Correction of Residual Radial Translation of the Distal Fragment in Distal Radius Fracture Open Reduction

Mark Ross, MBBS,*†‡ Lex Allen, MD,*†¶ Gregory B. Couzens, MBBS*†§

Distal radius fractures are common injuries of the upper extremity requiring treatment. In recent years, volar locking plate (VLP) fixation has become favored for operative treatment with the main goals being anatomic reduction and rigid fixation allowing for an early range of motion rehabilitation protocol. VLP fixation is excellent at correcting sagittal plane alignment with restoration of volar tilt. However, plate designs do not have any intrinsic features to their designs to assist with correction of coronal plane translation. One possible sequela of distal radius fractures is residual instability of the distal radioulnar joint. This instability can lead to pain and disability after treatment of distal radius fractures requiring further interventions. It has been demonstrated that coronal plane malreduction with residual radial translation of the distal fragment may contribute to ongoing distal radioulnar joint instability after distal radius fractures. We describe a technique for intraoperative correction of residual radial translation. It may be used when radial translation is recognized during internal fixation with a VLP or when correction of radial translation is required as part of a corrective osteotomy for radial malunion. *(J Hand Surg Am. 2015;40(12):2465–2470. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Distal radius fracture, DRUJ instability, radial translation, volar plate, wrist.

Surgical Technique

DISTAL RADIUS FRACTURES ARE THE most common fractures seen in the emergency department.[1] Management can either be operative or non-surgical depending on patient and fracture characteristics.[1–6] Various treatment approaches exist that aim to restore the functional anatomy. In recent years, there have been many advances in operative treatment, which contribute to achieving anatomical reduction, stable fixation, early mobility, and return to function.[1,2,4,7] The use of a volar locking plate (VLP) has consistently been able to achieve optimal outcomes.[2–5,7] The use of a VLP to treat distal radius fractures facilitates reduction and provides stability to allow for early range of motion protocols during the rehabilitation period.[2]

Instability of the distal radioulnar joint (DRUJ) is one of the well-recognized sequelae of distal radius fractures.[2,8–14] Various factors contribute to stability of the DRUJ, including osseous anatomy, joint capsule, radioulnar ligaments, triangular fibrocartilage complex, ulnocarpal ligaments, interosseous membrane (IOM), and muscles about the wrist joint.[9,15,16] The extent to which each of these structures contributes to DRUJ stability is not fully understood, but it is accepted that disruption of these structures, or the anatomic relationship between them, can lead to DRUJ instability. Instability of the DRUJ may lead to ongoing morbidity and often requires further interventions.[1,2,4,9,16] Many procedures have been described to address DRUJ instability with varying outcomes. However, prevention of DRUJ instability after distal radius fractures is preferred.

*From the *Brisbane Hand and Upper Limb Research Institute, Brisbane Private Hospital, Brisbane; the †Orthopaedic Department, Princess Alexandra Hospital, Woolloongabba; the ‡School of Medicine, The University of Queensland, St. Lucia; the §Institute of Health and Biomedical Innovation, Kelvin Grove, Queensland, Australia; and the ¶Southern Utah Orthopedics and Sports Medicine Clinic, Valley View Medical Centre, Cedar City, Utah.*

Received for publication February 25, 2015; accepted in revised form September 18, 2015.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Mark Ross, MBBS, Brisbane Hand and Upper Limb Research Institute, Brisbane Private Hospital, Level 9, 259 Wickham Terrace, Brisbane 4000, Queensland, Australia; e-mail: markross@upperlimb.com.

0363-5023/15/4012-0026$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2015.09.008

Because of their design, VLPs are a preferred treatment option for correcting volar tilt. They can be utilized to facilitate correction of radial inclination and ulnar variance intraoperatively.[2,8] Correction of these radiographic parameters is required to allow normal function of the wrist after distal radius fractures.

The more recently described radiographic parameter termed "radial translation" is used in assessing coronal plane malreduction of the distal radius fragment relative to the radial shaft during open reduction and internal fixation (ORIF) of distal radius fractures (Fig. 1).[2,8] This malreduction was found to be important because radial translation of the distal fragment is a potential cause of DRUJ instability.[2,8,11,12,14,16]

We first made this observation in our practice when we began using radial column plates as part of our fragment-specific approach to ORIF of distal radius fractures. We noted that in patients undergoing fracture fixation with a radial column plate, there was a lower incidence of DRUJ instability. After a review of our cases, we found that the differentiating factor between the radial column plate and the VLP was the quality of the reduction in the coronal plane.[8] By its design the radial column plate automatically corrects any radial translation of the distal fragment, whereas ORIF with the VLP does not by default necessarily correct the coronal plane deformity.

