Current Trends in the Management of Distal Radius Fractures

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abstract

This article discusses recent reports on distal radius fractures. The keyword “distal radius fracture” was used to query the PubMed database of the US National Library of Medicine. From the resulting list, articles published in the Journal of Hand Surgery (American Volume), the Journal of Hand Surgery (European Volume), and the Journal of Orthopaedic Trauma from April 2014 through December 2015 were reviewed. Related commentaries were also evaluated. Case series of fewer than 5 patients were excluded. The 65 studies and commentaries identified are categorized and summarized. [Orthopedics. 2017; 40(3):145-152.]

This update summarizes the numerous recently published investigations of distal radius fractures. The keyword “distal radius fracture” was used to query PubMed. Articles and related commentaries published in the Journal of Hand Surgery (American Volume), the Journal of Hand Surgery (European Volume), and the Journal of Orthopaedic Trauma from April 2014 through December 2015 were reviewed. Related commentaries were also evaluated. Case series of fewer than 5 patients were excluded. The identified articles were summarized and broadly organized into biomechanics, imaging, surgical technique, and postoperative findings.

BIOMECHANICS
Effect of Distal Radius Fracture Malalignment on the Distal Ulna
To measure the effects of distal radius malalignment on loading at the distal ulna by simulating graded angulation and translation malalignment of the distal radius, Ferreira et al measured force and torque on the distal ulna with a novel load cell design. The authors noted significant increases in force and torque on the distal ulna as both forms of malalignment increased and stated that “combined conditions of angulation and translation increased force and torque in the distal ulna to a greater extent than with either condition in isolation.” They postulated that the resultant articular incongruity at the distal radioulnar joint and the subsequent increase in triangular fibrocartilage complex tension may contribute to residual ulnar wrist pain and dysfunction after union of malaligned distal radius fractures.

Distal Radioulnar Joint Stability
Dy et al evaluated the importance of coronal alignment during fixation of distal radius fractures. Proper alignment may help to prevent distal radioulnar joint instability. After performing distal radius osteotomy proximal to the sigmoid notch base to simulate a distal radius fracture and transection of the ulnar styloid to simulate associated triangular fibrocartilage complex detachment, Dy et al placed modified volar locking plates and shifted the distal radius fragment radially in 2-mm increments to evaluate the effect of coronal alignment of the distal fragment on dorsal-volar distal radioulnar joint displacement during distal radial articular
loading. They found that loading only specimens with distinct distal oblique bundles of the interosseous membrane increased dorsal-volar distal radioulnar joint displacement at coronal shift of 2 mm. Greater coronal malalignment in these specimens or any malalignment in specimens without a distal oblique bundle had no effect on distal radioulnar joint displacement under load. Kloss and Clawson\(^3\) wrote a commentary on this article claiming that further study is needed to understand whether identifiable distal oblique bundles need repair in coronally translated distal radius fractures with distal radioulnar joint instability. They noted that “following [open reduction and internal fixation] of a distal radius fracture, the distal radioulnar joint shuck test, with/without radiographic distal radioulnar joint diastasis, remains the intraoperative indication for triangular fibrocartilage complex/ulnar styloid repair.”

In an evaluation of 29 patients with distal radius fractures and positive intraoperative radioulnar stress test results, Gong et al\(^4\) examined whether open repair of the triangular fibrocartilage complex or an ulnar styloid base fracture at the time of volar plating would enable early mobilization of the wrist without the risk of distal radioulnar joint instability. At 1 week after surgery, patients’ wrists were mobilized. All patients had stable distal radioulnar joints on stress testing and reasonable functional outcomes 1 year postoperatively. However, this study did not include a control group. Xing et al\(^5\) assessed contact characteristics of the distal radioulnar joint in patients with malunited distal radius fractures in vivo with computed tomography. They found that the contact area of the distal radioulnar joint and the centroids of the contact area on the sigmoid notch were altered. The distal radioulnar joint contact area increased during wrist flexion and decreased during wrist extension and ulnar deviation, and the sigmoid notch contact centroids moved volarly during wrist flexion-extension and ulnar deviation compared with the uninjured wrists.

