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Common Myths and Evidence in the Management of Distal Radius Fractures

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Abstract

Distal radius fractures are the most common fracture treated by physicians, yet there are questions regarding their optimal management. Over 200 years have been spent discussing fracture patterns, biomechanics and treatment strategies regarding DRFs. But research has revealed many controversies regarding long-held beliefs. These “common myths” have been propagated and thought of as fact but in reality, are not based on the best-available evidence. This review article aims to illustrate some of the major controversies that have come to light regarding the management of DRFs. As we strive to provide optimal care in a world of evidence-based medicine, we must shift our thinking and accept that some of the ideas we have been indoctrinated with may be flawed heuristic approach.

Introduction

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

DRFs have been a topic of discussion in the medical literature since Petit and Pouteau brought them to light in the early 18th century.[3] Prior to their work that established the entity of distal radius fracture, upper extremity deformities at the radiocarpal joint were believed to be caused by wrist dislocations and subluxations. However, due to poor dissemination of their works outside of France, Abraham Colles and the medical community at large were

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unaware of their theories when Colles published his seminal work, “On the fracture of the carpal extremity of the radius,” in 1814, and it is he who is most often rewarded with the eponym.[4] We have made large strides over the past 2 centuries to better understand the biomechanics of injury patterns, as well as 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. Though options have greatly increased, there is little definitive evidence 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 made on the basis of evidence from clinical research, thus removing emphasis from intuition and unsystematic clinical experience.[5] Yet, 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. There are several myths regarding the management of distal radius fractures that have been dogmatic in our training programs and are pervasive amongst clinicians at large. These myths may affect the outcome of treatment, and the value of our healthcare investment.

Myth #1 – Distal radius fracture 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 extra-articular classification. Other eponyms, such as Barton and Smith fractures, are often used as well, likely due to their historical significance, ease of remembering and prevalent usage. 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 a “Chauffeur’s fracture,” which originates from the torsional injuries suffered 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 historical 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.[6–9] Each system has champions who tout its strengths and detractors who point out its shortcomings, but all of the current classification schemes fail on multiple fronts. There is no standardized system, and one cannot translate easily from one system to another. Each of the classification systems lacks intra- and inter-rater reliability because of their complexity.[10–12] Most importantly, they fail to 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 required which specific treatments as to guide surgeons. Thus far, no classification system on DRF satisfies these requirements.

Myth #2 – Anatomic reduction is necessary for good functional outcomes

Regardless of operative or non-operative management of a fracture, anatomic reduction has been considered the goal in order to restore normal biomechanics to the pre-injury state.

This has been particularly true in regards to intra-articular DRF, in which it is often believed that incongruity of the radiocarpal joint must be corrected or functional limitations will result. A significant amount of the credence that is lent to this myth stems from the seminal paper by Knirk and Jupiter titled, "Intra-articular fractures of the distal end of the radius in young adults."[13] Although one of the most influential articles in the orthopaedic literature, it is often misunderstood and inaccurately referenced.[14] By basing on a retrospective analysis of the data, the authors found that residual intra-articular step-offs after bony union were associated with radiographic findings of arthritis. The presumption of this paper is that operative reduction of articular incongruities would prevent the development of radiographic signs of osteoarthritis, and consequently lead to superior outcomes.

Haus and Jupiter revisited this article in 2009, citing its flaws in methodology and limitations in its interpretations.[15] They acknowledged their absence of controls and lack of assessment of observer reliability in regards to radiologic analysis of arthritis and articular incongruity. They reviewed their original radiographs, demonstrating that a substantial number of the patients had carpal instability that likely influenced function as well as 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 (*i.e.*, Michigan Hand Outcomes Questionnaire[16], Disability of the Arm, Shoulder and Hand questionnaire [DASH][17], etc.) and correlate them with radiographic findings.

