

# Treatment of distal radius fractures in adults

## Main Editor

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### **Disclaimer**

In accordance with new international standards for reliable guidelines and "Guidance on evidence-based medical guidelines" issued by the Norwegian Directorate of Health's, clinical guidelines should include a systematic review of available documentation and a balanced assessment of the benefits and harms of existing treatment options. Clinical guidelines set a standard for assessment, treatment and follow-up of patients or diagnosis groups, and serve as an aid to healthcare personnel in the decision-making in their everyday clinical practice. Professional guidelines are instruments, which purpose is to prevent undesired variation in treatment quality between patients or patient groups.

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## Summary of recommendations

### 3 - Radiological definition of an unstable distal radius fracture

#### Practice Statement

It is good practice to consider operative treatment of distal radius fractures in adult patients  $\geq 18$  years where there are one or more of the following radiological parameters (= instability criteria) on the primary radiographs:

$\geq 10$  degrees dorsal angulation of the distal radius

Ulnar variance  $\geq 2$  mm

Intraarticular step formation  $\geq 2$  mm

Comminution in the fracture area / loss of intact dorsal cortex of the distal radius

Incongruence of distal radioulnar joint

If you choose non-operative treatment of a well-reduced but unstable fracture, it is good practice to follow the patient closely with regard to the the same parameters. It is also good practice to reduce the fracture to close as possible to the anatomical position, although the fracture on the the primary X-rays has less malposition than given above.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### 4 - Recommendation of operative treatment rather than conservative treatment

#### Operative treatment of unstable distal radius fractures in adult patients $\geq 18$ years yields a better result than conservative treatment

#### Strong Recommendation

We recommend operative treatment of patients with unstable distal radius fractures in adult patients  $\geq 18$  years.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### Weak Recommendation

We suggest operative treatment of patients with unstable distal radius fractures in adult patients > 65 years.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

## 5 - Supplementary CT in the radiological assessment of distal radius fractures

### Practice Statement

It is not good practice to perform CT examination routinely before operative treatment of all distal radius fractures.

If the assessment of conventional radiographs gives doubt regarding the choice of treatment or there is need for better preoperative mapping of complex intra-articular distal radius fractures, it is good practice to perform supplementary CT examination.

## 6 - Choice of time for operative treatment

### Practice Statement

When operation indication is set, it is good practice that the operation is carried out on a date agreed with the patient and without unnecessary fasting and latency. This unless other circumstances warrant emergency surgery.

*A planning of the operation allows the patient to be operated by an experienced surgeon or the patient may optionally be reallocated to a department with necessary expertise. Likewise, the patient may be fully informed about the impending treatment.*

### 7.1 - Volar locking plates versus external fixation or pinning

### **Volar locking plates yield a better early post-operative outcome than external fixation in adults, irrespective of age**

#### **Weak Recommendation**

We suggest using volar locking plates rather than external fixation for adult patients irrespective of age who meet the indication for operation.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### **Volar locking plates yield a better early post-operative outcome than percutaneous pinning in adults, irrespective of age**

#### **Weak Recommendation**

We suggest using volar locking plates rather than percutaneous pinning for adult patients irrespective of age who meet the indication for operation.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

## **7.2 - Other treatments or additional treatments**

### **External fixation combined with percutaneous pinning yield a better functional result than external fixation alone**

#### **Weak Recommendation**

If you choose to treat an unstable distal radius fracture in an adult patient with external fixation, we suggest the treatment combined with percutaneous fixation of the fracture fragment(s), since this yields a better functional result irrespective of the patients' age.

*There is insufficient documentation to be able to draw any conclusions about the relative outcome of the different methods of external fixation in the treatment of distal radius fractures in adults.*

### **Kapandji pinning probably results in more complications than regular pinning**

#### **Practice Statement**

If you choose to treat an unstable distal radius fracture in adult patients with percutaneous pinning, we suggest you use regular pinning technique rather than Kapandji pinning because of fewer complications, irrespective of the patient's age.

### **Use of biodegradable pins results in osteolytic lesions**

#### Practice Statement

If you choose to treat an unstable distal radius fracture in adult patients with percutaneous pinning, we suggest you use regular metal pins rather than biodegradable pins to avoid osteolytic lesions, irrespective of the patient's age.

### **Bone grafts or bone substitutes provides probably no better functional outcome than operative fixation alone**

#### Practice Statement

We suggest bone grafts or bone substitutes are not used in the treatment of unstable distal radius fractures in adult patients, neither as sole treatment or as a substitute to operative treatment, irrespective of the patient's age.

## **7.3 - Associated distal ulna fractures**

### **Concomitant operative fixation of an associated unstable ulna fracture provides better functional outcome and fewer complications than conservative treatment**

#### Practice Statement

If a distal radius fracture is accompanied by a distal ulna fracture, operative treatment should be performed on the distal radius fracture. The stability of the distal radioulnar joint should then be tested. In case of instability or a dislocated ulna fracture, operative fixation of the ulna fracture is suggested.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

## **8 - Immobilisation period after operative treatment with volar locking plate**

### **Short-term post-operative immobilisation after operative treatment with volar locking plate**

### Weak Recommendation

Consider using short-term plaster casting (< 2 weeks) after operative treatment with a volar locking plate, rather than long-term (> 5 weeks).

## 9 - Rehabilitation after operative treatment

### Routine training with an occupational therapist or physiotherapist only for patients with complicated courses

#### Practice Statement

It is not good practice to give training supervised by an occupational therapist or physiotherapist as a matter of routine to patients with an uncomplicated course, since there is no evidence that this gives better outcome than a single session of advice and a written exercise plan. It is good practice for all patients as a minimum to be offered instruction in independent exercises after a distal radius fracture, irrespective of the treatment method.

## 10 - Hearings

#### Not Set

Alle hearing responses are published on [www.handleddsbrudd.no](http://www.handleddsbrudd.no).

## 11 - Acknowledgements

#### Not Set

We thank Norwegian Orthopaedic Association for the mandate and trust we were given in the development of this guidelines. We thank the National Knowledge Centre for Health Services and the Norwegian Medical Association which has enabled this work, both methodologically and economically. A big thanks also to Per Olav Vandvik and Linn Brandt who have consecrated us to MAGICapp and that has been an essential prerequisite for the finalization of this guidelines. Finally, a big thanks to Danish Health and Medicines Authority for approving our use of part of their guideline "National klinisk retningslinje for behandling af håndledsnære brud (distal radiusfraktur)" published on 8 October 2014.





## 1 - Method and background

### **GUIDELINES FOR TREATMENT OF DISTAL RADIUS FRACTURES IN ADULTS**

**Editorial Committee:** Hebe Désirée Kvernmo, Per Olav Vandvik, Linn Brandt.

**Guideline Panel:** Hebe Désirée Kvernmo (Main Editor), Leiv Magne Hove, Katrine Bjørnebek Frønsdal, Ingrid Harboe, Adalsteinn Odinsonn, Yngvar Krukhaug.



Norwegian Orthopaedic Association

THE NORWEGIAN MEDICAL ASSOCIATION

We present guidelines for the treatment of distal radius fractures in adult patients  $\geq 18$  years. The guidelines were developed on the basis of newly published reviews of evidence on the topic (Frønsdal et al. 2013, Kvernmo and Krukhaug 2013) and new metaanalysis performed by the Norwegian Knowledge Centre for the Health Services (NOKC) on behalf of the Guideline Panel. We have subsequently also adopted parts of the guideline for treatment of distal radius fractures of the Danish Health and Medicines Authority (DHMA 2014). Our guidelines are being published in a new and user-friendly format specifically intended for healthcare personnel. In this chapter, we provide an account of the background to and organisation of the work.

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### **1. INTRODUCTION**

#### **1.1 PURPOSE**

The purpose of the guidelines issued on behalf of the Norwegian Orthopaedic Association (NOA) on the treatment of distal radius fractures is to provide evidence-based recommendations. These recommendations cover indications for surgery, treatments and functional retraining after treatment completion.

