Common Myths and Evidence in the Management of Distal Radius Fractures

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Distal radius fractures (DRFs) are common injuries that have a substantial impact on health care systems. They represent the most common fracture treated by physicians, with an incidence of greater than 640,000 cases annually in the United States alone.1 The bimodal distribution of this injury shows two peaks, one representing high-energy injuries in the young and the other representing low-impact injuries in osteoporotic elderly individuals. This latter group is expanding because the modern-day elderly generation is more active than its predecessors, and life expectancies are increasing. Thus, with a 10% incidence of DRFs in Caucasian women older than 65 years, the number of these fractures can only increase as the baby boomers enter retirement age.2 Consequently, physicians treating patients with this injury must have a complete understanding of the effectiveness, risks, and benefits of the different management options available Table 1.

DRFs have been a topic of discussion in the medical literature since Petit and Pouteau3 brought them to light in the early 18th century. Before their work that established the entity of DRF, upper extremity deformities at the radiocarpal joint were believed to be caused by wrist dislocations and subluxations. However, because of poor dissemination of their works outside of France, Abraham Colles4 and the medical community at large were unaware of their theories when Colles published his seminal work, “On the Fracture of the Carpal Extremity of the Radius,” in 1814, and therefore he is most often rewarded with the eponym.4 Great strides have been made over the past 2 centuries in better understanding the biomechanics of injury patterns and the kinematics and muscle forces that influence fracture stability. Device innovation has led to a wide array of options for percutaneous fixation, external fixation, and internal fixation. Although options have greatly increased, little definitive evidence exists regarding the superiority of one technique over the others.

In the 1990s, the Journal of the American Medical Association ushered in a revolutionary age in the practice of medicine with the concept of evidence-based medicine. The concept seems obvious enough: that clinical decision making should be based on evidence from clinical research, thus removing emphasis from intuition and unsystematic clinical experience.5 However, this paradigm shift has been more difficult to realize in the surgical specialties, where clinical questions often lack high-quality evidence, and randomized controlled trials are expensive and time-consuming. Several myths regarding the management of DRFs have been dogmatic in training programs and are pervasive among clinicians at large, and may affect the outcome of treatment and value of health care investment.

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MYTH #1: DRF CLASSIFICATION SCHEMES HAVE PRACTICAL VALUE

The nomenclature used in the discussion of DRFs has gone through several reinventions over the past 200 years, but interestingly, the most archaic terms have withstood the test of time. The Colles eponym, which represents a metaphyseal fracture with dorsal displacement of the distal segment, represents the most commonly used extraarticular classification. Other eponyms, such as Barton and Smith fractures, are also often used, likely because of their historic significance, ease of remembering, and prevalent use. However, eponyms are not helpful in the management of fractures because they do not quantify the severity of the injury nor do they provide guidance on treatment. Furthermore, some eponyms are redundant or lack contemporary context. A prime example is the Chauffeur’s fracture, which originated from the torsional injuries experienced by early chauffeurs when cars backfired as they were started with hand cranks in the early 20th century. The same fracture of the radial styloid may also be referred to as a backfire fracture or Hutchinson fracture. This redundancy in naming is confusing, and the reference to hand crank ignitions is only of historic interest.

DRF classification schemes have evolved over time from the eponymous to complex systems based on mechanism or anatomy. Some of the more commonly used schema include the Frykman, the Melone, the Mayo, and the AO classifications. Each system has champions who tout its strengths, but all of the current classification schemes fail on multiple fronts. No standardized system exists, and one cannot translate easily from one system to another. Each of the classification systems lacks intrarater and interrater reliability because of its complexity.10–12 Most importantly, these systems do not provide prognostic information or a treatment algorithm to follow when deciding management. For a DRF classification system to have great merit it should: (1) be widely adopted in the literature for research purposes, (2) describe patterns of injury with predictable outcomes, and (3) distinguish which patterns require which specific treatments to guide surgeons. Thus far, no classification system on DRFs satisfies these requirements.