In a cadaveric study that used a 3-dimensional tracking system, Hepper et al\(^6\) confirmed previous findings that showed that extra-articular coronal translation of distal radius fracture fragments had negligible effect on forearm rotation.

**Effects of Sagittal Plane Angulation Deformities**

Nishiwaki et al\(^7\) examined the effects of dorsal angulation deformities of distal radius fractures with and without triangular fibrocartilage complex rupture on the 3-dimensional kinematics of the distal radioulnar joint during simulated active motion. With a cadaveric model that used an adjustable implant, the authors found that even with an intact triangular fibrocartilage complex, as little as 10° dorsal angulation significantly increased distal displacement of the ulna. Sectioning of the triangular fibrocartilage complex further increased distal displacement and resulted in volar and ulnar displacement of the ulna. This finding highlights the importance of careful assessment of the integrity of the triangular fibrocartilage complex in treatment planning for patients with dorsally angulated distal radius fractures. In another study of the effects of volarly angulated distal radius fractures on forearm rotation and distal radioulnar joint kinematics, Nishiwaki et al\(^8\) found that 20° volar angulation deformity decreased wrist supination but preserved pronation. They also found that forearm rotation was not affected by the competency of the triangular fibrocartilage complex, although wrists with an intact triangular fibrocartilage complex showed dorsal translation of the ulna when pronating and showed volar translation when supinating. The ulna translated dorsally in wrists that had a sectioned triangular fibrocartilage complex.

In a cadaveric study of the effects of volar angulation on the stiffness of the distal radioulnar joint in extra-articular distal radius fractures, Bessho et al\(^9\) found that volar angulation deformities of the distal radius should be corrected to 10° volar tilt when the triangular fibrocartilage complex is intact. Otherwise, stiffness in the distal radioulnar joint becomes significant in multiple planes and with the wrist in multiple positions.

To help clarify the indications for surgical correction of malunited distal radius fracture with dorsal angulation of 10° to 20°, Chen et al\(^10\) used 3-dimensional computed tomography reconstruction measurements to investigate in vivo changes in the length of the carpal ligament. The length of the dorsal radiocarpal and ulnotriquetral ligaments showed substantial change, even with mild dorsal angulation of the distal radius, whereas the length of most other ligaments was not substantially affected.

**IMAGING**

**Postoperative Imaging**

In a large retrospective chart review, Stone et al\(^11\) found that routine 2-week postoperative radiographs had limited clinical utility after operative treatment of distal radius fractures. Only 1% of the study population had an “unexpected change in management,” based on radiographic findings, and these patients had trauma to the operative extremity in the interim between surgery and 2-week follow-up. Bohl et al\(^12\) rejected their own primary hypothesis that a “positive clinical assessment” would predict radiographic change at the initial postoperative visit after distal radius fracture fixation. No patient with a positive clinical assessment had changes on postoperative radiographs, and the secondary hypotheses suggesting that fracture comminution, patient age, stability of fixation, and Soong classification could predict radiographic changes postoperatively were rejected as well.

**Bone Density**

In women older than 50 years with distal radius fractures, bicortical thickness of the distal radius was positively correlated with femoral bone density, but not lumbar spine bone density, as measured
on dual-energy x-ray absorptiometry. In a retrospective review of 78 patients with displaced distal radius fractures managed with closed reduction and splinting, Robin et al evaluated the relationship between bone mineral density from dual-energy x-ray absorptiometry scans obtained within 1 year of injury and loss of reduction. The authors found that T-scores of the lumbar spine and femoral neck had no predictive value for maintenance of reduction in patients older than 65 years.