#### **1.2 DEFINITION OF CLINICAL GUIDELINES**

In accordance with new international standards for reliable guidelines and "Guidance on evidence-based medical guidelines" issued by the Norwegian Directorate of Health's, clinical guidelines should include a systematic review of available documentation and a balanced assessment of the benefits and harms of existing treatment options (Laine, Taichman and Mulrow 2011, Graham et al. 2011, Directorate of Health 2012).

Clinical guidelines set a standard for assessment, treatment and follow-up of patients or diagnosis groups, and serve as an aid to healthcare personnel in the decision-making in their everyday clinical practice. Professional guidelines are instruments, which purpose is to prevent undesired variation in treatment quality between patients or patient groups.

#### **1.3 MOTIVATION BEHIND NEW GUIDELINES FOR THE TREATMENT OF DISTAL RADIUS FRACTURES IN ADULTS**

Distal radius fractures are the most frequently occurring type of fracture in Norway, accounting for about 20 % of all fractures. Incidence rates indicate that we have more than 15 000 of these fractures each year in Norway (Hove 1994, Lofthus et al. 2008). The injury mechanism is normally a fall onto an outstretched arm. A fracture with malpositioning will typically leave patients with a wrist deformity. They will experience pain in connection with movement, and tenderness on palpation of the distal radius.

Some patients end up with a delayed operation or a malunited fracture. This is often because the anatomical position after reduction is considered satisfactory without considering whether the fracture may be unstable and (re-)dislocate. High degree of comminution, old age and high energy of the trauma are factors that more likely lead to loss of reduction. Stability is assessed on the basis of anatomical criteria such as radial tilt and/or radial shortening and/or intraarticular step formation and/or comminution of the fracture and/or incongruence in the distal radioulnar joints (Mackenney, McQueen and Elton 2006, Lutz et al. 2011, Catalano et al. 1997, Wilcke, Abbaszadegan and Adolphson 2007, Abramo, Kopylov and Tagil 2008). The challenge is thus to determine at the first medical consultation which fractures may (re-)dislocate and should be operated primarily to save the patient unnecessary postponement of final treatment and to ensure a good functional endresult.

Treatment with reduction of the fracture if needed, stabilising bandaging and subsequent follow-ups to check whether the fracture reduction has been maintained, has an important place in the treatment of non-displaced and slightly displaced distal radius fractures, whereas operative treatment is used for fractures which are regarded as unstable. The increased use of operative treatment on assumed unstable high-energy fractures in younger age groups has influenced the treatment of elderly, cognitively unimpaired patients with displaced fractures who are now receiving surgical treatment in increasing numbers if this is indicated by the instability criteria. However, surgeons are usually more reluctant to operate patients with a low functional level, even if eligible for operation according to instability criteria. By low functional level is meant permanent inability to deal independently with the activities of daily living.

Despite the growing emphasis on treatment of distal radius fractures, there is wide variation in practice. Many hospitals attempt to differentiate the treatment. Volar locking plates have become particularly popular, despite the scarcity of existing evidence on their superiority to other operative treatment options before these plates began to be used on a large scale. Other hospitals may offer more limited options with respect to both which fractures are operated on and choice of operative treatment method. This may result in a poorer outcome for some patients than might be expected in light of the various treatment options currently available. This unfortunate situation is illustrated by data from the Norwegian System of Compensation for Injuries to Patients, which show that distal radius fractures are one of the most frequent causes of successful claims brought by patients (Husby, Walløe and Willumstad, 2006). It is therefore important to ensure patients with distal radius fractures an optimal treatment.

#### **1.4 DELIMITATION OF PATIENT POPULATION AND FRACTURE TYPES**

The Guideline Panel has chosen exclusively to focus on clinical cases that can be categorized with respect to treatment options:

The patient population is adult patients  $\geq 18$  years who have incurred a distal radius fracture. The guidelines apply to fractures of AO classification types A2, A3 and C1-3, corresponding to the fractures previously called Colles fractures. The guidelines do NOT include volar angulated fractures (Smith fractures), shear fractures (Chauffeur's and Barton's fractures), open fractures, fractures resulting from high-energy trauma, isolated fractures of the distal ulna (AO type A1) or patients with other significant concurrent injuries to the wrist or hand, since these injuries almost always should be treated operatively.

#### **1.5 GUIDELINE TARGET GROUP**

The target group is healthcare professionals who treat distal radius fractures, primarily orthopaedic surgeons but also accident and emergency doctors and other doctors who treat distal radius fractures, as well as physiotherapists and occupational therapists who are concerned with the functional retraining of these

patients. The guidelines are relevant for nurses, patients and family who want to update themselves on the treatment of distal radius fractures.

### **1.6 PATIENT PERSPECTIVE**

In order better to highlight the patient perspective, we chose not to look purely at the radiological parameters as outcome measures, since the latter have limited correlation with the function and quality of life experienced by the patient (Kwok, Leung and Yuen 2011). We have therefore, used the patient-reported outcome measures (PROM), DASH (Disability of the Arm, Shoulder, and Hand) and PRWE (Patient-Rated Wrist Evaluation). Both measuring instruments have a scale from 0–100, where a low score is best. The lowest clinically relevant difference is 10 for DASH and 14 for PRWE (Sorensen et al. 2013).

### **1.7 LEGAL SITUATION**

The guidelines intend to help healthcare professionals to make good decisions when treating patients with distal radius fractures. The guidelines are to be considered as advice to healthcare professionals, which implies that relevant healthcare professionals are recommended to follow the guidelines. They are not legally binding, but professionally normative for choices considered to promote quality, sound practice and equality in services. Health professionals must nonetheless exercise discretion in their assessment of the individual patient, and take account of the individual patient's needs (Graham et al. 2011).

## **2. ORGANISATION OF THE WORK**

### **2.1 THE ASSIGNMENT OF TASK**

At its annual General Assembly in October 2006, the Norwegian Orthopaedics Association (NOA) agreed unanimously upon the need for guidelines for the treatment of distal radius fractures. NOA appointed a so-called Consensus Group to draw up recommendations for treating these fractures. The Norwegian Knowledge Centre for the Health Services (NOKC) was therefore contacted by the President of NOA, Dr Hebe Kvernmo, and commissioned to assist the Consensus Group in reviewing the evidence for treatment of wrist fractures. This review was to form the starting point for developing treatment recommendations.

From 2006–2009, the Consensus Group consisted of orthopaedic specialists, along with an accident and emergency doctor, who all have a special interest in the treatment of distal radius fractures. The Consensus Group included The Chairman of the Consensus Group, Hebe D. Kvernmo (Oslo University Hospital), and the following members: Leiv Magne Hove (University of Bergen and Haukeland University Hospital), Torstein Husby (Oslo University Hospital), Magne Røkkum (Oslo University Hospital), Adalsteinn Odinson (St. Olavs Hospital - Norwegian University of Science and Technology - NTNU), Knut Skoglund (Innlandet Hospital Trust), Knut Melhuus (Oslo University Hospital), John Williksen (Oslo University Hospital), Yngvar Krukhaug (University of Bergen and Haukeland University Hospital), and Vilhjalmur Finsen (NTNU and St. Olavs Hospital). The Project Group at NOKC during this period included Katrine B. Frønsdal (researcher and project leader), and the following members of the project staff: Lene K. Juvet (researcher), Bjørn A. Graff (former researcher at NOKC), Sari Susanne Ormstad (research librarian), Inger Natvig Norderhaug (research director), Vigdis Lauvrak (researcher), Ingrid Harboe (research librarian), Brynjar Fure (head of unit and project responsible).

The purpose of the project was to collect and evaluate all publically available scientific research on the treatment and rehabilitation of adult patients with wrist fractures.

The original research questions were as follows:

Which reduction method(s) is/are most suitable?

Which patient population(s) benefit from surgery rather than conservative treatment?

Which type(s) of surgery yield(s) the best outcome?

Which type(s) of rehabilitation yield the best outcome?