MYTH #2: ANATOMIC REDUCTION IS NECESSARY FOR GOOD FUNCTIONAL OUTCOMES

Regardless of operative or nonoperative management of a fracture, anatomic reduction has been considered the goal to restore normal biomechanics to the preinjury state, particularly in intraarticular DRFs, for which the common belief is that

| Table 1 Summary table of the best available evidence regarding common myths in DRF management |
|------------------------------------------------|---------------------------------------------------------------|
| **Common Myths of DRFs** | **Conclusions of Best Available Evidence** |
| 1. DRF classifications have practical value | Classification systems are complex and nonstandardized |
| | They lack intrarater and interrater reliability |
| | They lack prognostic information |
| 2. Anatomic reduction is necessary for good outcomes | Most patients with DRFs have good functional outcomes, even with radiographic arthritis |
| 3. Cast immobilization should include the elbow | Use of a sugar tong splint does not prevent displacement over a radial gutter splint |
| 4. Osteoporotic DRFs require rigid fixation | Rigid fixation results in better radiographic outcomes but no significant functional benefit |
| 5. Volar locking plates for DRF have superior outcomes to other rigid fixation | No significant benefit is seen at 1 year with volar locking plate over external fixation |
| 6. Displaced ulnar styloid fractures require ORIF with DRF | Most displaced ulnar styloid fractures do not require ORIF, as long as the DRUJ is stable |
| 7. Autologous bone grafting is superior to alternatives | No significant difference between autograft and substitutes except for complications at the donor site |
| 8. Early mobilization results in better function | Early motion is safe after ORIF, but does not improve functional outcomes |

Abbreviations: DRUJ, distal radioulnar joint; ORIF, open reduction internal fixation.
incongruity of the radiocarpal joint must be corrected or functional limitations will result. A significant amount of the credence given to this myth stems from the seminal paper by Knirk and Jupiter13 entitled “Intra-articular Fractures of the Distal End of the Radius in Young Adults.” Although one of the most influential articles in the orthopedic literature, it is often misunderstood and inaccurately referenced.14 In a retrospective analysis of the data, the authors found that residual intraarticular step-offs after bony union were associated with radiographic findings of arthritis. The presumption of this article is that operative reduction of articular incongruities would prevent the development of radiographic signs of osteoarthritis, and consequently lead to superior outcomes.

Haus and Jupiter15 revisited this article in 2009, citing its flaws in methodology and limitations in its interpretations. They acknowledged their absence of controls and lack of assessment of observer reliability regarding radiologic analysis of arthritis and articular incongruity. They reviewed their original radiographs, showing that a substantial number of the patients had carpal instability that likely influenced function and promoted the progression to arthritis. Because of a lack of validated instruments at the time of publication, they did not measure patient-rated functional outcomes (eg, Michigan Hand Outcomes Questionnaire16; Disability of the Arm, Shoulder and Hand questionnaire [DASH]17) and correlate them with radiographic findings.

Subsequent authors have addressed some of these questions through assessing for radiographic arthrosis with CT in patients with intraarticular incongruity after DRF, and comparing the results with function.18,19 Even with a 15-year follow-up and worsening radiographic arthritis, patient function remained excellent, and most patients (87.5%) were functioning at the 80th percentile or greater with the injured extremity compared with normal patients. However, even with these findings, the authors did not change their management strategies regarding displaced DRFs, and still aimed to achieve anatomic alignment at the articular surface in hopes of preventing radiographic changes, even in the presence of no discernible functional benefit.

A potential explanation for the lack of a relationship between articular integrity and patient-rated outcomes may be related to publication bias. Most of the outcomes studies published have emanated from high-volume centers that have unique expertise in treating DRFs. It is unlikely that many patients will have markedly unacceptable radiographic reductions in these series that deviate from acceptable norms. Therefore, the number of subjects with poor reductions is so low that significant relationships are not detected. If population-type data can be obtained to evaluate a spectrum of radiographic findings, reductions that are less than satisfactory are likely to be associated with worse patient-rated outcomes, particularly in the younger population. This hypothesis remains to be tested.

**MYTH #3: CAST IMMOBILIZATION AFTER REDUCTION MUST INCLUDE THE ELBOW TO PREVENT REDISPLACEMENT**

Various descriptions exist on how immobilization techniques after reduction of a DRF can prevent redisplacement. Some investigators have argued that the brachioradialis is a major deforming force, and consequently, the injured forearm must be splinted in a long arm brace that maintains the forearm in supination to reduce the brachioradialis’s influence.20,21 Others have made a case that the pronator quadratus is more deformational and thus splinted in pronation.22 The sugar tong splint is the most commonly used option for bracing a DRF after reduction. The classic teaching has been that this large and cumbersome splint prevents any movement of the forearm—it prevents flexion/extension at the wrist and elbow and pronation/supination at the distal radioulnar joint (DRUJ)—and that this stability is transferred to the patient’s reduction. The largest prospective randomized studies, however, have found no difference in redisplacement risk with inclusion or exclusion of the elbow, and alternatives such as a radial gutter splint can lead to increased patient satisfaction and comfort compared with the sugar tong splint.23,24