Roh et al identified factors that influenced delayed functional recovery, as assessed with grip strength testing, range of motion testing, and the Michigan Hand Outcomes Questionnaire, after volar plate fixation of distal radius fractures. Increased age and decreased bone mineral density were risk factors for delayed functional recovery up to 12 months postoperatively, and the effects of fracture severity and high-energy trauma slowed recovery for up to 6 months postoperatively. This study found that all measures of functional recovery showed continual improvement over the 12-month study period.

Sarfani et al assessed the efficacy of a multimodal approach to improve osteoporosis screening after distal radius fracture. They noted that the number of identified patients with distal radius fractures undergoing osteoporosis screening increased from 15% to 80% after a concerted approach by orthopedists, endocrinologists, and patient educators involving patient education by all parties, direct referrals to endocrinologists and for dual-energy x-ray absorptiometry scan, and follow-up telephone calls to assess barriers to initial referral. As a result of these efforts, 64% of referred patients were diagnosed with osteoporosis or osteopenia, allowing for adequate treatment.

Ultrasound-Guided Reduction

In patients with extra-articular distal radius fractures that were subsequently treated conservatively with cast immobilization, Kodama et al found that ultrasound-guided closed reduction was a viable and simple option for confirming and aiding reduction in the emergency department after initial radiographs. Patients who had closed reduction with ultrasound, fluoroscopy, or no imaging showed no difference in pre- and postreduction radiograph parameters, total cost, or “success rate.” However, ultrasound-guided reduction took longer than the other methods.

Reliability of Interobserver Assessment

After reviewing radiographs of distal radius fractures treated both operatively and nonoperatively, Patel et al created a radius union scoring system and evaluated its intra- and interobserver reliability for determining fracture union in the distal radius. The authors found substantial agreement for intraobserver reliability for fractures treated nonsurgically or with open reduction and internal fixation. Substantial agreement was found for nonsurgical treatment, and moderate agreement was found for open reduction and internal fixation for interobserver reliability. In addition, based on reviewer assessment, this scoring system had a statistically significant predictive value in differentiating between fracture union and nonunion. However, Rodrigues et al questioned these claims, citing flawed statistical methods and data interpretation.

In a web-based study of 252 orthopedic surgeons from a variety of countries, surgeons were randomized to receive either radiographs and clinical information or radiographs only for 30 patients who presented to an emergency department with distal radius fractures. Neuhaus et al found that, in both groups, surgery was recommended approximately 52% of the time. The recommendation for surgery was most strongly related to radiographic presentation rather than surgeon characteristics (years of experience, sex, hand specialization). Patient characteristics had little effect on the likelihood of choosing operative treatment. Additionally, younger surgeons and surgeons with hand specialization were only slightly more likely than other surgeons to concur on treatment.

Surgical Technique

Optimal Anesthesia for Reduction

As an alternative to procedural sedation for distal radius fracture reduction in children, Bear et al reported that hematoma block significantly reduced time spent in the emergency department and did not compromise radiographic alignment, patient satisfaction, or pain control. Limitations of this study included lack of randomization and allowing patients to choose their treatment arm. In addition, most of the patients were 9 years or older, which does not fully reflect the distribution of patients with distal radius fractures who present to a pediatric emergency department.

Important Factors Affecting the Operative Plan

In patients with proper volar plating for volar shearing fractures with separate scaphoid and lunate facet fragments (AO type B3.3) with proximal-distal lunate facet length of less than 15 mm available for fixation or initial lunate subluxation of greater than 5 mm, Beck et al recommended added fixation of the lunate facet fragments to maintain reduction.

In a retrospective database study, Teunis et al concluded that preoperatively unreduced distal radius fractures were not associated with increased adverse events or subsequent surgery. However, they noted limitations, including the lack of prospective study design and comparison of patient satisfaction and pain level.

In a population of patients younger than 65 years undergoing either operative or nonoperative treatment of distal radius fractures with and without associated ulnar styloid fractures, Daneshvar et al found that patients with an associated ulnar styloid fracture had higher pain and disability, as measured with the Patient-Rated Wrist Evaluation, through the 12-month follow-up period, but these
differences were not clinically significant. Although recovery of wrist flexion and grip strength was slower in these patients compared with those without ulnar styloid fracture, no long-term deficits were identified at 12 months, even in the presence of ulnar styloid fracture nonunion.