A review of the evidence resulted in two publications in 2013 (Frønsdal et al. 2013, Kvernmo and Krukhaug 2013), however, documentation was often sparse and the quality of the evidence often low. Thus, many crucial research answers remained unanswered.

In 2013, a reduced Consensus Group continued the work following the conclusion of the first cooperative project with NOKC. The group was now named the Guideline Panel for Preparing Guidelines for Treating Wrist Fractures. This group received further assistance from Per Olav Vandvik (NOKC) and Linn Brandt in developing evidence-based guidelines using GRADE and the electronic platform MAGICapp, as well as assistance from Ingrid Harboe (NOKC) with new literature searches and Katrine B. Frønsdal (NOKC) with new metaanalyses.

NOA decided that the guidelines were to be based on the new trustworthy clinical guidelines for systematic and transparent use of GRADE (Guyatt et al. 2008, Laine et al. 2011, Qaseem et al. 2012).

## **2.2 PARTICIPANTS**

### *The Editorial Committee*

The work was coordinated by an Editorial Committee consisting of Hebe Kvernmo, Linn Brandt and Per Olav Vandvik. This committee was responsible for ensuring that the guidelines are prepared according to the method described in Section 3 below. Hebe Kvernmo acted as Editor.

### *The Guideline Panel*

The Guideline Panel for Chapters 1-4 included:

Hebe Désirée Kvernmo (University Hospital of North Norway and University of Tromsø - the Norwegian Arctic University) - Chairman.

Leive Magne Hove (University of Bergen and Haukeland University Hospital)

Katrine Bjørnebek Frønsdal (NOKC)

Ingrid Harboe (NOKC)

John Håkon Williksen (Oslo University Hospital)

Torstein Husby (Oslo University Hospital.)

Adalsteinn Odinson (St. Olavs Hospital and NTNU)

Yngvar Krukhaug (University of Bergen and Haukeland University Hospital)

Chapter 3 and 4 is later revised by the latest Guideline Panel (see below).

### *The Guideline Panel for Chapters 3-9 included:*

Hebe Désirée Kvernmo (University Hospital of North Norway and University of Tromsø - the Norwegian Arctic University) - Chairman

Leive Magne Hove (University of Bergen and Haukeland University Hospital)

Katrine Bjørnebek Frønsdal (NOKC)

Ingrid Harboe (NOKC)

Adalsteinn Odinson (St. Olavs Hospital and NTNU)

Yngvar Krukhaug (University of Bergen and Haukeland University Hospital)

In the revision of Chapter 4 (former Chapter 3) we have adjusted the instability criteria ulnar variance from 3 to 2 mm after assumed references from the guidelines of the Danish Health and Medicines Authority (DHMA 2014) for indications for operative treatment and made clear what X-ray examinations which form the basis for this evaluation. In revision of Chapter 3 (former Chapter 4) we have given a remark that restraint should be exercised with respect to using operative treatment for patients with a lasting low functional level. Also this change is in line with the guidelines of DHMA.

### 3. DEVELOPMENT OF THE GUIDELINES

#### 3.1 FORMULATION OF RESEARCH QUESTIONS

The starting point for developing recommendations for treatment guidelines was to identify key questions about clinical practice.

The questions we had formulated prior to the initial review of evidence were clearly defined in the so-called PICO format, with a precise description of population (P), the treatment options interventions (I) and comparators (C), and outcomes (O) (Guyatt et al. 2011). Only outcomes of importance to patients were selected. An example, for patients aged over 18 years with an unstable distal radius fracture (P), are volar locking plates (I) superior to percutaneous pinning (C) for the patient-reported outcome measures (O) DASH and VAS pain? The various questions appear in each of the chapters in the evidence profiles.

#### 3.2 LITERATURE SEARCH

Literature searches based on PICO questions were conducted with the assistance of experts in systematic literature search and review at NOKC. In addition to the original evidence based on systematic reviews, the Guideline Panel also conducted new searches and performed meta-analyses comparing volar locking plates with external fixation and percutaneous pinning, respectively. For search strategy, see Section 10 in this Chapter.

#### 3.3 SUMMARY AND ASSESSMENT OF DOCUMENTATION

The GRADE instrument was used to determine the strength of the effect estimates, i.e. to what degree we could be confident on estimates. In this way, expected effects between treatment options based the most relevant studies were reported through a systematic and transparent process (<http://www.gradeworkinggroup.org>). In the absence of already published systematic reviews, the Guideline Panel performed its own meta-analyses of results from primary studies as a basis for further work. The best evidence base for each individual outcome was then assessed in accordance with GRADE through the following steps:

1. Quality of the documentation (confidence in estimated outcomes) was determined by considering five factors: Risk of systematic error in individual studies; heterogeneity across studies; transferability from studies to individual patients; precision of estimated effects (width of confidence intervals) and risk of publication bias. Table 1 defines documentation quality levels.
2. The relative and absolute effects of treatment options were estimated, and the relative estimated effects were applied to the risk of a given outcome.
3. Development of outcome tables for documentation across outcomes, i.e. evidence profiles and summary of findings tables.

High quality	We are very confident that the estimated effect is close to the true effect	It is unlikely that further research will affect our confidence in the estimated effect
Moderate quality	We have moderate confidence in the estimated effect: The estimated effect is probably close to the true effect, but may also be different from the true effect	It is likely that further research will affect our confidence in the estimated effect. Further research may also change the estimate

Low quality	We have limited confidence in the estimated effect: The estimated effect may be very different from the true effect	It is highly likely that further research will affect our confidence in the estimated effect. Further research will probably change the estimate
Very low quality	We have very little confidence that the estimated effect is close to the true effect	The estimated effect is very uncertain

Table 1: Documentation quality and implications for further research in accordance with GRADE (Atkins et al. 2004, Guyatt et al. 2011).

### **3.4 VALUES AND PREFERENCES**

An essential step in the development of recommendations using GRADE is to weigh up the benefits against drawbacks of the various treatment options. There are no studies of patients' values and preferences for treatment of wrist fractures, but the group has made assumptions on behalf of the patient population in cases where the patient perspective has been considered important. In the longer term, the Guideline Panel intends to conduct a separate study of patients' preferences and include this in an updated recommendation.

### **3.5 USE OF RESOURCES AND COST/BENEFIT ANALYSES**

In the longer term the Guideline Panel will consider incorporating cost/benefit assessments in the development of recommendations. An economic evaluation with cost/benefit analyses will only be included in recommendations where it is probable that these analyses may shift the direction or strength of the recommendation. To assist in these economic considerations, the Guideline Panel will consult health economists with clinical expertise, to ensure that resource considerations are taken correctly into account.

### **3.6 CONFLICTS OF INTEREST**

There is broad international consensus that transparent reporting of conflicts of interest is necessary to ensure the quality of professional guidelines (McLean et al. 2012). There is also a growing understanding that intellectual conflicts of interest are just as important as financial ones. The method we have used has systematically recorded both types of conflict of interest, and also distinguishes between primary and secondary conflicts of interest. In principle, participants with primary conflicts of interest should be excluded from taking part in the final wording of the recommendations. The Guideline Panel has chosen to allow the whole group to take part in the entire process, even if conflicts of interest are noted. The Editor and Chairman of the Guideline Panel and the Editing Committee have reported no primary conflicts of interest.

### **3.7 FROM DOCUMENTATION TO RECOMMENDATION**

The direction and strength of each recommendation are classified according to GRADE on the basis of the following four key factors:

The balance between benefits (desired consequences) and drawbacks (undesired consequences) of the treatment

The quality of the documentation (degree of confidence in the estimated effects)

In light of lack of data on the following points, they were only briefly taken into account:

Patient values and preferences  
Cost assessments

Apart from this, the strength of the recommendation is assessed on the basis of the following principles:

*Strong recommendation for a measure:* The benefits clearly outweigh the drawbacks.

*Weak recommendation for a measure:* It is uncertain whether the benefits outweigh the drawbacks.

