AAOS Clinical Practice Guideline Summary

# Treatment of Distal Radius Fractures

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## Abstract

The clinical practice guideline is based on a systematic review of published studies on the treatment of distal radius fractures in adults. None of the 29 recommendations made by the work group was graded as strong; most are graded as inconclusive or consensus; seven are graded as weak. The remaining five moderate-strength recommendations include surgical fixation, rather than cast fixation, for fractures with postreduction radial shortening >3 mm, dorsal tilt >10°, or intra-articular displacement or step-off >2 mm; use of rigid immobilization rather than removable splints for nonsurgical treatment; making a postreduction true lateral radiograph of the carpus to assess dorsal radial ulnar joint alignment; beginning early wrist motion following stable fixation; and recommending adjuvant treatment with vitamin C to prevent disproportionate pain.

## Overview and Rationale

The treatment of distal radius fractures practice guideline was approved by the American Academy of Orthopaedic Surgeons (AAOS) on December 4, 2009. The purpose of the clinical practice guideline is to help improve treatment based on the current best evidence. Current evidence-based practice standards demand that physicians use the best available evidence in their clinical decision making. To assist in this, the guideline consists of a series of systematic reviews of the available literature regarding the treatment of distal radius fractures in adults. These systematic reviews were conducted between July 2008 and June 2009 and show where good evidence exists, where evidence is lacking, and which topics must be targeted in future research to improve the treatment of patients with distal radius fractures.

This guideline serves as an educational tool and should not be construed as including all proper methods of care or excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. In 5 years, this guideline will be revised in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology.

## Potential Harms and Contraindications

Most treatments are associated with some known risks, especially invasive and surgical treatments. In addition, contraindications vary widely based on the treatment administered. Therefore, discussion of available treatments and procedures applicable to the individual patient rely on

mutual communication between the patient and physician.

## Methods

The methods used to develop this guideline were designed to combat bias, enhance transparency, and promote reproducibility. Their purpose is to allow interested readers the ability to inspect all of the information the work group used to reach its decisions, and to verify that these decisions are in accord with the best available evidence. The draft of this guideline was subject to peer review and public commentary before being approved by the Board of Directors of the AAOS. The methods used to prepare this guideline are detailed in the full clinical practice guideline, which is available at http://www.aaos.org/research/guidelines/drfguideline.pdf.

## Recommendations

Each recommendation in this guideline summary is accompanied by a grade indicating the strength of the recommendation, as follows:

Grade strength: Strong. Overall quality of evidence: good (level I evidence from more than one study with consistent findings for recommending for or against the intervention or diagnostic).

Grade strength: Moderate. Overall quality of evidence: fair (level II or III evidence from more than one study with consistent findings, or level I evidence from a single study for recommending for or against the intervention or diagnostic).

Grade strength: Weak. Overall quality of evidence: poor (level IV or V evidence from more than one study with consistent findings, or level II or III evidence from a single study for recommending for against the intervention or diagnostic).

Grade strength: Inconclusive. Overall quality of evidence: none or conflicting (the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention or diagnostic).

Grade strength: Consensus. Overall quality of evidence: no evidence (there is no supporting evidence; in the ab-

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sence of reliable evidence, the work group is making a recommendation based on their clinical opinion considering the known harms and benefits associated with the treatment).

## Recommendation 1

We are unable to recommend for or against performing nerve decompression when nerve dysfunction persists after reduction.

Recommendation strength: Inconclusive

We identified only one study that enrolled patients with persistent nerve dysfunction after reduction of a distal radius fracture and that met our inclusion criteria.[1] This study used subjective symptoms and objective clinical tests to determine the persistence of nerve dysfunction after reduction. Only patients with symptoms and a positive clinical test underwent nerve exploration (ie, carpal tunnel release). Patients receiving carpal tunnel release may have had spontaneous improvement or may have benefited from surgery. The spontaneous resolution of symptoms in patients not receiving carpal tunnel release may support this.

## Recommendation 2

We are unable to recommend for or against casting as definitive treatment of unstable fractures that are initially adequately reduced.