In reality, the type of splint applied after reduction of a DRF has less impact on redisplacement than one would hope. Although surgeons feel that a sugar tong splint is a defense against losing reduction, the ability of a splint to adequately maintain the reduction of a fracture is more likely to be a product of the initial injury and the instability of the fracture pattern than the qualities of the splint itself. A good splint should counter the displacement of the fracture, so that a simple reduced extraarticular Colles fracture can have the reduction maintained with a radial gutter or a dorsal blocking splint with the wrist in slight flexion. More—cumbersome constructs are unlikely to keep unstable reductions from collapsing.

**MYTH #4: OSTEOPOROTIC DRFs NECESSITATE RIGID FIXATION BECAUSE OF POOR BONE STOCK**

DRFs are of significant concern in elderly individuals, representing a substantial public health
Impact given that as many as 372,000 individuals 65 years of age and older experience this type of fracture on a yearly basis.25 Although these fractures have traditionally been treated nonoperatively with casting, a greater than fivefold increase in the use of internal fixation in this population has occurred since 1997.26 Nonoperative management resulted in malunion in at least 50% of fractures, and with the introduction of the volar locking plate, a movement toward aggressive fixation in the elderly has been seen with the hope of speeding recovery and maximizing a patient’s potential to live independently.27,28 The osteoporotic bone of the dorsal cortex is believed to be prone to collapse, and the disuse from prolonged immobilization is thought to lead to stiffness that impacts long-term function. However, limited prospective comparative studies have evaluated the available treatment modalities.

A systematic review of all the literature over the past 30 years showed that although rigid fixation with external fixation or volar locking plates resulted in improved radiographic outcomes, no evidence of significant benefit was seen in range of motion or functional outcome scores.25 This form of analysis is limited by the comparison of heterogenic patient groups and the aggregation of data from several case series, yet it serves as a synthesis of the best available evidence. Two ongoing multicenter, randomized, controlled trials, the ORCHID trial in Germany and the WRIST trial in the United States, will elucidate the best way to treat this increasing elderly population.29,30

MYTH #5: THE UBIQUITOUS USE OF VOLAR LOCKING PLATES FOR UNSTABLE DRFs IS SUPPORTED BY SUPERIOR OUTCOMES

Since the introduction of volar fixation for unstable DRFs a decade ago, a sizable increase in the number of products available and a steady increase in the national use of the internal fixation procedure have been seen.31,32 Medicare beneficiaries who are treated by hand surgeons undergo internal fixation at a significantly higher rate than those treated by other physicians.33 On the surface, one would assume that this increase in the use of a new technique and implant is a reflection of superior outcomes.

Volar fixation has numerous proponents, especially because of fewer tendon complications compared with the dorsal approach.34 However, few prospective trials have compared it with other operative techniques in the management of unstable DRFs. Evidence shows that management of a DRF with a volar locking plate leads to improved function in range of motion, grip strength, and functional outcome scores compared with external fixation for the first 3 months postoperatively.35,36 However, those benefits decrease at 6 months and are insignificant if patients are followed out to a full year. Because these studies have been published in only the past 3 years, the dramatic rise in the use of volar locking plates for operative fixation is not a result of evidence of superior outcomes. Instead, this increase is more a manifestation of surgeon factors, such as comfort and ease of a technique, and the variation of operative management is influenced by geography and patient age.26,37 The lack of long-term superior outcomes of open reduction internal fixation (ORIF) with volar plating reflects an early dissemination of a surgical technique that still requires comparative evidence to validate its use.

MYTH #6: DISPLACED ULNAR STYLOID FRACTURES WARRANT SURGICAL FIXATION AT THE TIME OF RADIUS ORIF

Management of an ulnar styloid fracture in the setting of DRFs is another controversial subject matter. Ulnar styloid fractures are fairly common and have been estimated to be present in more than 50% of DRFs, with approximately a quarter of those proceeding to nonunion.38 Some authors have argued that a fracture through the base of the ulnar styloid represents a significant injury to the triangular fibrocartilage complex (TFCC) and its ligamentous attachments to the ulna, and thus can result in DRUJ instability.39,40 Anatomical dissections supported this claim, with evidence that the TFCC and its attachments to the ulnar styloid are important in maintaining a congruous DRUJ.41 Consequently, some authors recommend that a fracture through the base of the ulnar styloid with a 2-mm displacement or more warrants surgical fixation.42