Using GRADE, only one of the recommendations was strong. The others were weak, reflecting a fine balance between benefits and drawbacks and/or expected wide variation in individual patients' values and preferences.

*When recommendations are weak, it is all the more important to make the evidence base available, so that clinicians can use the recommendations in a balanced manner in encounters with individual patients.*

#### **4. USER PARTICIPATION AND ASSESSMENT OF PATIENT PREFERENCES**

Assumed patient preferences have been discussed for each recommendation. User representatives will be included in the next iteration of the guideline.

#### **5. REVIEW AND CIRCULATION FOR COMMENTS**

The medical and methodological quality of the guidelines for wrist fractures follows recommendations for making guidelines (Guyatt et al. 2008, Laine et al. 2011, Qaseem et al. 2012). NOA, prior to NOA's General Meeting in autumn 2013, have been invited to provide their comments on Chapter 1-4 of the guideline. The comments have been incorporated in this updated version. The guideline method and preliminary conclusions have also been presented at the NOA Autumn Meeting annually since the work started, and similarly in 2013. Indeed, the guidelines were adopted and approved as NOA's guidelines for treatment of patients with distal radius fractures at NOA's General Assembly October 2013. Further work is from now on considered as updating of the guidelines. The second and so far last update was circulated for amendments among members of NOA from October 20, 2014 to November 14, 2014, before the final version was published December 4, 2014.

#### **6. PUBLICATION**

The guidelines will be published on the internet in a new electronic format at [www.haendleddsbrudd.no](http://www.haendleddsbrudd.no) as well as in the Journal of the Norwegian Medical Association and in international peer reviewed journals. The English version is published on [www.wristfractures.no](http://www.wristfractures.no).

The guidelines will be made available via several media, including the internet (as applications for tablets and smart phones), in addition to publication in the Journal of the Norwegian Medical Association. A link to the guidelines will be available from NOA's website [www.ortopedi.no](http://www.ortopedi.no) og Norwegian Society for Surgery of the Hand [www.handkirurgi.no](http://www.handkirurgi.no). An information campaign will also be conducted, with an article in the health sector newspaper Dagens Medisin.

#### **7. BACKGROUND TO NEW PRESENTATION FORMAT**

The guidelines are being presented in a new format that can function as an evidence support tool on various platforms. The presentation format is integrated into a combined author and publication tool for guidelines that is available for internet and mobile applications and systems for integration into electronic patient records. The SNAP IT project is a part of MAGIC10. This is a research programme aimed at achieving more effective development, dissemination and updating of evidence based guidelines. MAGIC is associated in its turn with the international research project DECIDE (Developing and Evaluating Communication strategies to support Informed Decisions and practice based on Evidence) which has been developed by the GRADE Working Group, financed by the EU and includes leading international guideline organisations with partners in 10 countries. For more information please see:

<http://www.decide-collaboration.eu>

<http://www.gradeworkinggroup.org>

<http://www.magicproject.org>

#### **8. UPDATING**

Regular updating of the guidelines is planned. Instead of putting fixed time interval for update search, we have over the past few months experienced the need for the Guideline Panel to make updated search for individual



guidelines/chapters where we see there are new publications. Such dynamic updates are one of the major advantages of using the MAGIC platform. Likewise, the platform is created so that users can give feedback to the expert panel for each of the various recommendations.

## 9. CONFLICT OF INTEREST

All participants have made a written statement concerning their intellectual and financial conflicts of interest.

The conflicts of interest are as follows:

Prof Hebe Désirée Kvernmo has been a peer reviewer for the Danish Health and Medicines Authority on their guidelines for distal radius fractures. She has previously received lecture fees from OrtoMedic for teaching Norwegian orthopaedic surgeons to use OrtoMedic's osteosynthetic materials in the treatment of wrist fractures; cf. the obligation in the invitation to tender to provide user instruction. Dr Kvernmo has co-authored a study that compares volar locking plates with external fixation. She is the author of a chapter of an international textbook on distal radius fractures that is being published in 2014, but in which no relevant treatment is promoted, and will not receive income from the sale of the book.

Prof Leiv Magne Hove took the initiative for and is editor-in-chief of an international textbook on distal radius fractures that is being published in 2014, but in which no relevant treatment is promoted, and will not receive income from the sale of the book. Dr Hove also took the initiative for a book on wrist surgery published in 2009, the income from which goes to the Norwegian Society for Surgery of the Hand. He has previously been involved in developing a dynamic external fixator, for which he did not receive a fee. Katrine Bjørnebek Frønsdal has no conflicts of interest to be declared.

Dr Adalstein Odinson is the author of a chapter of an international textbook on distal radius fractures that is being published in 2014, but in which no relevant treatment is promoted, and will not receive income from the sale of the book. No other conflicts of interest are declared.

Dr Yngvar Krukhaug has previously received consulting fees from OrtoMedic/Biomet and Smith & Nephew and lecture fees from Stryker. These companies sell osteosynthetic materials for use in the treatment of wrist fractures. Dr Krukhaug has co-authored a number of scientific studies that compare various methods, both conservative and surgical, of treating distal radius fractures. He is the author of a chapter of an international textbook on distal radius fractures that is being published in 2014, but in which no relevant treatment is promoted, and will not receive income from the sale of the book.

## 10. SEARCH STRATEGY

Databases: Embase (Ovid), Ovid Medline, Cochrane Library, Centre for Reviews and Dissemination, PubMed (e-pub ahead of print)

Date: 2013-04-15

Time limit: 2007-01-01 - 2013-04-15

Updated search: 2013-09-30

Time limit: 2000-01-01 - 2013-09-30

Study design: Systematic review (Ovid's clinical queries: "reviews (maximizes specificity)" og systematic\* review\*.tw), Health Technology Assessment, Randomised controlled trial (Ovid's clinical queries: "therapy (maximizes specificity)")

Total results: 37 (25+12) Systematic reviews, 63 (55+8) Randomised controlled trials

Comment: the same search strategies as below were used in the update search with time limit 2000-01-01 - 2013-09-30

Performed by: Ingrid Harboe

[Link to full search strategy](#)

## 11. REFERENCES

See separate tab for references.



## 2 - How to read the guideline

### NEW STRUCTURING OF RECOMMENDATIONS IN TOP LAYER FORMAT

[The top layer consists of:](#)

[Direction and strength of each recommendation](#)

[The following article is recommended for a swift, informative introduction to GRADE.](#)

[Explanation and illustration of the information to be found under the recommendations](#)

A top layer is defined as the minimum information clinicians need to be able to apply the recommendation in their own practice, and has been developed through extensive user testing by clinicians in seven countries through the DECIDE research project. The top layer format is especially adapted for use in the guidelines for the GRADE method.

#### **The top layer consists of:**

The recommendation: Written in structured and active language.

The strength of the recommendation: Communicated with colour codes and text.

Key information: Brief information about the balance between benefits and drawbacks, the quality of the documentation, preferences and values and resource considerations.

Rationale: Balancing the different key factors that lead to the direction and strength of the recommendation in question

In addition, the following are associated with each individual recommendation:

- Documentation: Relevant Summary of Findings tables,
- Practical information on procedure and risk stratification tools.
- Adaptation: A separate category called "adaptation" is used for modified recommendations to give a description of and rationale for the change.
- Decision-making aids: These are being developed, and do not form an integral part of the guideline yet.

The direction and strength of each recommendation are classified according to GRADE on the basis of the four key factors. Apart from this, the strength of the recommendation is assessed on the basis of the following principles:

- Strong recommendation (green) for a measure: The benefits clearly outweigh the drawbacks. This means that all, or virtually all, patients will want the recommended treatment.
- Weak recommendation (yellow) for a measure: It is more uncertain whether the benefits outweigh the drawbacks. This means that most patients will still want the recommended treatment. However, there is a greater likelihood of variation in individual preferences.
- Practical advice (purple) for a measure: Advice based on professional expertise. Not evaluated according to GRADE because of inadequate documentation. This means that they are significantly different from recommendations, and must be based more on personal discretion.

