Treatment of Intra-articular Distal Radius Fractures

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KEYWORDS

• Intra-articular distal radius fracture • Arthroscopy • Fracture malunion
• Triangular fibrocartilage complex • Scapholunate ligament • Distal radioulnar joint

KEY POINTS

- Understanding of detailed morphology of the distal radius is required to prevent flexor tendon problems after plate surgery.
- A plate presetting and arthroscopic reduction technique (PART) is described, that can simplify combination of plating and arthroscopy in treating this fracture.
- Complete ligament rupture at dorsal scapholunate ligament (SL) space and foveal triangular fibrocartilage complex (TFCC) attachment can be diagnosed arthroscopically, and the repair may lead to better clinical results rather than attempting to manage chronic instability.
- Accurate corrective osteotomy for intra-articular fracture malunion is possible using CT bone models and a custom-made surgical template.

DISTAL RADIUS MORPHOLOGY

Volar locking plate (VLP) fixation is popular in the treatment of unstable distal radius fractures (DRFs). In surgical management of DRFs with severe comminution or marked osteoporosis, the authors believe it is particularly important to apply a subchondral buttress fixation involving distal locking screws and a plate to stabilize the volar fragment. In these cases, very distal placement of the locking plate may be necessary[1] but with a risk of flexor tendon impingement.

The Watershed Line Revisited

Orbay[2] reported that the concave surface of the volar radius was limited distally by a transverse ridge or watershed line. Implants placed over or projecting above the watershed line can potentially irritate and even lead to the rupture of the flexor tendons.

The authors recorded the macroscopic appearance of the volar aspect of the distal radius, volar radiocarpal ligaments, and pronator quadratus.[3] Ulnarly the volar radius had 2 main distal transverse lines indicating the bony prominence. One

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comprises the distal higher bony prominent line and the other comprises the proximal lower bony prominent line forming the distal bony ridge of the pronator fossa (Fig. 1). Radially these 2 lines merge. The volar radius also has radial and ulnar bony prominences (see Fig. 1; Fig. 2) on the distal higher line, which can be palpated in all specimens even on the articular capsule and volar radiocarpal ligaments. The ulnar bony prominence is larger than the radial bony prominence and the highest point on the volar aspect of the distal end of the radius. A line connecting the distal margin of the pronator quadratus (see Fig. 1) does not correspond to the distal ridge of the pronator fossa.

Another study by the authors showed that the flexor digitorum profundus (FDP) tendon of the index finger runs on the radial surface of the ulnar bony prominence. The flexor pollicis longus (FPL) tendon runs just laterally to the FDP tendon in all 26 specimens.[4] Therefore, the ulnar bony prominence on the volar aspect of the distal end of the radius is a reliable landmark. The dangerous zone for flexor impingement was a mean of 11 mm ± 1 mm radial to the ulnar bony prominence of the volar distal end of the radius in the 26 specimens. In this zone, surgeons should avoid volar implants protruding anterior to the volar rim of the distal radius (see Fig. 2). Microscopically, the authors assessed a series of sagittal sections of the wrist regions to investigate the positional relationships over the volar aspect of the distal radius, pronator quadratus, intermediate fibrous zone, and radiocarpal ligaments (Fig. 3).

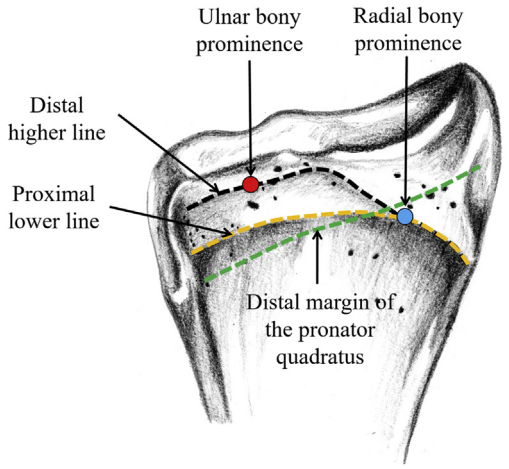

Fig. 1. Schematic drawing of the volar aspect of the radius. The 2 dotted lines indicate the bony inflexion points based on the macroscopic and microscopic observations. The black dotted line indicates the distal higher bony inflexion points, and the yellow dotted line indicates the proximal lower bony inflexion points, as the most distal ridge of the pronator fossa. The green dotted line indicates the distal margin of the pronator quadratus muscle. In addition, there are 2 bony prominences, ulnar and radial, on the black dotted line indicated by the red dot and blue dot, respectively.

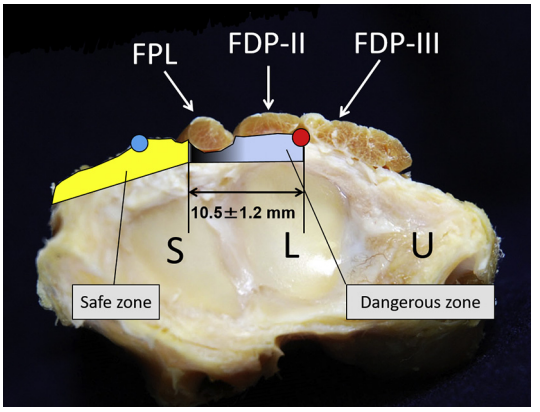

Fig. 2. Articular view. The radial prominence is indicated by the blue dot and the ulnar prominence by the red dot. The FDP tendon to the index finger runs on the lateral surface of the ulnar prominence. The FPL tendon runs just laterally to the FDP II and III tendon of the index and middle finger and between the 2 bony prominences in all specimens. The dangerous zone is 10 mm ± 1 mm radial to the ulnar prominence of the radius. In this zone, the volar implants should not be projected anterior to the rim of the distal radius. L, lunate bone; S, scaphoid bone; U, ulna.

The authors believe that the watershed line is not a distinct line; it corresponds to the distal margin of the pronator fossa in the radial aspect of the volar radius and to a hypothetical line between the distal and proximal lines in the ulnar aspect. The radial and ulnar bony prominences on the volar radius should be key structures for accurate plate placement to avoid flexor tendon injury.

Volar Morphology of the Distal Radius

Based on CT scans of 70 normal forearms, Oura and colleagues[5] found that the concavity depth was at its maximum (1.7 ± 0.8 mm) at 6 mm proximal to the palmar edge of the lunate fossa and progressively decreases toward the proximal radius. The FPL is closest to the radius at 2 mm proximal to the palmar edge of the lunate fossa; the volar surface of the distal radius was supinated from proximal to distal (mean external rotation: 10°). Yoneda and colleagues[6] investigated the teardrop height ratio and teardrop inclination angle, representing the volar projection of the lunate facet of the distal radius; they showed