Recommendation strength: Inconclusive

This recommendation is inconclusive because we did not identify any qualifying studies investigating the role of conservative treatment in adequately reduced and maintained unstable fractures.

## Recommendation 3

We suggest surgical fixation for fractures with postreduction radial shortening >3 mm, dorsal tilt >10°, or intra-articular displacement or step-off >2 mm as opposed to cast fixation.

Recommendation strength: Moderate

Five randomized clinical trials met our inclusion criteria and compared fixation with cast immobilization.[2-6] Fracture instability is difficult to define but was consistently defined within these studies as loss of radiographic alignment after initial closed reduction and splinting. The studies did not differentiate between articular fractures and extra-articular fractures, nor did they distinguish between patient populations on the basis of age. It was thus not possible to analyze these groups individually. There were differences in pain at 24 and 52 weeks, but not 8 and 12 weeks, in one study; differences in motion at 52 weeks in one study; and differences in complications, overall, in four studies. Complications were defined with variable criteria and included carpal tunnel syndrome, thumb pain, ulnar nerve symptoms, and malunion. The differences were all in favor of surgical treatment.

## Recommendation 4

We are unable to recommend for or against any one specific surgical method for fixation of distal radius fractures.

Recommendation strength: Inconclusive

Fourteen clinical trials met the inclusion criteria: eight combined intra- and extra-articular fractures,[7-14] five studied only intra-articular fractures,[15-19] and one studied only extra-articular fractures.[20] Inclusion was based on inadequate radiographic alignment after initial adequate closed reduction and splint immobilization. The studies did not allow for stratification by fracture type. Only two treatment comparisons were made by more than one study, thus making meta-analysis impossible. All had at least one methodologic flaw and were downgraded to level II. The studies do not address many important aspects of the surgical treatment of distal radius fractures, including specific treatment of different fracture types (eg, volar rim fractures, fracture-dislocations).

Only 3 of 14 studies had statistically significant findings. In one study, there was only a statistically significant difference in complications. In another study, there was a possibly clinically important difference in the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire at 1 year but not at 3 or 6 months. In the third study, there was significantly better function at 2 years for percutaneous fixation compared with open reduction and internal fixation. All other outcomes evaluated by the included studies were not statistically significant. It is therefore not possible to come to an evidence-based conclusion for the optimal surgical treatment of distal radius fractures.

## Recommendation 5

We are unable to recommend for or against surgical treatment of patients aged >55 years with distal radius fractures.

Recommendation strength: Inconclusive

The available evidence does not demonstrate any difference between casting and surgical fixation in patients aged >55 years.

We questioned the role of surgical compared with nonsurgical treatment of unstable distal radius fractures in the elderly, defined by age, infirmity, low functional demands, and poor bone quality, with low-energy injuries. We were unable to identify studies that distinguished patients based on any of these factors apart from age. The cut-off age

for elderly patients has not been established; we selected the age of 55 years and found three clinical trials that did not include any patient aged <55 years.[21-23] Two trials compared external fixation with cast immobilization, and one trial compared percutaneous pinning with cast immobilization. All had at least one methodologic flaw and were downgraded to level II. One addressed extra-articular fractures; one, articular fracture; and one included both. The amount of pain experienced after 1 year was not significantly different in patients treated with percutaneous pinning or with a cast. There was also no significant difference in overall mental or physical health as determined by the Medical Outcomes Study 36-Item Short Form score and no significant difference in the occurrence of complications in patients treated with percutaneous pinning or cast. However, percutaneous pinning did have pin-related complications that do not occur in the cast group. Both randomized controlled trials that compared patients treated with external fixation with casting found no statistically significant differences for pain after 1 year. Similarly, no statistically significant differences were noted for various functional activities.

## Recommendation 6

We are unable to recommend for or against locking plates in patients aged >55 years who are treated surgically.