The following article is recommended for a brief and informative introduction to GRADE:

[G. Goldet, J. Howick. Understanding GRADE: an introduction. Journal of Evidence-Based Medicine 6 \(2013\) 50-54.](#)

Explanation and illustration of the information to be found under the recommendations:

For more explanation, see [help.magicapp.org](http://help.magicapp.org)

## Navigating a recommendation

### 7.1 Volar locking plates versus external fixation combined with pinning

Background Text

Volar locking plates yield a better early post-operative outcome than external fixation in adults, irrespective of age

#### Weak recommendation

Consider choosing volar locking plates rather than external fixation for adult patients irrespective of age who meet the indication for operation.

*Restraint should be exhibited with respect to using surgery for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

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Click anywhere on the recommendation to open it so that you can view

- the PICO questions that will underpin the recommendation
- the key information that summarize the supporting evidence for the end user
- the rationale to support your decisions
- other content you would want to add

# Viewing the key information

**1** Key information a narrative summary of the 4 major factors behind a recommendation. It should help you understand and apply the recommendation in practice.

**2** View different types of information by using the tabs

**4** The guideline panels confidence in the benefits related to each factor results in a color change in the colorbar related to that factor

The screenshot displays a digital guideline interface. At the top, a yellow box indicates a "Weak recommendation". Below this, a text block states: "It is less clear whether the benefits outweigh the drawbacks/harms." A subsequent paragraph reads: "We suggest using volar locking plates rather than external fixation for adult patients irrespective of age if they meet the indication for operation." A dashed line separates this from a note: "Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities." Below the text is a horizontal tabbed menu with options: "Effect estimates", "Key info" (which is selected and highlighted in grey), "Rationale", "Practical advice", "Adaptation", "References", and "Dissemination". The main content area below the tabs is divided into three sections: "Benefits and harms", "Quality of evidence", and "Preference and values".

**Weak recommendation**

It is less clear whether the benefits outweigh the drawbacks/harms.

We suggest using volar locking plates rather than external fixation for adult patients irrespective of age if they meet the indication for operation.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

Effect estimates   **Key info**   Rationale   Practical advice   Adaptation   References   Dissemination

**Benefits and harms**

Volar locking plates yield significantly better DASH scores 3, 6 and 12 months post-operatively than external fixation of unstable distal radius fractures. The clinically relevant difference between the methods diminishes over time, however (volar locking plates result in 16 points better function than external fixation after 3 months, while after 6 and 12 months the outcomes are only 6.4 and 8 points better).

The Guideline Panel considers that the complications associated with the two treatment methods are comparable.

**Quality of evidence**

Both the meta-analyses and the RCT that is not included in the meta-analyses are of generally good quality. The quality of the documentation across the studies is regarded as moderate. The patient population corresponds to that covered by the guidelines.

**Preference and values**

There are no studies of patient's values and preferences. Values and preferences may differ in different patient groups.

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### 3 - Radiological definition of an unstable distal radius fracture

*The Guideline Panel's research question was as follows:*

Is there evidence to indicate that one or more of the following radiological parameters, assessed by X-ray examination of the wrist, can be used to arrive at an indication for operative treatment or reduction:

≥ 10 degrees dorsal tilt of distal radius

Intra-articular step formation or diastasis ≥ 2 mm

Ulnar variance ≥ 3 mm

Incongruence of distal radio-ulnar joint

Comminution in the fracture area / loss of intact dorsal cortex of the distal radius

*Background to choice of research questions:*

About 15 000 distal radius fractures are treated annually in Norway. These fractures account for a large portion of the work load in orthopaedics. The recognised method of diagnosing distal radius fractures is an ordinary X-ray of the wrist. Stable fractures can be handled conservatively, with a good functional result. However there is still discussion as to which radiological threshold criteria define a stable or unstable distal radius fracture. These threshold criteria, in conjunction with an assessment of the patient's overall functional ability and morbidity, will determine whether a patient is offered conservative or operative treatment. This chapter presents the evidence for the radiological threshold criteria for when a fracture can be expected to be such that unless operative treatment is used to reduce and stabilise it, discomfort and reduced function in patients is highly likely to result, and in the longer term reduced quality of life.

In order to bring out the patient perspective better, we chose not to look purely at the radiological parameters as outcome measures, since they have little correlation with the function and quality of life experienced by the patient (Kwok, Leung and Yuen 2011). We have, however, used the patient-reported outcome measures (PROM – Patient Reported Outcome Measures) DASH (Disability of the Arm, Shoulder, and Hand) AND PRWE (Patient-Rated Wrist Evaluation) Both measuring instruments have a scale from 0–100, where a low score is best. The lowest clinically relevant difference is 10 points for DASH and 14 points for PRWE (Sørensen et al. 2013).

The guidelines concern fractures of AO classification type A2, A3 and C1-3 in adult patients ≥ 18 years. These classification types cover what were previously usually called Colles fractures. The guideline does not deal with shear fractures (Chauffeur's and Barton's fractures), volar displaced extra-articular fractures (Smith fractures), open fractures, fractures resulting from high-energy trauma, isolated fractures of the distal ulna, or patients with other concurrent injuries in the hand or wrist, since these injuries almost always should be treated operatively.

*Literature:*

There is no evidence based on systematic reviews or randomised controlled trials that answer the research question. However, there are two treatment guidelines (AAOS 2009, Lichtmann et al. 2011, DHMA 2014) for distal radius fractures, which have presented a recommendation based on best available evidence. Of these, only the Danish Health and Medicines Authority (DMHA) used satisfactory methodology and also the most updated search, expanded to include cohort studies from 1983–2014. 2709 cohort studies were assessed, and five were considered to answer the research question (Mackenney, McQueen and Elton, 2006, Lutz et al. 2011, Catalano et al. 1997, Wilcke, Abbaszadegan and Adolphson 2007, Abramo, Kopylov and Tagil 2008). Of these, one was a prognostic study and 4 were follow-up studies, three of which used DASH as outcome measures.

The prognostic study followed a cohort of 4024 patients with distal radius fractures prospectively over a period of 5.5 years (Mackenney, McQueen and Elton 2006). On the basis of the X-ray images, the authors constructed formulas that predict the risk of early and late instability and malunion in the event that no treatment other than

primary reduction is given. The study shows that dorsal angulation of  $> 5-10$  degrees in the lateral plane (at right angles to the long axis of the radius), radial shortening (or ulnar variance = the ulna's distal articular surface is longer than the radius)  $> 0$  mm and comminuted fracture with loss of material from either the volar or the dorsal cortex are all significant risk factors for loss of reduction and/or malunion. Age is the greatest predictor for both loss of reduction and malunion, independently of other factors.

Two follow-up studies (Lutz et al. 2011, Catalano et al. 1997) both followed two groups of patients with intra-articular distal radius fractures, with steps in the articular surface and lack of congruency of the articular surface on healing. Both studies showed significantly increased radiocarpal arthritis, but this was not correlated with changes in functional scores after 5.5 years and 9 years, respectively.

A third follow-up study (Wilcke, Abbaszadegan and Adolphson, 2007) followed a group of patients who were treated for a dislocated distal radius fracture that was treated with closed reduction or external fixation. The radiological parameters (the difference between the healthy and the fractured side) were compared with the patient's DASH score after the follow-up period of 2.2 years. The study showed a significantly poorer DASH score with radial shortening  $\geq 2$  mm and dorsal angulation of  $\geq 15$  degrees.