In reality, most ulnar styloid fractures associated with a DRF do not warrant surgical fixation, particularly if anatomic reduction is achieved with open reduction and internal fixation of the distal radius. Nonunion of the ulnar styloid is a common result, but it is usually asymptomatic.43,44 Even a nonunion at the base of the ulnar styloid with substantial displacement (>2 mm) does not seem to result in an appreciable loss of motion or diminished functional outcome if the concomitant DRF is treated with a volar locking plate and the DRUJ is clinically stable after distal radius fixation.45-47 Anatomists have recently theorized that this is likely a result of the stabilizing effect of the distal oblique bundle of the interosseous membrane on the DRUJ.48,49 Undoubtedly, some ulnar styloid fractures result in DRUJ instability, and the
literature supports their treatment with operative fixation. However, this is a much smaller subset; the need for surgery cannot be determined with radiographs alone and requires clinical examination and acumen to assess stability.

**MYTH #7: AUTOLOGOUS BONE GRAFTING IS SUPERIOR TO ALLOGRAFT OR BONE SUBSTITUTES IN DRF FIXATION WITH BONY LOSS**

In treating unstable DRFs with significant metaphyseal comminution, surgeons have often addressed the bony loss through adding some load-bearing substance to fill the defect. Autologous iliac crest bone graft has long been deemed the standard for treating these gaps. It is readily available in both cancellous and cortical forms. It is osteoconductive, osteoinductive, and readily incorporates into the surrounding architecture of the radius. Unfortunately, many problems are associated with autologous bone graft harvest. Iliac bone harvest adds operative time, increases blood loss, has risks for complications, and can result in substantial postoperative pain. The incidence of minor complications is estimated to be 10%, whereas major complications, including hernia, vascular injury, deep infection, and fracture, have an incidence of 5.8%. Furthermore, almost 20% of patients may complain of pain at their donor site as far out as 2 years from surgery.

Given the morbidity of autologous bone harvest, a market is available for industry to create alternatives to meet the demand for a product with fewer side effects. The options are varied and include demineralized bone matrix, bovine collagen, coralline hydroxyapatite, and injectable cements. With such a large number of products available, few comparative data are available guide the choice among the options. Rajan and colleagues published the only prospective randomized study comparing the use of cancellous allograft and autologous bone graft in the repair of comminuted DRFs. They found no significant difference in range of wrist motion, grip strength, and radiologic parameters during follow-up of up to a year. Conversely, a sizable discrepancy was seen in operative time and complications at the donor site. Complications included hematoma, seroma, and a relatively high rate of meralgia paresthetica, which is a chronic, painful mononeuropathy caused by entrapment of the lateral femoral cutaneous nerve. Overall, they concluded that use of cancellous allograft at distal radius ORIF was not significantly different from autologous bone grafting regarding fracture union and clinical outcome at the operative wrist, but could be performed more quickly and was not associated with the complications at the iliac donor site.

**MYTH #8: EARLY MOBILIZATION RESULTS IN BETTER FUNCTIONAL OUTCOMES IN DRFS**

An argument has been commonly made in favor of ORIF because it afforded the patient with an opportunity to start an early motion protocol at 2 weeks rather than waiting 6 to 8 weeks with cast immobilization or external fixation. Extrapolating from findings in other periartricular fractures, the thought has been that early mobilization would result in better motion at the wrist and thus better functional results. However, evidence does not support these claims. When other confounders are eliminated and timing of mobilization is viewed as an independent variable, early motion after internal fixation seems to have no benefit. Early wrist mobilization after internal fixation is safe, but it does not improve final arc of motion, grip strength, pain, DASH score, or radiographic measurements.

**SUMMARY**

DRFs remain a public health concern, and this impact is sure to increase as the baby boomer generation enters the elder years. Even with 2 centuries of intellectual discourse regarding the pathophysiology, treatments, and outcomes of DRFs, many questions remain, necessitating further inquiry. Many of the widely held viewpoints regarding the management of DRFs are not based on the best available evidence. Although it is difficult to break practice patterns and easy to be enamored of new instrumentation, clinicians must fight the urge to follow trends indiscriminately without critically evaluating the results. To conform to evidence-based medicine standards, high-powered, randomized, multicenter studies must be designed to further elucidate optimal treatment strategies for DRFs.

**REFERENCES**

Diaz-Garcia & Chung


plating than after external fixation but the outcomes are similar after 1 year. Acta Orthop 2011;82(1):76–81.


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