Subsequent authors have addressed some of these questions by assessing for radiographic arthrosis with computed tomography in patients with intra-articular incongruity after distal radius fracture and comparing it with function.[18, 19] It is interesting that even with a 15 year follow-up and worsening radiographic arthritis, patient function remained excellent, and the majority (87.5%) of patients were functioning at the 80th percentile or greater with the injured extremity in comparison to normal patients. Yet even with these findings, the authors concluded that this did not change their management strategies regarding displaced DRFs, and they still aimed to achieve anatomic alignment at the articular surface in hopes of preventing radiographic changes, even if there was 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 a unique expertise in treating DRFs. It is unlikely 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, it is quite likely that reductions that are less than satisfactory may 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

There have been various descriptions on how immobilization techniques after reduction of a distal radius fracture can prevent redisplacement. Some investigators 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' 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, as well as pronation/supination at the DRUJ—and this stability is transferred to one's reduction. The largest prospective, randomized studies, however, have found no difference in redisplacement risk with inclusion or exclusion of the elbow, and alternatives like a radial gutter splint can lead to increased patient satisfaction and comfort in comparison to the sugar tong.[23, 24]

In reality, the type of splint applied after reduction of a DRF has less impact on redisplacement than we 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 extra-articular 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 distal radius fractures necessitate rigid fixation due to poor bone stock

DRFs are of significant concern in the elderly, in which the public health impact is great given that as many as 372,000 individuals 65 years of age and older suffer this type of fracture on a yearly basis.[25] Although these fractures have traditionally been treated non-operatively with casting, there has been a greater than 5-fold increase in the use internal fixation in this population since 1997.[26] Non-operative management resulted in malunion in at least 50% of fractures, and with the introduction of the volar-locking plate, there has been a movement for aggressive fixation in the elderly in the hopes of speeding recovery and maximizing a patient's potential to live independently.[27, 28] It is felt that the osteoporotic bone of the dorsal cortex is prone to collapse, and that the disuse by prolonged immobilization leads to stiffness that impacts long term function. However, there are limited prospective comparative studies that have evaluated the available treatment modalities.

A systematic review of all the literature over the past 30 years revealed that although rigid fixation with external fixation or volar locking plates resulted in improved radiographic outcomes, there was no evidence of significant benefit in regards to 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 that from several case series, yet it serves as a synthesis of the best available evidence. There are two ongoing multi-center randomized, controlled trials—the ORCHID trial in Germany and the WRIST trial in the United States—that will elucidate the best way to treat this growing, 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 distal radius fractures a decade ago, there has been a sizable increase in the number of products available and the steady increase in the national use of internal fixation procedure.[31, 32] Medicare beneficiaries who are treated by hand surgeons receive 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 when compared to the dorsal approach.[34] However, few prospective trials have been done to compare it to other operative techniques in the management of unstable DRFs. There is evidence that management of a DRF with a volar-locking plate leads to improved function in regards to range of motion, grip strength and functional outcome scores as compared to 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 ORIF with volar plating reflects an early dissemination of a surgical technique that still needs 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 distal radius fractures is another controversial subject matter. Ulnar styloid fractures are fairly common and have been estimated to be present in over 50% of DRFs with approximately a quarter of those proceeding to nonunion.[38] It has been argued that a fracture through the base of the ulnar styloid represents a significant injury to the TFCC and its ligamentous attachments to the ulna, and thus can result in DRUJ instability.[39, 40] Anatomic 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 2mm displacement or more warrants surgical fixation.[42]

In reality, the majority of 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 (>2mm) does not appear 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] This is likely a result of the stabilizing effect of the distal oblique bundle of the interosseous membrane on the DRUJ, as recent anatomists have theorized.[48, 49] Undoubtedly, there are some ulnar styloid fractures that result in DRUJ instability and the literature would support 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 by 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 of 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%.[50] Furthermore, almost 20% patients may complain of pain at their donor site as far out as 2 years from the date of surgery.[51]

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, there are few comparative data to guide the choice among the options. Rajan *et al.* published the only prospective, randomized study that compared the use of cancellous allograft versus autologous bone graft in the repair of comminuted distal radius fractures.[52]

They found no significant difference in range of wrist motion, grip strength, and radiologic parameters for up to a year follow-up. Conversely, there was a sizeable discrepancy in operative time and complications at the donor site. Complications included hematoma, seroma, and relatively high rate of meralgiaparaesthetica, which is a chronic, painful mononeuropathy due to entrapment of the lateral femoral cutaneous nerve. Overall, they concluded that use of cancellous allograft at the time of distal radius ORIF was not significantly different from autologous bone grafting with regards to fracture union and clinical outcome at the operative wrist, but could be done more quickly and was not wrought 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 this afforded the patient with an opportunity to start an early motion protocol at 2 weeks rather than waiting 6-8 weeks with cast immobilization or external fixation.[53, 54] Extrapolating from findings in other peri-articular fractures, the thought has been that early mobilization would result in better motion at the wrist and thus better functional results. However, the evidence does not support such claims. When other confounders are eliminated and timing of mobilization is viewed as an independent variable, there appears to be no benefit to early motion after internal fixation. 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.[55, 56]