A fourth follow-up study (Abramo, Kopylov and Tagil 2008) validated the outcome of a treatment protocol for patients with distal radius fractures in southern Sweden. In the protocol, the following algorithm was used as an indicator for offering surgery: dorsal angulation  $\geq 10$  degrees, ulnar variance  $\geq 2$  mm, intraarticular step formation  $\geq 1$ mm. As a result of the algorithm, the patients were divided into 3 groups: 1) non-dislocated fractures that were immobilised with a plaster cast, 2) dislocated fractures that were reduced and plaster casted and which maintained their position at a check-up after 7–10 days, and 3) patients who either initially or after a check-up came under the radiological algorithm for operative treatment, and were therefore offered an operation. However, not everyone had operative treatment. 360 patients were followed up with DASH scores after 12 months. The patients in the three groups had roughly the same median DASH scores of 15, 17 and 16 points. The patients were compared with a background population matched for age and gender, where DASH was 2.5 points. The study concluded that the protocol used with the specified radiological parameters as indicators for operative treatment was appropriate for bringing all patients to the same level after one year. However, there was a tendency for patients with fractures that became displaced and who were offered a later operation to end up with slightly poorer DASH scores. The authors assumed that this finding could be explained by a general reluctance to operate on older patients.

The Danish guideline (DHMA 2014) concludes on the basis of these studies that 1) *there is evidence for recommending a maximum dorsal angulation limit of between 5 and 10 degrees*, measured at right angles to the long axis of the radius, since larger tilt results in a greater risk of the fracture becoming displaced, malunion and poorer patient-reported outcome measures measured by DASH, 2) *intraarticular step formation  $\geq 1-2$  mm* results in increased risk of radiological arthritis, 3) *ulnar variance of  $\geq 0-2$  mm* in a higher risk of displacement of the fracture, malunion and poorer DASH, and 4) *loss of dorsal matter and comminuted fracture* result in a higher risk of dislocation of the fracture and malunion.

The Norwegian Guideline Panel endorses this assessment, but also added that it is good practice to consider operative treatment from the primary radiographs taken before reduction. If you choose conservative treatment of a velreduced but unstable fracture, it is good practice to follow the patient with close follow-ups with regard to the same criteria. It is also good practice to reduce the fracture to close as possible to the anatomical position, although the fracture in the primary X-rays have less dislocation (s) than those given above.



### Practice Statement

It is good practice to consider operative treatment of distal radius fractures in adult patients  $\geq 18$  years where there are one or more of the following radiological parameters (= instability criteria) on the primary radiographs:

$\geq 10$  degrees dorsal angulation of the distal radius

Ulnar variance  $\geq 2$  mm

Intraarticular step formation  $\geq 2$  mm

Comminution in the fracture area / loss of intact dorsal cortex of the distal radius

Incongruence of distal radioulnar joint

If you choose non-operative treatment of a well-reduced but unstable fracture, it is good practice to follow the patient closely with regard to the the same parameters. It is also good practice to reduce the fracture to close as possible to the anatomical position, although the fracture on the the primary X-rays has less malposition than given above.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### Practical Advice

#### Key Info

##### Benefits and harms

Surgery is very likely to be more effective if the indication for surgery has been made using one or more of the specified radiological parameters.

##### Quality of evidence

There is only indirect evidence, and as a result no evaluation of evidence has been conducted.

##### Preference and values

The patients' preferences are considered to be self-evident since the majority of patients will want the best possible result.

##### Resources and other considerations

Costs and resource consumption are not considered.

### Rationale

There are no systematic reviews or randomised controlled trials that describe the outcome of using the specified radiological parameters as a basis for decision-making. On the contrary, the specified radiological parameters have emerged against a background of well-conducted cohort trials, which predict only the probability of fracture instability with the aid of regression analysis and follow-up studies. These show that if the fracture has a poorer radiological position than the specified parameters, the patient also has a poorer DASH score on follow-up. The Guideline Panel has chosen ulnar variance of 2 mm rather than the initially proposed 3 mm since the studies found show convincing data in support of a 2 mm threshold value. With regard to dorsal angulation and step

formation in the articular surface, 10 degrees is proposed rather than 5 degrees, and 2 mm rather than 1 mm since the literature found does not consensually recommend lower values.

## References

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- Amelia A Sorensen, Daniel Howard, Wen Hui Tan, Jeffrey Ketchersid, Ryan P Calfee Minimal clinically important differences of 3 patient-rated outcomes instruments. [23481405](#) 10.1016/j.jhsa.2012.12.032
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- Maria K T Wilcke, Hassan Abbaszadegan, Per Y Adolphson Patient-perceived outcome after displaced distal radius fractures. A comparison between radiological parameters, objective physical variables, and the DASH score. [17954350](#)
- Antonio Abramo, Philippe Kopylov, Magnus Tagil Evaluation of a treatment protocol in distal radius fractures: a prospective study in 581 patients using DASH as outcome. [18622842](#) 10.1080/17453670710015283
- National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

## 4 - Recommendation of operative treatment rather than conservative treatment

The Norwegian Orthopaedic Association has had no guidelines for treatment of distal radius fractures and there is ongoing discussion as to which fractures should be treated conservatively and which should undergo operative treatment. The following is a presentation of the patient-reported outcome measures of percutaneous pinning, external fixation and volar locking plate osteosynthesis versus conservative treatment.

### Percutaneous pinning compared with conservative treatment

*The research question was:*

For adult patients aged  $\geq 18$  with an unstable distal radius fracture, what are the effect and risk associated with operative treatment with percutaneous pinning compared with conservative treatment with/without reduction and plaster cast immobilisation assessed on the basis of patient-reported outcome measures?

*Literature:*

The evidence for the research question is a Cochrane review (Handoll, Vaghela and Madhok, 2007) which included 5 RCTs with a total of 420 adult patients and compared percutaneous pinning with conservative treatment of unstable or potentially unstable fractures, the outcomes of which are summarised in new meta-analyses by the Norwegian Knowledge Centre for the Health Services (Frønsdal et al. 2013), and a similar summary from the Danish Health and Medicines Authority (DHMA 2014) in which account was also taken of follow-up time. The studies in the Knowledge Centre's report are fairly old, the oldest being from 1992. The studies did not use PROM in the form of DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Two of the RCTs included only intra-articular fractures, and three of them only extra-articular fractures. Only two of the included RCTs defined radiological criteria for unstable fractures, i.e. what dislocation degree was necessary for inclusion in the trials. In the one study, this was  $\geq 10^\circ$  dorsal tilt and/or  $\geq 3$  mm shortening and in the other  $\geq 20^\circ$  dorsal tilt and/or comminution in the fracture area.

Cross-pinning was used in five of the studies. NOKC performed metaanalysis of these studies (Frønsdal et al. 2013). Metaanalysis of three of these studies which looked at functional scores found that percutaneous pinning was significantly superior to conservative treatment. It is noted in particular that re-dislocation resulting in secondary treatment occurred in 0 % of the group with pinning compared with 14.3 % of the group with conservatively treated fractures. There was a higher risk of complications with Kapandji pinning, on the other hand. No conclusion was reached as to which sub-groups of patients and fractures should be treated.

The function-scoring systems used in the above studies graded the results as excellent, good and fair/poor. However, the NOKC's meta-analyses did not consistently present results only after 1 year follow-up. The DHMA has conducted further meta-analyses of studies of these three functional scoring categories at the follow-up times of 6 months (Shankar and Crawford 1992, Gupta et al. 1999) and 12 months (Rodriquez-Merchan 1997), respectively. From 6 to 12 months follow-up, there was an increasing number of patients in the group treated conservatively found to be in the scoring category "fair/poor" (increased by 44 %), whereas in the percutaneous pinning group a slight decrease was seen. At 1 year follow-up, there were 312 fewer patients per 1000 patients with the scoring fair/poor in the percutaneous pinning group compared with those who had received conservative treatment. The pinning group also suffered significantly less from pain (VAS) at rest (Azzopardi et al. 2005) and from time-to-time (Rodriquez-Merchan 1997). SF-36 mental and physical scores yielded no significant differences (Azzopardi et al. 2005). The five studies included in the meta-analyses of DHMA had not collected and recorded complications systematically. The DHMA therefore extracted the reported complications, and found more serious complications in the form of malunion and need for surgery due to re-dislocation in the group with conservative treatment. A small portion of the patients who had been treated with pinning also experienced re-dislocation, but

the risk of re-operation was considerably less if pinning had been performed initially. These data are according to the findings from the meta-analyses performed by the the Guideline Panel/NOKC.