This residual radial translation contributed to DRUJ instability because malpositioning of the distal fragment results in loss of tension of the distal portion of the IOM and pronator quadratus (PQ).[8,16] A consequence of this tension loss is that even if the sigmoid notch is well positioned in all other respects (length, coronal tilt, and sagittal tilt), the ulnar head may not be held firmly into the concavity of the sigmoid notch possibly contributing to instability of the DRUJ.[8] Wolfe et al contributed to this observation by confirming in a cadaver study that residual translation of the distal radius fragment in distal radius fractures can indeed contribute to DRUJ instability by detensioning the IOM.[16]

Radial translation can be assessed by intraoperative radiographs using a recently developed parameter.[8] When radial translation is identified, it can be corrected during ORIF with VLPs as we describe in this technique, thereby decreasing the potential for DRUJ instability.

INDICATIONS

The decision to manage distal radius fractures operatively or nonoperatively is complex. A complete discussion of this topic is beyond the scope of this article,

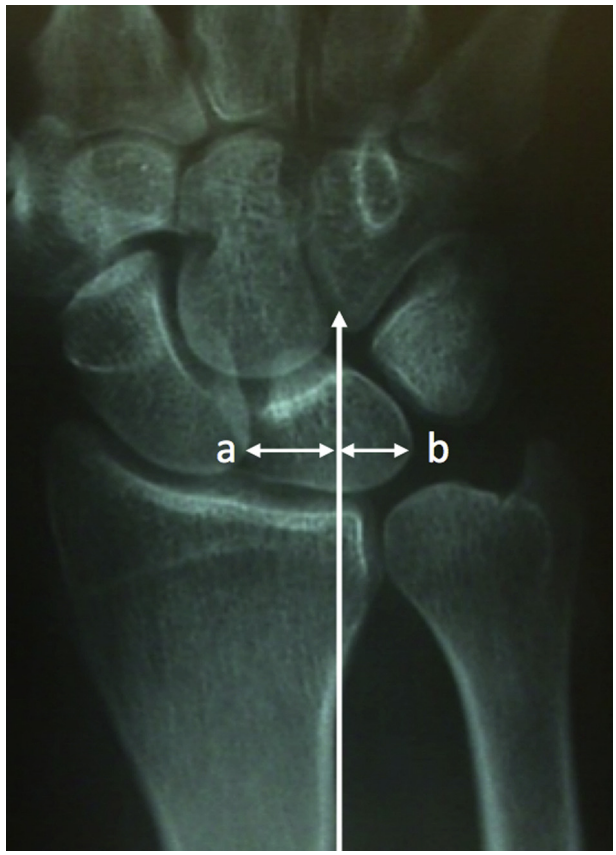

FIGURE 1: Measurement of the radial translation parameter described by Ross et al. A line is drawn on the PA radiograph along the ulnar aspect of the radius before the metaphyseal flare. A line is drawn along the lunate, parallel with the distal radial articulation. The proportion of lunate on the radial side is expressed as a percentage: $a/(a+b) \times 100$.

but once the decision is made to proceed with operative treatment, correction of residual radial translation needs to be one of the priorities in obtaining an anatomic reduction. We utilize the radiographic parameter recently described by the senior authors of this article for intraoperative assessment of radial translation.[8] Radiographs of the other side may be beneficial in quantifying this parameter. The parameter is defined by the percentage of lunate that lies radial to a line drawn along the ulnar border of the radial diaphysis extending distally to bisect the lunate on an AP radiograph of the wrist. In 100 normal wrists, an average of 45.48% (range, 25% to 73.68%) of the lunate was found to lie radial to this bisecting line.[8] This parameter should be used to assess the degree of coronal plane residual translation that may exist when assessing the quality of the reduction. We would recommend using this parameter to make a quantitative comparison of coronal plane translation relative to the opposite wrist. This will allow an assessment of what is normal for this patient and