complete restoration of normal anatomy and alignment. Fourteen days later, a routine X-ray examination made with the cast revealed loss of fixation of the volar fragment and recurrence of carpal displacement. The patient required repeat open reduction and internal fixation. Although post-operative examination revealed restoration of normal radio-carpal alignment, after one month there was a partial loss of reduction with minimal carpal volar subluxation that persisted at final follow-up. Clinically he presented with normal

appearance of the wrist but loss of mobility (flexion 50°, extension 45°) and slight pain on manual activity, with some interference with his work.

— Clinical signs of *irritation of the median nerve* manifested in one case soon after plate fixation. The patient developed clinical signs of a carpal tunnel syndrome, which were confirmed by electromyography. Symptoms lasted until a carpal tunnel release was performed, 3 months after distal radius fixation. No signs of direct contact of the median nerve to the plate were found at operation.

No difference was noted in the incidence of complications with respect to the type of plate used (first or second generation implant).

## DISCUSSION

Initial reports of plate fixation for distal intra-articular radius fractures have shown acceptable results although high complication rates have been reported, up to 50% (2). Many of these complications have been related to the features of the device that was used (shape, thickness, material, screws) or to the surgical approach. Recent technical advancements produced several low profile plates designed to take screws that can be fixed to the plate, so as to avoid a secondary loss of reduction of the periarticular fragments, and lag screws to fix the plate to the shaft of the radius. Good results with lower complication rates have been reported with the use of a low profile preshaped rigid stainless steel plate (6), with a contourable titanium dorsal plate (AO pi plate) (5,18) or with a fixed angle volar T-shaped plate (1,16,17,19). In recent studies complications reported with a palmar approach ranged from 0% (19) to 16% (9).

Extensor tendon rupture or irritation is the most frequent problem associated with dorsal approach. Palmar plating avoids violating the extensor compartment and should virtually eliminate the complications of extensor tendon irritation and rupture. Despite this, extensor tendon rupture has been reported in some cases following volar plate fixation. In our series we observed two cases of tendon rupture (ELP and EIP + EIC) and one tenosynovitis of the extensor communis tendons all due to the tips of protruding screws. Rupture of ELP occurred without warning symptoms while rupture of index finger extensor tendons was preceded by swelling, weakness and mild pain.

Flexor tendon ruptures have been reported more frequently as a complication of volar plating. Bell *et al* (3) described three complete ruptures and one partial rupture of the flexor pollicis longus (FPL) caused by attrition from a volar buttress plate. In all cases the distal edge of the plate appeared to be prominent or to have become prominent as a result of collapse of the fracture; three cases were also associated with chronic use of steroids. According to Drobetz and Kutscha-Lissberg (9) rupture of FLP is the most frequent complication of locking screw volar plate fixation, occurring in 12% of patients at

a mean of 10 months after operation. In our series we have observed one rupture of FPL and one functional impairment of the flexor profundus of the index. In the first case the distal edge of the plate appeared prominent and the rupture was clearly due to an attritional lesion. The pathogenesis of the second case was more uncertain. Although the plate was not perfectly adherent to the bone, there were no signs of attritional damage to the tendon; it appeared elongated and frail but continuous. No signs of neurological lesion of the interosseous nerve were recorded by electromyography. An unrecognized lesion at the time of trauma or secondary to the operation was considered a possible cause.

Volar shearing fractures of the distal radius may be complicated by secondary loss of fixation and carpal dislocation. The problem is relevant when a marginal fracture of the volar lunate facet is present. Harness *et al* (11) described seven patients who lost fixation of a volar lunate facet fragment with subsequent carpal displacement after volar plate fixation of distal radius fractures. Four patients required repeat open reduction and internal fixation and one had a radiocarpal arthrodesis. Two patients declined additional operation and had persistent carpal dislocation. In our series loss of reduction was observed in one marginal lunate facet fracture. The reduction was considered adequate, but 14 days later, radiographs revealed complete carpal dislocation; reoperation and new plate fixation restored normal alignment. However, late follow-up revealed incomplete restoration of normal radio-carpal alignment with mild volar dislocation of the carpus, with partial loss of mobility and mild pain during heavy work.

With the exception of this peculiar type of fracture, loss of fixation in volar plating of distal radius fractures, using the modern fixation devices, seems to be rare and may be related with improper indication or imperfect surgical reduction.

Carpal tunnel syndrome following plate fixation was observed in one case and required surgical release. This complication has been described in association with volar plating (7,10,12), but may occur in distal radius fractures irrespective of the method of treatment used.

Other complications described occasionally in literature such as infections (12), compartment syndrome (11), breakage of the plate or vascular injury (8) were not observed.

### CONCLUSIONS

Complications were noted in 8% of cases following volar plating of distal radius fractures. Tendon ruptures or irritation of flexor and extensor tendons were the most frequent complications observed. They usually occurred months after operations with no or minor warning symptoms.

Extensor tendons impairment was associated with attrition caused by the protruding tips of distal screws. This emphasizes the need for accuracy in the measurement and placement of the locked distal screws.

Flexor tendon rupture is generally caused by attrition from a prominent distal edge of the plate. The FPL tendon is most prone to attritional damage.

When radiographs show dorsal protrusion of the screws or prominence of the distal edge of the plate, the patient should be informed about the risks of tendon rupture and early removal of the plate, according to the progress of fracture healing, should be suggested.

In volar shearing fractures with a displaced lunar facet fragment and carpal dislocation, all attempts should be made to achieve a perfect and stable fixation of this small fragment, considering the high incidence of loss of fixation that can be expected.

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