The studies are including patient aged 18- 80 years, except from the study of Azzopardi and co-workers from 2005 which includes patients > 60 years.

## **External fixation compared with conservative treatment**

*The research question was:*

For adult patients aged  $\geq 18$  with an unstable distal radius fracture, what are the effect and risk associated with operative treatment with external fixation compared with conservative treatment with/without reduction and plaster cast immobilisation assessed on the basis of patient-reported outcome measures?

*Literature:*

The evidence for the research question is a Cochrane review (Handoll, Huntley and Madhok 2007) which pooled the results of 15 RCTs with a total of 1022 adult patients, and compared external fixation with conservative treatment of unstable, mainly dorsally displaced fractures. The evidence includes new meta-analyses of these outcomes performed by the NOKC (Frønsdal et al. 2013). The NOKC's report found wide variation in the type of external fixation used. Some of the studies are fairly old, the oldest being from 1988. The studies did not use PROM in the form of DASH, Q-DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Eleven RCTs did not evaluate functional outcomes. Eight of them detected an improved functional outcome in the external fixation group, while 7 studies showed no significant differences. Although the studies reported an improved function for patients who had undergone external fixation, some studies had a high drop-out rate. The results were not pooled in any meta-analyses, and the quality of the outcome assessment was usually assessed as being low. The results of sensitivity analyses were non-significant. There was a higher share of patients with a functional score of excellent in the external fixation group than with conservative treatment. In other words, a smaller share of those in the external fixation group did not have an excellent function score. Nine of the included RCTs showed that external fixation maintains the reduction significantly better than conservative treatment. Only 2 % of the fractures in the external fixation group redisplaced, while 15 % redisplaced in the conservatively treated group. External fixation is associated with numerous complications, even though they are described as minor, for example pin infections. No statistically significant difference was found for more serious complications, such as complex regional pain syndrome. However, there was a considerable and significant difference in the number of redisplacements requiring treatment, in favour of external fixation. No conclusion was reached as to which subgroups of patients and fractures should be treated.

The functional scoring systems used in the above studies classify the patients in the groups as excellent, good and fair/poor. However, in the NOKC's meta-analyses (Frønsdal et al. 2013), follow-up time is not consistently 1 year. The evidence therefore also includes a meta-analyses performed by the Danish Health and Medicines Authority (DHMA 2014) which has conducted new meta-analyses of these three functionscore categories to follow-up times of 3–6 months (ur Rahman et al. 2012, Roumen et al. 1991, Stein et al. 1990) and 1-10 år (Foldhazy and Ahrengart 2010, Howard et al. 1989, Horne et al. 1990, Abbaszadegan og Jonsson 1990, Kapor et al. 2000, Hegeman et al. 2004, Zheng et al. 2003, Young et al. 2003, Merchan et al. 1992). As these studies did not use DASH or PRWE but the same older scoring systems mentioned above, most weight has been attached to the studies that have used scoring systems that have subsequently been compared and validated in relation to DASH (Kwok, Leung and Yuen 2011). After 3–6 months there were significantly less patients with fair/poor scores among those treated conservatively, whereas after 1–10 years, this had changed in favour of external fixation. Complications were not recorded systematically. The DHMA therefore extracted the reported complications, and found no difference between the groups for serious complications, but there were more superficial infections in the group of external fixation.

Age is no variable in these studies. In most of the studies, patient aged > 65 years are included.

### **Volar locking plates compared with conservative treatment**

*The research question was:*

For adult patients  $\geq 18$  years with an unstable distal radius fracture, what are the effect and risk associated with operative treatment involving volar locking plates compared with conservative treatment with/without reduction and plaster cast immobilisation assessed on the basis of patient-reported outcome measures?

*Literature:*

There are no systematic reviews that have compared treatment with volar locking plates with conservative treatment, and only one RCT (Arora et al. 2011) on unstable distal radius fractures. The trial was conducted on patients  $\geq 65$  years. The inclusion criteria for the trial (= instability criteria) were those published in 2003 by Beumer and McQueen for "low demand elderly dependent or demented patients" where reduction was regarded as acceptable if volar or dorsal tilt did not exceed 10 degrees, radial shortening was not more than 3 mm and there was carpal alignment. Seventy three patients were included and randomised to either open reduction and volar locking plates ( $n = 36$ ) or closed reduction and plaster cast immobilisation ( $n = 37$ ). The outcome measures were Patient-Rated Wrist Evaluation (PRWE) score, Disabilities of the Arm Shoulder and Hand (DASH) score, the pain level, range of motion (ROM), number of complications and radiological parameters such as dorsal tilt, radial inclination and ulnar variance.

The results showed significant, clinically relevant differences in patient-reported outcome measures such as DASH and PRWE favouring volar locking plates after 3 months (DASH score 13.3 points in the plate group compared with 23.2 points in the conservatively treated group), but there were no significant differences between the groups after 6 and 12 months. The result must be viewed with some reservations because the patient material is limited to 73 patients.

At 12 months follow-up examination, malunion (defined as  $\geq 10^\circ$  of dorsal tilt,  $\geq 2$  mm of radial shortening, and  $\geq 1$  mm of articular incongruity) occurred in all patients (100 %) in the non-operative treatment group, whereas the same parameters were significantly better, and loss of reduction was significantly lower, in the operative treatment group. In the operative treatment group, 35 % with intraarticular fractures developed stage-1 osteoarthritis compared to 48 % in the non-operative group, 15 % with intra-articular fractures developed stage-2 osteoarthritis compared to 28 % in the non-operative group, and 30 % with extra-articular fractures developed stage-1 osteoarthritis compared to 33 % in the non-operative group.

The number of other complications was significantly higher in the operative group (13 compared with 5,  $p < 0.05$ ). However, the complications were not purely uniform, as only malunion and CRPS were reported in the conservatively treated group, the latter was noted in 5 of the conservatively treated group compared to 2 in the operatively treated group. If the complications in this study are compared with the complications with conservative treatment in the two groups above (pinning and external fixation vs conservative treatment), the complications are considered to be comparable. Dorsal tilt, radial inclination and radial shortening were significantly better in the operation group than in the conservatively treated group at all times post-operatively ( $p < 0.5$ ). The results revealed no significant differences between the groups for ROM or pain level through the follow-up period ( $p > 0.05$ ).

No literature has been found that describes the differences between volar locking plates and conservative treatment for younger patients. On the other hand, there is a good deal of literature comparing volar locking plates with external fixation. The guideline panel has therefore concluded that the results of the study of patients aged over 65 can be extrapolated to also apply to younger patients. This is consistent with the conclusion of the working group that drew up the DHMA guideline (DHMA 2014).

## Operative treatment of unstable distal radius fractures in adult patients $\geq 18$ years yields a better result than conservative treatment

### Strong Recommendation

We recommend operative treatment of patients with unstable distal radius fractures in adult patients  $\geq 18$  years.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### Practical Advice

Operative treatment with percutaneous pinning is a relatively simple and brief procedure, but presupposes reasonable bone quality.

Operative treatment with external fixation requires pin care, and the external fixator may cause discomfort. The method presupposes reasonably good bone quality.

Operative treatment with volar locking plates permits earlier mobilisation than the other treatment methods. This points to plate osteosynthesis in cases where special needs indicate a need for rapid mobilisation, for example walking with a rollator. However, the method requires correct positioning of the plate to reduce the risk of long-term complications. On suspicion of too long screws or suboptimal positioning of the plate with screw penetration into the radiocarpal joint, the patient should be informed, and re-operation should be considered. To avoid these complications, the procedure should therefore be carried out during daytime, so that an experienced surgeon can perform the surgery.