Conclusions

Distal radius fractures remain a public health concern, and this impact is sure to increase as the “Baby Boomer” generation enters the elder years. Even with two centuries of intellectual discourse regarding the pathophysiology, treatments and outcomes of DRFs, many questions remain unanswered and thus necessitate further inquiry. Many of the viewpoints that are widely held regarding the management of DRFs are not based on the best-available evidence. We acknowledge that it is difficult to break practice patterns and easy to be enamored by new instrumentation. However, 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 need to be designed to further elucidate optimal treatment strategies for distal radius fractures.

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References

1. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am. 2001; 26:908–15. [PubMed: 11561245]
2. Cummings SR, Black DM, Rubin SM. Lifetime risks of hip, Colles', or vertebral fracture and coronary heart disease among white postmenopausal women. Arch Intern Med. 1989; 149:2445–8. [PubMed: 2818106]

3. Peltier LF. Fractures of the distal end of the radius. An historical account. Clin Orthop Relat Res. 1984:18–22. [PubMed: 6378480]
4. Colles A. On the fracture of the carpal extremity of the radius. Edinburgh Med Surg J. 1814; 10:182–6.
5. Evidence-based medicine. A new approach to teaching the practice of medicine. JAMA. 1992; 268:2420–5. [PubMed: 1404801]
6. Frykman G. Fracture of the distal radius including sequelae--shoulder-hand-finger syndrome, disturbance in the distal radio-ulnar joint and impairment of nerve function. A clinical and experimental study. Acta Orthop Scand. 1967; (Suppl 108):3+. [PubMed: 4175195]
7. Melone CP Jr. Articular fractures of the distal radius. Orthop Clin North Am. 1984; 15:217–36. [PubMed: 6728444]
8. Cooney WP. Fractures of the distal radius. A modern treatment-based classification. Orthop Clin North Am. 1993; 24:211–6. [PubMed: 8479719]
9. Newey ML, Ricketts D, Roberts L. The AO classification of long bone fractures: an early study of its use in clinical practice. Injury. 1993; 24:309–12. [PubMed: 8349339]
10. Naqvi SG, Reynolds T, Kitsis C. Interobserver reliability and intraobserver reproducibility of the Fernandez classification for distal radius fractures. J Hand Surg Eur Vol. 2009; 34:483–5. [PubMed: 19321533]
11. Andersen DJ, Blair WF, Steyers CM Jr, Adams BD, el-Khouri GY, Brandser EA. Classification of distal radius fractures: an analysis of interobserver reliability and intraobserver reproducibility. J Hand Surg Am. 1996; 21:574–82. [PubMed: 8842946]
12. Flikkila T, Nikkola-Sihto A, Kaarela O, Paakko E, Raatikainen T. Poor interobserver reliability of AO classification of fractures of the distal radius. Additional computed tomography is of minor value. J Bone Joint Surg Br. 1998; 80:670–2. [PubMed: 9699835]
13. Knirk JL, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults. J Bone Joint Surg Am. 1986; 68:647–59. [PubMed: 3722221]
14. Porrino JA Jr, Tan V, Daluiski A. Misquotation of a commonly referenced hand surgery study. J Hand Surg Am. 2008; 33:2–7. [PubMed: 18261657]
15. Haus BM, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults: reexamined as evidence-based and outcomes medicine. J Bone Joint Surg Am. 2009; 91:2984–91. [PubMed: 19952264]
16. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. J Hand Surg Am. 1998; 23:575–87. [PubMed: 9708370]
17. Gummesson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. BMC Musculoskelet Disord. 2003; 4:11. [PubMed: 12809562]
18. Catalano LW 3rd, Cole RJ, Gelberman RH, Evanoff BA, Gilula LA, Borrelli J Jr. Displaced intra-articular fractures of the distal aspect of the radius. Long-term results in young adults after open reduction and internal fixation. J Bone Joint Surg Am. 1997; 79:1290–302. [PubMed: 9314391]
19. Goldfarb CA, Rudzki JR, Catalano LW, Hughes M, Borrelli J Jr. Fifteen-year outcome of displaced intra-articular fractures of the distal radius. J Hand Surg Am. 2006; 31:633–9. [PubMed: 16632059]
20. Sarmiento A, Pratt GW, Berry NC, Sinclair WF. Colles' fractures. Functional bracing in supination. J Bone Joint Surg Am. 1975; 57:311–7. [PubMed: 1123382]
21. Bunger C, Solund K, Rasmussen P. Early results after Colles' fracture: functional bracing in supination vs dorsal plaster immobilization. Arch Orthop Trauma Surg. 1984; 103:251–6. [PubMed: 6391415]
22. Wahlstrom O. Treatment of Colles' fracture. A prospective comparison of three different positions of immobilization. Acta Orthop Scand. 1982; 53:225–8. [PubMed: 7136568]
23. Pool C. Colles's fracture. A prospective study of treatment. J Bone Joint Surg Br. 1973; 55:540–4. [PubMed: 4125714]
24. Bong MR, Egol KA, Leibman M, Koval KJ. A comparison of immediate postreduction splinting constructs for controlling initial displacement of fractures of the distal radius: a prospective