Recommendation strength: Inconclusive

Locking plates have been purported to be beneficial for fixation of osteoporotic fractures. A single level II prospective nonrandomized comparative cohort study addressed this recommendation by comparing volar locked plating with intrafocal pinning in patients aged >60 years.[24] To maintain consistency with other recommendations, the specified age in this recommendation is 55 years. No differences in complications were noted in the two groups. Patients aged >60 years and treated with volar locking plates or intrafocal pinning did not experience tendon rupture, osteomyelitis, cellulitis, or complex regional pain syndrome (CRPS) significantly more often in any one group. However, pin tract infections were unique to the pinning group.

## Recommendation 7

We suggest rigid immobilization in preference to removable splints when using nonsurgical treatment of the management of displaced distal radius fractures.

Recommendation strength: Moderate

For the purposes of this recommendation, we considered rigid immobilization to be immobilization that was firm (eg, plaster, fiberglass) and not intended for self-removal. Less-rigid immobilization was any type of wrap or brace that either incompletely immobilized the wrist or was intended to be removed by the patient. Five level II randomized controlled trials met the inclusion criteria.[25-29] There were significant differences in pain at 5 to 6, 8, and 24 weeks in favor of casting. There was no significant difference in the two groups at later follow-up. Although radial nerve symptoms occurred more often in patients treated with less-rigid immobilization, other complication rates were not significantly different in the two groups.

## Recommendation 8

The use of removable splints is an option when treating minimally displaced distal radius fractures.

Recommendation strength: Weak

For the purposes of this recommendation, minimal displacement was defined as acceptable alignment at initial presentation before any reduction. Four clinical trials that compared cast to splint treatment met the inclusion criteria.[25,30-32] All had at least one methodologic flaw and were downgraded to level II. Pain at 2 weeks was significantly lower in casted patients in one of four trials. Pain at 6 or 8 weeks was significantly lower in splinted patients in two of four trials. There were no significant differences in pain between the two groups at other time intervals. Complications, including loss of alignment, were largely similar for both groups. Both groups also had similar functional abilities, except for knife/fork use, which was significantly better in the splint group.[32] This resulted in the downgrading of the recommendation to weak.

## Recommendation 9

We are unable to recommend for or against immobilization of the elbow in patients treated with cast immobilization.

Recommendation strength: Inconclusive

For the purposes of this recommendation, we considered immobilization of the elbow applied to prevent forearm rotation. One randomized controlled trial compared above-elbow to below-elbow splinting for maintenance of reduction for 2 weeks after manipulative reduction and found no differences.[33] No other outcomes were assessed; hence, data are insufficient to critically evaluate the need for elbow/forearm immobilization.

## Recommendation 10

Arthroscopic evaluation of the articular surface is an option during surgical treatment of intra-articular distal radius fractures.

Recommendation strength: Weak

Two studies met the inclusion cri-

teria comparing surgical treatment of distal radius fracture with or without adjunctive wrist arthroscopy.[34,35] Only one[34] was sufficiently powered to detect the minimal clinically important difference. Functional outcome was assessed by DASH scores. In the arthroscopy-assisted fixation group, the improvement in DASH score at 3 months was clinically relevant in the arthroscopy group, but the difference was not relevant at 1 and 2 years postoperatively.

## Recommendation 11

Surgical treatment of associated ligament injuries (SLIL injuries, LT, or TFCC tears) at the time of radius fixation is an option.

Recommendation strength: Weak

One level II trial that compared the arthroscopic reduction and fixation of distal radius fracture combined with arthroscopic treatment of associated intracarpal ligament and triangular fibrocartilage complex (TFCC) injuries to fluoroscopic reduction and fixation of the radius alone.[33] In the arthroscopy group, the DASH scores were clinically important at the 3-month interval. Regardless of arthroscopy, the difference in function as determined by DASH scores was not relevant at 1 and 2 years postoperatively. The authors demonstrated that arthroscopy is a valuable adjunctive method for evaluating and treating these lesions that are not detectable on standard radiographs. One limitation of this study is the possibility that the observed carpal lesions may have been preexisting. Additionally, the true incidence of carpal ligament lesions in the fluoroscopy group was unknown.

