

MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS FOR DISTAL RADIUS FRACTURES: SURGICAL TECHNIQUE

M. TOBE¹, K. MIZUTANI¹, Y. TSUBUKU¹, Y. YANAGIHARA²

¹Department of 2nd Orthopaedic Surgery, Toho University, Tokyo, Japan

²Department of Orthopaedic Surgery, Sanno Hospital

SUMMARY

Purpose: Palmar locking plate has been undergone for dorsally displaced fractures of distal radius. But it is usually required with wide exposure involving the pronator quadratus muscle. A new technique of minimally invasive osteosynthesis using a new palmar locking plate system which are developed by authors is reported. **Methods:** From 2004 to 2006, 35 wrists in 35 patients with the mean age of 58 years. The type of fractures consist on 14 wrists in A2, 10 in A3, 7 in C1, 4 in C2 according to the AO classification. The follow-up period ranged from six to 24 months, with a mean of nine months. After incising the distal and proximal edges of the PQ, it is elevated subperiosteally. A locking plate is passed beneath the pronator quadratus muscle from the distal margin without transecting the muscle. Insertion of the proximal screws and reduction of the intra-articular fragment are performed through the limited incision of the pronator quadratus muscle. Active motion of fingers and wrist are started at next day after surgery. **Results:** Union was achieved in all fractures without loss of reduction in X-ray measurement. The clinical evaluations were excellent in 33 wrists, good in 2 according to a modified the Green and O'Brien score. An almost normal function was reached within 3 weeks follow-up examination. **Conclusions:** This new technique prevents soft tissue damage and adhesion around the pronator quadratus muscle. Although the indications of this technique are limited for the fractures of all extra-articular fractures or simple type of intra-articular fractures, we believe that distal radius fractures without severe comminution can be cured within three weeks.

Riv Chir Mano 2006; 3: 280-284

KEY WORDS

Osteosynthesis, distal radius, fractures

INTRODUCTION

Distal radius fractures are most common fracture in upper extremity. Many kinds of methods such as closed reduction with plaster immobilization, external fixator and conventional plate fixation from dorsal or palmar have been performed in the past.

Recently, palmar locking plate has been used for dorsally displaced fractures of distal radius (1). But it is usually required with wide exposure involving the pronator quadratus muscle (PQ).

Technique of minimally invasive plate osteosynthesis (MIPO) has been reported for the fractures in the lower extremity (2-4). They were developed to minimize soft tissue damage (5). In the up-

per extremity, there is a report without transecting the pronator quadratus muscle for fractures of the metaphysis of the radius (6).

A new technique of minimally invasive osteosynthesis using a palmar locking plate is reported.

MATERIALS AND METHODS

From 2004 to 2006, 35 wrists in 35 patients with the mean age of 58 years at the time of the injury (range, 24-88 years). The type of fractures consist on 14 wrists in A2, 10 in A3, 7 in C1, 4 in C2 according to the AO classification. The cause of injury was stumbling in 27, traffic accident in 6 and falling from a height in 2. The follow-up period ranged from six to 24 months, with a mean of nine months. All patients underwent to surgical treatment within 7 days; ranged from 2 to 7 days with a mean of 4 days. For the fixation, we have used distal window plate systems which were developed by authors.

SURGICAL TECHNIQUE

In all the patients surgery is performed with the patient in supine position under brachial plexus block or general anesthesia, and a pneumatic tourniquet is applied. Fluoroscopic examination is necessary to confirm the reduction. Henry approach, about 6 cm in length, is made. The fascia is divided longitudinally between the flexor carpi radialis tendon and the radial artery. After allowing retraction of flexor tendons and median nerve toward ulnar site, the entire pronator quadratus muscle is visualized.

After incising the distal and proximal edges of the PQ, it is elevated subperiostally (Fig. 1A). The fracture is reduced under fluoroscopic control. When good reduction is not achieved, Kapandji's technique is performed from dorsal site using a 1.8 mm K-wire.

Dorsally displaced fragments of the distal radius usually exist in the distal portion of the pronator quadratus muscle, so a locking plate is passed beneath the muscle from the distal margin (Fig. 1B). It is important to note that the fracture is usually covered with the pronator quadratus muscle and it

is easy to reduce the fracture without transecting through longitudinally.

Correct placement of the plate over the fracture is confirmed by fluoroscopy. The plate is secured to the distal radius with distal locking screws which are inserted into subchondral bone just beneath the articular surface. The proximal site of the plate is lifted up using an elevator with an adapted angle under fluoroscopy (Fig. 1C). Subsequently, the proximal site of the plate is lined to the radial shaft. Since this procedure make the tension to the dorsal periosteum, the displaced fragments on the dorsal are reduced anatomically. We so called "periost taxis". It is an important technique to achieve an exactly reduction.

The alignment, radial length and rotation of the fracture were confirmed under fluoroscopy and screws are inserted in the proximal end of the plate.