randomized study of long-arm versus short-arm splinting. J Hand Surg Am. 2006; 31:766–70. [PubMed: 16713840]

25. Diaz-Garcia RJ, Oda T, Shauver MJ, Chung KC. A systematic review of outcomes and complications of treating unstable distal radius fractures in the elderly. J Hand Surg Am. 2011; 36:824–35. e2. [PubMed: 21527140]
26. Chung KC, Shauver MJ, Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. J Bone Joint Surg Am. 2009; 91:1868–73. [PubMed: 19651943]
27. Mackenney PJ, McQueen MM, Elton R. Prediction of instability in distal radial fractures. J Bone Joint Surg Am. 2006; 88:1944–51. [PubMed: 16951109]
28. Beharrie AW, Beredjiklian PK, Bozentka DJ. Functional outcomes after open reduction and internal fixation for treatment of displaced distal radius fractures in patients over 60 years of age. J Orthop Trauma. 2004; 18:680–6. [PubMed: 15507821]
29. Bartl C, Stengel D, Bruckner T, et al. Open reduction and internal fixation versus casting for highly comminuted and intra-articular fractures of the distal radius (ORCHID): protocol for a randomized clinical multi-center trial. Trials. 2011; 12:84. [PubMed: 21426543]
30. Chung KC, Song JW. A guide to organizing a multicenter clinical trial. Plast Reconstr Surg. 2010; 126:515–23. [PubMed: 20375760]
31. Orbay JL. The treatment of unstable distal radius fractures with volar fixation. Hand Surg. 2000; 5:103–12. [PubMed: 11301503]
32. Koval KJ, Harrast JJ, Anglen JO, Weinstein JN. Fractures of the distal part of the radius. The evolution of practice over time. Where's the evidence? J Bone Joint Surg Am. 2008; 90:1855–61. [PubMed: 18762644]
33. Chung KC, Shauver MJ, Yin H. The Relationship Between ASSH Membership and the Treatment of Distal Radius Fracture in the United States Medicare Population. J Hand Surg Am. 2011; 36:1288–93. [PubMed: 21715104]
34. Lucas G, Fejfar ST. Complications in internal fixation of the distal radius. J Hand Surg Am. 1998:23.
35. Wilcke MK, Abbaszadegan H, Adolphson PY. Wrist function recovers more rapidly after volar locked plating than after external fixation but the outcomes are similar after 1 year. Acta Orthop. 2011; 82:76–81. [PubMed: 21281262]
36. Egol K, Walsh M, Tejwani N, McLaurin T, Wynn C, Paksima N. Bridging external fixation and supplementary Kirschner-wire fixation versus volar locked plating for unstable fractures of the distal radius: a randomised, prospective trial. J Bone Joint Surg Br. 2008; 90:1214–21. [PubMed: 18757963]
37. Fanuele J, Koval KJ, Lurie J, Zhou W, Tosteson A, Ring D. Distal radial fracture treatment: what you get may depend on your age and address. J Bone Joint Surg Am. 2009; 91:1313–9. [PubMed: 19487507]
38. Bacorn RW, Kurtzke JF. Colles' fracture; a study of two thousand cases from the New York State Workmen's Compensation Board. J Bone Joint Surg Am. 1953; 35-A:643–58. [PubMed: 13069552]
39. Hauck RM, Skahen J 3rd, Palmer AK. Classification and treatment of ulnar styloid nonunion. J Hand Surg Am. 1996; 21:418–22. [PubMed: 8724472]
40. May MM, Lawton JN, Blazar PE. Ulnar styloid fractures associated with distal radius fractures: incidence and implications for distal radioulnar joint instability. J Hand Surg Am. 2002; 27:965–71. [PubMed: 12457345]
41. Haugstvedt JR, Berger RA, Nakamura T, Neale P, Berglund L, An KN. Relative contributions of the ulnar attachments of the triangular fibrocartilage complex to the dynamic stability of the distal radioulnar joint. J Hand Surg Am. 2006; 31:445–51. [PubMed: 16516740]
42. Mikic ZD. Treatment of acute injuries of the triangular fibrocartilage complex associated with distal radioulnar joint instability. J Hand Surg Am. 1995; 20:319–23. [PubMed: 7775777]
43. Zenke Y, Sakai A, Oshige T, Moritani S, Nakamura T. The effect of an associated ulnar styloid fracture on the outcome after fixation of a fracture of the distal radius. J Bone Joint Surg Br. 2009; 91:102–7. [PubMed: 19092013]