## Recommendation 12

In patients with distal radius intra-articular fractures, arthroscopy is an option to improve diagnostic accuracy for wrist ligament injuries, and CT is an option to improve diagnostic accuracy for patterns of intra-articular fractures.

Recommendation strength: Weak

Arthroscopy can improve the evaluation of carpal ligament lesions, but the included studies did not examine the effect of these findings on patient outcome.[36,37] The single study on the use of CT demonstrated better fracture characterization but did not associate these findings with improved outcome.[38]

## Recommendation 13

We are unable to recommend for or against the use of supplemental bone grafts or substitutes when using locking plates.

Recommendation strength: Inconclusive

There were no qualified studies identified that addressed this recommendation.

## Recommendation 14

We are unable to recommend for or against the use of bone graft (ie, autograft, allograft) or bone graft substitutes for the filling of a bone void as an adjunct to other surgical treatments.

Recommendation strength: Inconclusive

Only one study compared the use of allograft versus autograft after dorsal plating.[39] No difference in pain or function was observed. The authors did, however, report complications related to autograft harvesting. Several studies suggest some benefit related to pain reduction when calcium phosphate is used to support fixation.[40-45] These studies did not compare the outcome of fixation with and without the material and hence are not applicable to this recommendation.

## Recommendation 15

In the absence of reliable evidence, it is the opinion of the work group that distal radius fractures that are treated nonsurgically be followed by ongoing radiographic evaluation for 3 weeks and at cessation of immobilization.

Recommendation strength: Consensus

This is a consensus recommendation because of the lack of scientific studies that examine the frequency of radiographic evaluation against displacement. Such studies may be lacking in part because of ethical concerns about a control group without radiographic follow-up.

Redisplacement during nonsurgical treatment of distal radius fractures may result in symptomatic malunions. If the fracture is noted to lose reduction during this period, then the surgeon and patient may agree to alter treatment. This recommendation will involve patient visits and radiographic assessment that is already part of orthopaedic care of these injuries.

## Recommendation 16

We are unable to recommend whether two or three Kirschner wires should be used for distal radius fracture fixation.

Recommendation strength: Inconclusive

There were no qualified clinical studies identified that addressed this recommendation.

## Recommendation 17

We are unable to recommend for or against using the occurrence of distal radius fractures to predict future fragility fractures.

Recommendation strength: Inconclusive

We identified six prospective cohort studies reporting the occurrence of fragility fractures after distal radius fracture that met our inclusion criteria.[46-51] The likelihood ratios for the included studies have conflicting results. One of the six studies suggests that a distal radius fracture

generates small but sometimes important changes in the probability of a future fragility fracture. The other five studies suggest that distal radius fracture alters the probability of a future fragility fracture to a small and rarely important degree. Additionally, a diagnostic meta-analysis of the ability of distal radius to predict a future hip fracture shows low sensitivity and high specificity for predicting future fragility fracture.

## Recommendation 18

We are unable to recommend for or against concurrent surgical treatment of distal radioulnar joint (DRUJ) instability in patients with surgically treated distal radius fractures.

Recommendation strength: Inconclusive

Two studies were found that investigated the functional outcome of DRUJ injuries.[52,53] In both papers, DRUJ instability was identified at the conclusion of treatment. Therefore, no instabilities were diagnosed or treated at the time of initial surgery. Although these studies demonstrated that patients with DRUJ instability had poorer outcomes, neither study addressed the question whether early surgical intervention is indicated.

## Recommendation 19

We suggest that all patients with distal radius fractures receive a postreduction true lateral radiograph of the carpus to assess DRUJ alignment.

Recommendation strength: Moderate

In the presence of a distal radius fracture, identification of associated DRUJ dislocation can be difficult. We were interested in determining whether true lateral radiographs in a patient with a radius fracture can identify DRUJ dislocation to allow early intervention. Two studies addressed this question.[54,55] One study used the piso-scaphoid distance; the other studied scaphoid/lunate/triquetral bone overlap to assess radioulnar alignment. Both of these studies are based on level II evidence and showed that accurately performed lateral radiographs can reliably identify DRUJ dislocation when associated with distal radius fractures.