**Approaches and Techniques**

Cannon et al\(^\text{25}\) reported a technique that spares the pronator quadratus. This technique is ideal for, but not limited to, volar shear and metaphyseal fractures that involve tunneling a volar locking plate between the pronator quadratus and the volar surface of the distal radius without releasing the radial border of the pronator quadratus. Although radiographic outcomes were promising, the authors did not assess clinical outcomes.

Fok et al\(^\text{26}\) outlined a less invasive distal osteotomy of the radius for symptomatic patients with malunited dorsally displaced extra-articular distal radius fractures. Through a dorsal incision, a dorsal open wedge osteotomy is performed over a hinge located at the palmar cortex and subsequently stabilized with a single fixed-angle dorsal nail plate placed in both extra- and intramedullary spaces.

Mithani et al\(^\text{27}\) reported a case series of fracture salvage with a dorsal spanning distraction plate for the rare and complex case of distal radius nonunion with osteopenia or distal fractures and fractures with severe shortening that cannot be reduced and rigidly fixed with nonspanning techniques alone. The authors noted significant improvement in arc of motion, supination, and Disabilities of the Arm, Shoulder and Hand scores from preoperative scores and reported distraction plating with or without supplemental nonspanning fixation and bone grafting as a reasonable alternative to wrist arthrodesis.

Kim and Tae\(^\text{28}\) reported favorable outcomes with insertion of 1 or 2 K-wires in the subchondral bone parallel to the radiocarpal joint surface and through the distal radioulnar joint adjunctively to an accepted percutaneous orthogonal crosspinning method. In addition, this technique was effective in preventing fracture settling. Although the sample size was small and no comparison was made with other forms of fixation, 2-year follow-up did not show any distal radioulnar joint arthrosis and showed minimal fracture settling, with excellent Disabilities of the Arm, Shoulder and Hand scores, low pain levels, and functional range of motion after this minimally invasive and cost-effective technique.

After distal radius fractures with metaphyseal comminution were created in matched cadaveric pairs, a dorsal distraction plate was applied to all specimens and fixed distally to either the second or third metacarpal. Plates fixed to the third metacarpal led to tendon entrapment in the first and third compartments in all 6 specimens, but no tendon entrapment occurred in any specimen in which the plate was fixed to the second metacarpal. Dorsal sensory nerves were not affected with either site of fixation.\(^\text{29}\) The authors recommended formal exposure of the extensor tendons over the zone of injury when applying a distraction bridge plate to the third metacarpal. Lauder et al\(^\text{30}\) assessed range of motion, grip strength, and extension torque after distraction bridge plating and compared these results with the contralateral, uninjured wrist. They concluded that the operative technique yielded significant decreases in these outcomes. These decreases, except in wrist flexion, were not shown when analyzing dominant-side injuries, and the authors attributed this difference to higher usage and rehabilitation. These results were similar to those achieved with other treatment methods for distal radius fractures.

In a comparison of the single-incision extended flexor carpi radialis approach with prophylactic carpal tunnel release at the time of volar locking plate placement and the traditional volar Henry approach, Tannan et al\(^\text{31}\) prospectively compared 27 patients (15 with the extended flexor carpi radialis approach and 12 with the volar Henry approach) with distal radius fractures requiring open reduction and internal fixation who did not have preoperative acute carpal tunnel syndrome. Both groups showed equally significant improvement in functional severity scores, symptom severity, and grip strength. The authors concluded that the extended flexor carpi radialis approach can be used safely for all patients undergoing volar plating, not just those with concurrent carpal tunnel syndrome. Floyd et al\(^\text{32}\) discussed the optimal management of median neuropathy in the setting of distal radius fracture. In patients with acute onset after distal radius fracture reduction, these authors suggested urgent carpal tunnel release while concurrently addressing the distal radius fracture.