Transverse incision which is about 4 mm in a diameter is made in the muscle belly under fluoroscopy above the central screw hole. A central screw is inserted through the pronator quadratus muscle (Fig. 1D). When the reduction with bone grafting is required in comminuted fractures, it can be performed using the bone impactor through the window after transverse limited exposure on the PQ (Fig. 1E). After reduction for displaced fragments we usually use the injectable calcium phosphate bone cement (Fig. 1F). Thus, the reduction for the comminuted fractures is performed in minimally invasive technique (Fig. 1G, H).

Active motion of fingers and wrist are started at next day after surgery. No splint and no external fixator are needed after surgery.

The clinical assessment was assessed according to a modified the Green and O'Brien score, the range of motion was measured on 1, 3, 6, 24 weeks and an X-ray measurement (palmar tilt and ulnar variance) was performed.

RESULTS

Union was achieved in all fractures. The clinical evaluations were excellent in 33 wrists, good in 2 according to a modified the Green and O'Brien score.

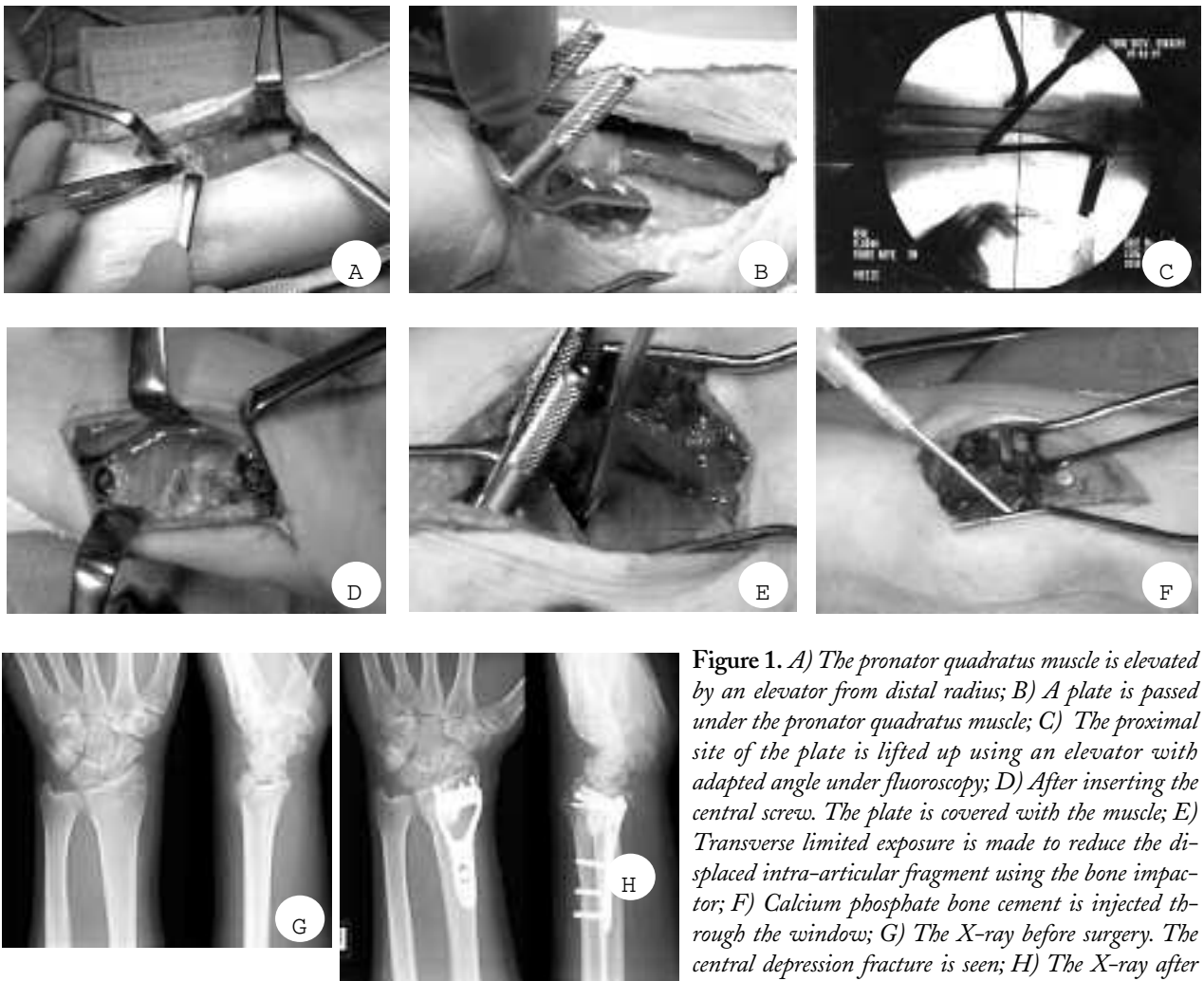


Figure 1. *A) The pronator quadratus muscle is elevated by an elevator from distal radius; B) A plate is passed under the pronator quadratus muscle; C) The proximal site of the plate is lifted up using an elevator with adapted angle under fluoroscopy; D) After inserting the central screw. The plate is covered with the muscle; E) Transverse limited exposure is made to reduce the displaced intra-articular fragment using the bone impactor; F) Calcium phosphate bone cement is injected through the window; G) The X-ray before surgery. The central depression fracture is seen; H) The X-ray after surgery. Anatomical reduction is achieved.*

Early functional results are presented in figure 2. An almost normal function was reached within 3 weeks follow-up examination (Fig. 3).