## Recommendation 20

In the absence of reliable evidence, it is the opinion of the work group that all patients with distal radius fractures and unremitting pain during follow-up be reevaluated.

Recommendation strength: Consensus

This recommendation is a consensus statement because we were not able to identify relevant studies that evaluated the effect of unremitting pain and patient outcome after distal radius fractures.

The pain associated with a distal radius fracture will typically diminish after initiation of appropriate treatment. Patients' reports of unremitting pain during the early treatment period may signal a concomitant associated condition (eg, nerve irritation, nerve compression) that requires investigation. The members of the work group deemed that issuing a recommendation on this topic is warranted, despite the lack of evidence to support or refute the investigation into the source of unremitting pain following treatment. Patients undergoing treatment of distal radius fracture should report their progress in recovery. When pain levels do not decrease as expected, it is appropriate to evaluate the patient for causes of pain. This recommendation may result in costs associated with assessment and management, but we believe these actions are consistent with the current practice of most orthopaedic surgeons.

## Recommendation 21

A home exercise program is an option for patients prescribed therapy after distal radius fracture.

Recommendation strength: Weak

Five randomized controlled trials compared a directed home exercise program against various forms of supervised therapy.[56-60] All had at least one methodologic flaw and were considered level II evidence. By design, these studies excluded patients with complications (finger stiffness, CRPS), and their data reflect the effect of therapy in radius fractures that were healing without any adverse events.

In four of the five studies, patients were treated with casting (with or without pins), and therapy was started after removal of fixation (cast or external fixator). In one study, all patients were treated with volar plating and therapy was commenced 1 week postoperatively.[56] In studies comparing a directed home exercise program with supervised therapy begun after removal of fixation, there was no difference in pain or function. In the study in which patients were mobilized 1 week after plating, the home exercise group had significantly better functional (patient-rated wrist evaluation) scores than did the group that received formal therapy. The strength of this recommendation was graded as weak based on the possibly clinically important effects identified by this study.[56]

## Recommendation 22

In the absence of reliable evidence, it is the opinion of the work group that patients perform active finger motion exercises following diagnosis of distal radius fractures.

Recommendation strength: Consensus

Hand stiffness is one of the most functionally disabling adverse effects

following distal radius fracture. Stiffness of the fingers can result from a combination of factors, including pain, swelling, obstruction by splints or casts, and apprehension or lack of understanding by the patient. Finger stiffness can be very difficult to treat after fracture healing, requiring multiple therapy visits and possibly additional surgical intervention. Instructing the patient at the first encounter to move the fingers regularly and through a complete range of motion may help to minimize the risk of this complication.

Finger motion does not have any adverse effects on an adequately stabilized distal radius fracture in regard to reduction or healing. This is an extremely cost-effective intervention; it does not require pharmaceutical intervention or additional visits, but it provides a significant impact on patient outcome. Although finger stiffness is a critical adverse effect of distal radius fractures and directly affects patient outcome, the effects of early finger motion cannot be ethically evaluated in a level I prospective study. The members of the work group therefore consider it important to make this a recommendation by consensus opinion.

## Recommendation 23

We suggest that patients do not need to begin early wrist motion routinely following stable fracture fixation.

Recommendation strength: Moderate

Three studies were included in this recommendation.[3,61,62] Each study investigated different surgical treatment methods: volar plate, transstyloid fixation, or external fixation. In the two internal fixation studies, therapy was started approximately at 1 week; in the external fixation study, mobilization was begun at 3 weeks. In two studies, the control group was either casted or immobilized with a fixator. In the volar plating study, the control group patients were fitted with a thermoplastic splint that they were instructed to remove for showering; therefore, these patients are not a reliable control group. The outcome measures used were pain and function (DASH) and/or complications. None of the outcomes was significantly different between early and late motion. These data support the recommendation that patients do not need to begin early wrist motion after stable fracture fixation.

## Recommendation 24

To limit complications when external fixation is used, limiting the duration of fixation is an option.