With the use of 2007 Medicare claims data, Waljee et al\(^\text{33}\) analyzed the influence of surgeon age on distal radius fracture treatment patterns. When controlling for patient factors, the authors found that younger surgeons and members of the American Society for Surgery of the Hand were more likely to perform open reduction and internal fixation vs external fixation or percutaneous pinning.

For quick reference, Douglass and Yao\(^\text{34}\) reviewed the dimensions and indications for the most commonly used headless screws, standalone lag screws, nonlocking and locking screws for plating, and biocomposite screws.

Brogan et al\(^\text{35}\) reviewed management strategies for highly comminuted distal radius fractures, from spanning fixation to fragment-specific fixation.

**Volar Plates**

To treat intra-articular distal radius fractures (AO type C2-C3), Boretto et al\(^\text{36}\) found no differences in radiographic outcomes with the use of locking screws vs smooth locking pegs with volar plating. In a cadaveric study, Limthongthang et al\(^\text{37}\) examined volar locking plate design and flexor pollicis longus anatomy with
quantitative computed tomography and 3-dimensional digitization techniques. They found that plates from different manufacturers had variable volar prominences at the watershed line and that the flexor pollicis longus sits, on average, at approximately 54% of the maximal width of the distal radius, as measured from the volar-ulnar corner, providing more explanation of the interference between volar locking plates and the flexor pollicis longus. Ljungquist et al calculated similar lunate depths to compare sagittal magnetic resonance imaging and lateral radiographs and correlated lunate depth and distal radius depth at 4 locations along the volar surface from ulnar to radial. They suggested using lunate depth on preoperative lateral wrist radiographs to estimate the longest screw used in volar locking plate fixation to prevent the use of excessively long screws and irritation of the extensor tendon.

Marshall et al compared the biomechanical properties of cadaveric 4-part distal radius fractures (AO type C3) fixed with titanium and compression stainless steel volar locking plates. They concluded that fractures fixed with stainless steel volar locking plates in compression may result in less displacement and rotation of fracture fragments than those fixed with titanium volar locking plates, but they found no differences between the constructs in mechanical load to failure and stiffness.

O’Shaughnessy et al retrospectively reviewed clinical and radiographic outcomes of patients with AO type B or C distal radius fractures with volar marginal rim fragments treated with a volar hook plate. Although 19% of patients had hardware irritation requiring removal, adequate radiographic reduction was maintained in all patients at an average of 9 months of follow-up.

Ross et al described a technique for intraoperative correction of residual radial translation when it is recognized during internal fixation with a volar locking plate or when correction of radial translation is required as part of corrective osteotomy for radial malunion. They used a serrated bone holding forceps to rotate the distally fixed volar locking plate-distal fracture fragment construct around a proximal cortical screw to translate the distal fragment ulnarly, allowing for correction of the coronal plane deformity.

Mellstrand Navarro et al compared outcomes after fixation with a volar locking plate or external fixation with optional addition of K-wires in patients 50 to 74 years old. They found that these were equally suitable treatment options for dorsally displaced distal radius fractures after low-energy trauma in these patients. Although better restoration of radial height and volar tilt and better radial deviation were noted in patients treated with volar locking plates, clinical outcome measures and the rate of complications were equivalent at final follow-up of 1 year in this randomized control trial.

**Brachioradialis Release**

When treating 42 consecutive patients with volar plate fixation for distal radius fractures, Kim et al performed brachioradialis release in 22 patients who had unsatisfactory preliminary reduction. They found that release of the tendon at its insertion, without subsequent repair, had no effect on elbow flexion strength or wrist function 3 months postoperatively. In an effort to clarify the procedure, Xie questioned the release technique used by Kim et al and described a technique that included repair of the brachioradialis release and subsequent pronator quadratus repair to the brachioradialis repair site.