In X-ray measurement, there is no significant difference between just after surgery and 6 months after surgery in palmar tilt and ulnar variance (Fig. 4).

DISCUSSIONS

Several dorsal plates for dorsally displaced fracture of the distal radius have been developed based on the theory “buttress effect”. But many investigators have pointed out the complications of dorsal

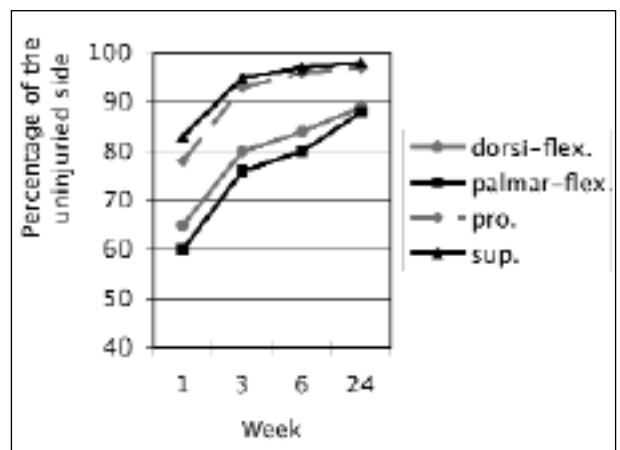


Figure 2. *Early functional results in range of motion.*

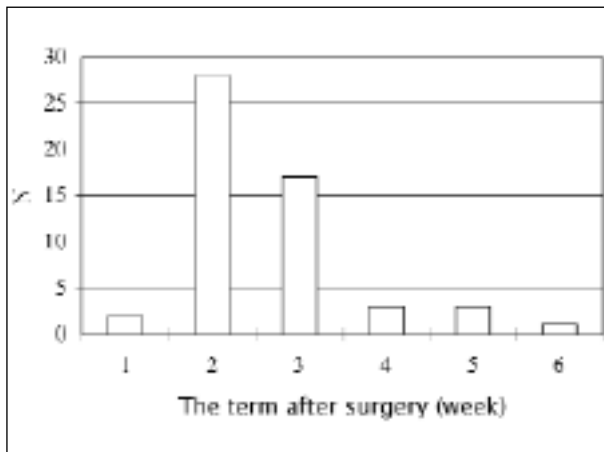


Figure 3. The graph in the term of return to daily activities.

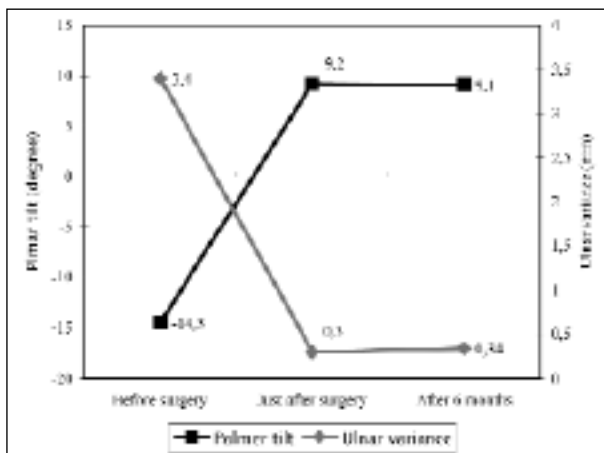


Figure 4. The outcomes of X-ray measurement in palmar tilt and ulnar variance.

plating including tendon ruptures and irritations. And, dorsal plating using conventional plates cannot prevent radial shorting or displacement of the distal radius. In addition, a loosening of the screw and bone collapse may frequently occur in the elderly due to its osteoporosis.

Palmar locking plate for dorsally displaced fracture of the distal radius has been reported recently. Distal fixation through the insertion of buttress pins just into the subchondral bone with an adjusted angle to the articular surface and the proximal limb of the plate lined up the radius shaft reduce the fracture anatomically in terms of radial length and palmar tilt. (1, 7-9) However, it is usually re-

quired wide exposure involving an injury to the pronator quadratus muscle.

The PQ has two distinct heads. The superficial head is prime mover in forearm pronation and the deep head is a dynamic stabilizer of distal radio-ulnar joint (10). The pronator quadratus muscle is expanded about 1 cm by maximum pronation and supination (11). When the pronator quadratus muscle is divided longitudinally, adhesion around the muscle may inevitably occur. Therefore, an early exercise of forearm pronation and supination is limited in conventional palmar plating.

This new technique prevents soft tissue damage and adhesion around the PQ. Keeping the PQ does not become a trouble during surgery and it yields to high functional results just after surgery. Although the indications of this technique are limited for the fractures of all extra-articular fractures or simple type of intra-articular fractures, we believe that distal radius fractures without severe comminution can be cured within three weeks.

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