Recommendation strength: Weak

Three prospective studies met the inclusion criteria. Collectively, these studies do not agree on a length of immobilization in a fixator; thus, we chose not to define a specific duration in the recommendation. The first study demonstrated no significant difference in groups treated with external fixation for 5 weeks, compared with 3 weeks of external fixation and 2 weeks of additional casting.[63] The results were reported using a nonvalidated patient outcome score; hence, no clear effect could be demonstrated by the early discontinuation of the external fixator. Two additional studies that used a nonvalidated patient outcome score showed a statistically significant association between poorer outcomes with prolonged external fixation.[64,65] Based on limitations of the outcome instruments, the strength of recommendation was weak.

## Recommendation 25

We are unable to recommend against overdistraction of the wrist when an external fixator is used.

Recommendation strength: Inconclusive

Two level II studies met the inclusion criteria because they evaluated wrist distraction with patient outcome.[64,65] There was no statistically significant association between the amount of distraction and patient outcome using a nonvalidated instrument. However, the work group agreed that the important potential adverse effect of finger stiffness was not evaluated in these studies. It would not be ethical to conduct a prospective study to examine the effect of overdistraction; thus, the work group has downgraded the recommendation to inconclusive.

## Recommendation 26

We suggest adjuvant treatment of distal radius fractures with vitamin C for the prevention of disproportionate pain.

Recommendation strength: Moderate

We were interested in determining the potential benefit of nutritional supplements in recovery of function after treatment of distal radius fractures. Two studies by the same group met our inclusion criteria, and both examined the use of vitamin C.[66,67] Specifically, the studies found a significant reduction in the incidence of CRPS after treatment of distal radius fracture when the patients were given supplemental vitamin C. However, these studies have a serious limitation: there is no objective method to conclusively diagnose CRPS, and there is no method to assess outcome after CRPS. The authors used subjective criteria to define a pain syndrome in these studies, which affects the reliability of the data.

## Recommendation 27

Ultrasound and/or ice are options for adjuvant treatment of distal radius fractures.

Recommendation strength: Weak

We identified two prospective studies that used patient outcome measures in regard to the effect of mechanical adjuvant treatment modalities for distal radius fractures.[68,69] Neither study used validated patient outcome measures to study the effect of intervention. The study examining the effect of low-intensity ultrasound reported statistically significant improvement in the number of patients with no pain and with radiographic union.[68] No long-term or permanent benefit related to a validated outcome measure was demonstrated. The second study demonstrated the value of ice at 3 and 5 days but showed no benefit for pulsed electromagnetic field therapy.[69]

## Recommendation 28

We are unable to recommend for or against fixation of ulnar styloid fractures associated with distal radius fractures.

Recommendation strength: Inconclusive

Ulnar styloid fractures are relatively common in association with distal radius fractures. We were interested in the effect of concomitant fixation of the styloid fracture on patient outcome. One study found no difference in radiographic appearance or patient outcomes between treatment (fixation) and no treatment of the ulnar-sided injury along with closed reduction and casting of the radius.[70] They did not use any validated outcome measures. The other study identified ulna styloid fractures after treatment was completed and found that there were clinically important differences between patients with and without ulna styloid fractures.[71] By design, none of the ulna styloid fractures were treated at the time of initial surgery. Although the patients with ulna styloid fractures had poorer outcomes, the study did not address the question of whether early surgical intervention is indicated.

## Recommendation 29

We are unable to recommend for or against using external fixation alone for the management of distal radius fractures in the presence of depressed lunate fossa or four-part fracture (sagittal split).

Recommendation strength: Inconclusive

No qualified studies were identified that addressed this recommendation.

No studies specifically investigated distal radius fractures with depressed lunate fossa or four-part fractures that met our inclusion criteria.

## Future Research

The overall lack of strong recommendations reflects the need for more research into treatment of this common injury. Future studies should also include a priori power analyses to ensure that clinically important improvements are measured because these, rather than radiographic outcomes alone, are the improvements that matter to patients.

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