**POSTOPERATIVE FINDINGS**

**Complication Rates**

Jiang et al used data from the National Surgical Quality Improvement Program database and reviewed patients who underwent open reduction and internal fixation for distal radius fracture. They found an overall 2% complication rate at 30 days. Patients who had a complication within 30 days were more likely to have a history of hypertension or congestive heart failure, preoperative chemotherapy or radiation therapy, longer operative time, or preoperative impairment in independent living. Schick et al completed a similar investigation of 30-day postoperative morbidity and mortality after internal fixation of distal radius fractures. Also using the National Surgical Quality Improvement Program database, they showed a 3% overall complication rate, which was higher in patients with cardio-pulmonary disease, increased American Society of Anesthesiologists class, and dependent functional status. Although the results were similar, Hentz noted discrepancies in the methods and results of these 2 studies and discussed the challenges associated with analyzing databases and the utility of the results.

To identify predictors of secondary displacement in distal radius fractures, Walenkamp et al completed a systematic review and meta-analysis. By pooling data from 27 included studies, they found an increased risk of secondary displacement in patients with fractures with dorsal comminution, women, and patients older than 60 years. Additionally, the authors found that associated ulnar fractures or intra-articular involvement did not result in increased risk of secondary displacement.

In a prospective study, Yamazaki et al used logistic regression to determine that crepitus and volar placement of hardware on lateral radiographs were independent risk factors for flexor pollicis longus attrition. Their goal was to identify factors that would aid in the decision for early hardware removal, thus preventing tendon rupture.

In a comparison of complication rates for distal radius fractures treated operatively (28.7%) and nonoperatively (17.1%) in prospectively matched patients older than 65 years, Lutz et al reported median neuropathy (8 patients treated operatively and 14 patients treated nonop-
eratively) as the most common complication, followed by surgical site infection (4 patients) and complex regional pain syndrome (3 patients). The authors also reported complications in 22% of patients undergoing volar plating, 50% undergoing dorsal plating, 42% undergoing external fixation, and 23% undergoing percutaneous pinning.

Nelson et al\textsuperscript{51} compared high-activity adults older than 60 years who had distal radius malunion with high-activity participants with well-aligned fractures and found no significant difference in Quick Disabilities of the Arm, Shoulder and Hand score, visual analog scale function score, strength, or wrist motion despite statistically significant but not clinically relevant increases in visual analog scale pain score. Further, the authors found that operative treatment of malunion did not improve outcomes but increased the complication rate and significantly decreased grip strength at 1-year follow-up.

Mrkonjic et al\textsuperscript{52} evaluated the natural history of patients with untreated complete or partial scapholunate ligament tears associated with displaced distal radius fracture and found no differences in subjective, objective, or radiographic outcomes when compared with each other or with patients without scapholunate injury after 13 to 15 years of follow-up. Scapholunate ligament tears were identified at initial injury treatment with arthroscopy, and fractures were treated with various methods, including closed and open reduction with or without internal fixation. Surprisingly, no patients had scapholunate dissociation or scapholunate-associated collapse of the wrist.

To identify possible risk factors for postoperative instability, Farah et al\textsuperscript{53} reviewed radiographic signs of displacement after external fixation (48.5% of patients) and found no correlation with patient age, sex, type of fracture, degree of initial displacement, associated ulnar fracture, or seniority of the treating surgeon.

**Readmission Rates**

In a large study of readmissions after distal radius fractures treated with internal fixation, closed reduction, or external fixation, Curtin and Hernandez-Boussard\textsuperscript{54} found that 1679 (9%) of the 18,302 patients included were readmitted within 30 days after discharge. Closed reduction (14%) and external fixation (11%) were associated with the highest readmission rates, followed by internal fixation (8%), with high numbers of patients reporting inadequate pain management as their presenting complaint.

**Reoperation Rates**

Navarro et al\textsuperscript{55} used data from the Swedish National Patient Registry to evaluate reoperation rates after 36,618 distal radius repairs treated with spanning external fixation, percutaneous pinning, and volar plating. They reported an incidence of reoperation with external fixation, pinning, and plating of 100, 140, and 222 per 10,000 person-years, respectively. Although a significantly higher reoperation rate was associated with volar plating, especially for carpal tunnel release or tendon repair, complications were more likely to occur earlier in the postoperative period with pinning and external fixation. Reoperation was commonly indicated because of a loss of reduction.