44. Kim JK, Yun YH, Kim DJ, Yun GU. Comparison of united and nonunited fractures of the ulnar styloid following volar-plate fixation of distal radius fractures. Injury. 2011; 42:371–5. [PubMed: 20961540]
45. Buijze GA, Ring D. Clinical impact of United versus nonunited fractures of the proximal half of the ulnar styloid following volar plate fixation of the distal radius. J Hand Surg Am. 2010; 35:223–7. [PubMed: 20079580]
46. Kim JK, Koh YD, Do NH. Should an ulnar styloid fracture be fixed following volar plate fixation of a distal radial fracture? J Bone Joint Surg Am. 2010; 92:1–6. [PubMed: 20048089]
47. Sammer DM, Shah HM, Shauver MJ, Chung KC. The effect of ulnar styloid fractures on patient-rated outcomes after volar locking plating of distal radius fractures. J Hand Surg Am. 2009; 34:1595–602. [PubMed: 19896004]
48. Kihara H, Short WH, Werner FW, Fortino MD, Palmer AK. The stabilizing mechanism of the distal radioulnar joint during pronation and supination. J Hand Surg Am. 1995; 20:930–6. [PubMed: 8583064]
49. Noda K, Goto A, Murase T, Sugamoto K, Yoshikawa H, Moritomo H. Interosseous membrane of the forearm: an anatomical study of ligament attachment locations. J Hand Surg Am. 2009; 34:415–22. [PubMed: 19211201]
50. Arrington ED, Smith WJ, Chambers HG, Bucknell AL, Davino NA. Complications of iliac crest bone graft harvesting. Clin Orthop Relat Res. 1996:300–9. [PubMed: 8769465]
51. Goulet JA, Senunas LE, DeSilva GL, Greenfield ML. Autogenous iliac crest bone graft. Complications and functional assessment. Clin Orthop Relat Res. 1997:76–81. [PubMed: 9186204]
52. Rajan GP, Fornaro J, Trentz O, Zellweger R. Cancellous allograft versus autologous bone grafting for repair of comminuted distal radius fractures: a prospective, randomized trial. J Trauma. 2006; 60:1322–9. [PubMed: 16766978]
53. Wright TW, Horodyski M, Smith DW. Functional outcome of unstable distal radius fractures: ORIF with a volar fixed-angle tine plate versus external fixation. J Hand Surg Am. 2005; 30:289–99. [PubMed: 15781351]
54. Smith DW, Brou KE, Henry MH. Early active rehabilitation for operatively stabilized distal radius fractures. J Hand Ther. 2004; 17:43–9. [PubMed: 14770137]
55. Lozano-Calderon SA, Souer S, Mudgal C, Jupiter JB, Ring D. Wrist mobilization following volar plate fixation of fractures of the distal part of the radius. J Bone Joint Surg Am. 2008; 90:1297–304. [PubMed: 18519324]
56. Allain J, le Guilloux P, Le Mouel S, Goutallier D. Trans-styloid fixation of fractures of the distal radius. A prospective randomized comparison between 6- and 1-week postoperative immobilization in 60 fractures. Acta Orthop Scand. 1999; 70:119–23. [PubMed: 10366909]

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 non- standardized • They lack intra- and inter-rater reliability • They lack prognostic information
2. Anatomic reduction is necessary for good outcomes	• The majority of 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	• There is no significant benefit at 1 year with VLP over external fixation
6. Displaced ulnar styloid fractures require ORIF with DRF	• The majority of 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