After volar plate fixation, Lutsky et al\textsuperscript{56} found a 10% incidence of hardware removal. Patients requiring hardware removal had greater plate prominence volar to the critical line compared with those who did not require removal. However, plate distance to the volar rim did not differ between groups.

**Psychological Aspects of Recovery**

Roh et al\textsuperscript{57} used wrist range of motion, grip strength, and Michigan Hand Outcomes Questionnaire score to assess patient function and the Pain Catastrophizing Scale and Pain Anxiety Symptoms Scale to evaluate levels of anxiety and catastrophic pain ideation during early recovery after volar plate fixation of distal radius fractures. Preoperative scores on the Pain Catastrophizing Scale and Pain Anxiety Symptoms Scale were significantly associated with a decrease in grip strength, range of motion, and Michigan Hand Outcomes Questionnaire score at week 4. However, at week 24, only age and fracture severity were associated with the Michigan Hand Outcomes Questionnaire score, emphasizing the importance of preoperative psychological assessment and early intervention.

In a study of rate, risk factors, and longitudinal improvement of sleep disturbance after common orthopedic traumatic conditions, Shulman et al\textsuperscript{58} found that 25% of patients with distal radius fractures reported sleep difficulty at 3-month follow-up. At 12 months, the 36-Item Short Form Mental Component score was an independent predictor of poor sleep rather than poor functional status.

Teunis et al\textsuperscript{59} studied the association of demographic, injury, and psychological factors with finger stiffness at the time of suture removal and 6 weeks after distal radius fracture surgery. Catastrophic thinking, as measured by the Pain Catastrophizing Scale, was a major determinant of finger stiffness, measured as increased distance of the nail tip to the distal-palmar crease, averaged over the digits at both time points. Women, married patients, those treated by specific surgeons, those undergoing carpal tunnel release, and those with AO type C fractures had increased stiffness, but only until suture removal.

In a study of nonpelvic orthopedic trauma, Shulman et al\textsuperscript{60} found high rates of sexual dysfunction in those with distal radius fracture, especially within the first 3 months after injury (32%).

In an analysis of 70 closed malpractice claims in New York State from 1981 to 2005 related to distal radius fracture management, malunion and poor physician-patient relationships were the major indications for malpractice litigation, whereas
the likelihood of making an indemnity payment was strongly associated with the age of the defendant and lack of American Board of Orthopedic Surgery certification.61

Physical Therapy

Valdes et al62 found that patients with an uncomplicated postoperative course showed equal benefit from either home programs or supervised therapy after volar plate fixation of distal radius fractures. Zhong et al63 found that postacute care, including inpatient rehabilitation and skilled nursing facilities, accounted for 69% of the total cost of distal radius fracture care in Medicare patients. In addition, older patients, women, those with more comorbid conditions, those with higher socioeconomic status, and those living in urban environments used more postacute care.

Postoperative Use of Vitamin C

Malay and Chung64 reported adequate support in the current literature for prophylactic use of vitamin C to prevent complex regional pain syndrome after distal radius fracture. The findings of 4 relevant articles and 1 systematic review showed that 6 of the 9 Hill criteria for causation were met (strength of association, consistency, biologic gradient, experimental evidence, temporality, analogy). The authors also found a statistically significant reduction in chronic regional pain syndrome in all 4 studies. Tennis and Ring65 cautioned that the current evidence is insufficient to justify that claim, given the ambiguity of the diagnosis of chronic regional pain syndrome and the lack of high-quality randomized trials.

Conclusion

Distal radius fractures continue to be an active area of investigation. In addition to advancing the understanding of distal radius fractures, recent studies have highlighted the need for further investigation into biomechanics, imaging, surgical technique, and postoperative findings.

References

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