### Key Info

#### Benefits and harms

Given 1000 patients with unstable distal radius fracture treated with pinning compared with conservative treatment, we find 257 fewer with the function grading fair or poor with pinning, 143 fewer re-dislocations requiring treatment with pinning and 500 more with 50 % reduced grip strength in the conservatively treated group. In addition 440 fewer had a poor anatomical outcome with pinning. There are no significant differences for CTS, CRPS, infections, damage to the sensory radial nerve.

For 1000 patients with unstable distal radius fracture treated with external fixation compared with conservative treatment, we find 74 fewer with the function grading fair or poor with pinning, 125 fewer re-dislocations requiring treatment and 420 fewer with a poor anatomical outcome with external fixation. There are significantly more infections (155 vs 0) and cases of injury to the radial sensory nerve (80 vs 0) with external fixation compared with conservative treatment, but there are no significant differences for CTS or CRPS. Irritation and pin infection are not serious complications and do not affect the outcome of the treatment. They may cause patients concern nonetheless, and require extra resources compared with conservative treatment.

Only 1 RCT has considered volar locking plates. The study included only patients  $> 65$ . There are significant and clinically relevant differences in patient-reported outcome measures such as DASH and PRWE favouring volar locking plates after 3 months (DASH score 18.8 points in the plate group compared with 34.4 points in the conservatively treated group) and after 3 months

(DASH 13.3 and 23.2 points, respectively, while the differences after six and 12 months are not significant. The result must be viewed with some reservations since the patient material is limited to 73 patients. However, the complications were not necessarily of a similar nature, as only complications of operative treatment were reported, not those affecting the conservatively treated patient group except for malunion. If the complications in this study are compared with the complications associated with conservative treatment for the two groups above (pinning and external fixation vs conservative treatment), the complications are considered to be comparable.

### Quality of evidence

The quality of the documentation is generally low. The evidence is very largely old and has been downgraded because of the risk of bias, lack of blinding, lack of analysis of patient dropout and failure to use patient-reported outcome measures. Outdated function gradings have been used instead, and the plaster-casting position in the group of conservatively treated patients is outdated (wrist with volar flexion and ulnar deviation).

The quality of the one included study for comparing volar locking plates with conservative treatment is very low all in all. Although the trial was well conducted, the evidence has been downgraded because of the risk of bias, lack of blinding, lack of reporting of patient dropout. In addition, there is only one study, which implies a risk of lack of precision.

### Preference and values

There are no studies of the patient's values and preferences. Although patients are not expected to be unanimous in their values and preferences, given a choice of operative or conservative treatment patients are expected to favour surgical treatment of unstable fractures because of the better functional outcome and reduced risk of serious complications compared with conservative treatment. However, some patients will undoubtedly choose conservative treatment rather than pinning and external fixation, for example to avoid problems caused by the implant. With regard to plate osteosynthesis with volar locking plates, it is expected that most patients will feel it is important to return rapidly to a normal functional level and will therefore choose volar locking plates rather than any alternative, and that this will make up for the drawback of the operation.

### Resources and other considerations

No studies have considered the problem. It is difficult to make definite estimates of the resources spent on the one treatment as compared with the other.

## Rationale

The strong recommendation of operative rather than conservative treatment of patients  $\geq 18$  years with an unstable distal radius fracture is due to the existing evidence and expected homogeneity of the values and preferences of the patient group. The recommendation applies to patients irrespective of age, but restraint should be exercised with respect to patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.

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#### PICO (4.1)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Percutaneous pinning

**Comparator:** Conservative treatment

**Outcomes:** Function score, Pain, Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Percutaneous pinning	Difference with	Participants (studies), Follow-up
Functional grading fair or poor - independent on length of follow up-period	Moderate <i>Due to risk of bias (systematic error)</i>	RR: 0.31 <i>(CI 0.15 - 0.64)</i>	373 <i>per 1000</i>	116 <i>per 1000</i>	257 fewer <i>(CI 317 fewer - 134 fewer )</i>	135 (3 RCT)
Functional grading fair or poor after 12 months follow-up	Very Low <i>No blinding, no "intention to treat" analysis, lost to follow-up badly described, and the functional-grading is not a good patient important outcome measure</i>	RR: 0.31 <i>(CI 0.14 - 0.69)</i>	452 <i>per 1000</i>	140 <i>per 1000</i>	312 fewer <i>(CI 389 fewer - 140 fewer )</i>	85 (2 RCT)
Re-dislocation needing surgical correction	Moderate <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.09 <i>(CI 0.02 - 0.37)</i>	143 <i>per 1000</i>	13 <i>per 1000</i>	130 fewer <i>(CI 140 fewer - 90 fewer )</i>	269 (4 RCT)

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Percutaneous pinning	Difference with	Participants (studies), Follow-up
Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.53 <i>(CI 0.19 - 1.46)</i>	54 <i>per 1000</i>	29 <i>per 1000</i>	25 fewer <i>(CI 44 fewer - 25 more )</i>	363 (5 RCT)
Complex regional pain syndrome	Low <i>Risk of bias (systematic errors) and few participants</i>	RR: 0.84 <i>(CI 0.45 - 1.59)</i>	168 <i>per 1000</i>	141 <i>per 1000</i>	27 fewer <i>(CI 99 fewer - 92 more )</i>	188 (3 RCT)
Grip strength	Low <i>Risk of bias (systematic errors), few participants</i>	RR: 0.04 <i>(CI 0 - 0.67)</i>	500 <i>per 1000</i>	0 <i>per 1000</i>	500 fewer <i>(CI 165 fewer - 0 more )</i>	45 (1 RCT)
Anatomical grading fair eller poor	Low <i>Risk of bias (systematic errors)</i>	RR: 0.2 <i>(CI 0.05 - 0.82)</i>	400 <i>per 1000</i>	80 <i>per 1000</i>	320 fewer <i>(CI 380 fewer - 72 fewer )</i>	50 (1 RCT)
Functional grading fair or poor after 6 months	Very Low <i>No blinding, no "intention to treat" analysis, lost to follow-up badly described, and the functional-grading is not a good patient important outcome measure</i>	RR: 0.76 <i>(CI 0.41 - 1.4)</i>	253 <i>per 1000</i>	193 <i>per 1000</i>	60 fewer <i>(CI 149 fewer - 101 more )</i>	148 (2 RCT)

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### PICO Summary

The evidence for the research question is a Cochrane review (Handoll, Vaghela and Madhok, 2007) which included 5 RCTs with a total of 420 adult patients and compared percutaneous pinning with conservative treatment of unstable or potentially unstable distal radius fractures, the outcomes of which are summarised in new meta-analyses by the NOKC (Frønsdal et al. 2013), and a similar summary from the Danish Health and Medicines Authority (DHMA 2014) in which account was also taken of follow-up time. The studies in the NOKC's report are fairly old, the oldest being from 1992. The studies did not use PROM in the form of DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Two of the RCTs included only intra-articular fractures, and three of them only extra-articular fractures. Only two of the included RCTs defined radiological criteria for unstable fractures, i.e. what dislocation degree was necessary for inclusion in the trials. In the one study, this was  $\geq 10^\circ$  dorsal tilt and/or  $\geq 3$ mm shortening and in the other  $\geq 20^\circ$  dorsal tilt and/or comminution in the fracture area.

Cross-pinning was used in five of the studies. NOKC performed meta-analyses of these studies (Frønsdal et al. 2013). Meta-analyses of three of these studies which looked at functional scores found that percutaneous pinning was significantly superior to conservative treatment. It is noted in particular that re-dislocation resulting in secondary treatment occurred in 0 % of the group with pinning compared with 14.3 % of the group with conservatively treated fractures. There was a higher risk of complications with Kapandji pinning, on the other hand. No conclusion was reached as to which sub-groups of patients and fractures should be treated.

The functional scoring systems used in the above studies graded the results as excellent, good and fair/poor. However, the NOKC's meta-analyses did not consistently present results only after 1 year follow-up. The DHMA has conducted further meta-analyses of studies of these three functional scoring categories at the follow-up times of 6 months (Shankar and Crawford 1992, Gupta et al. 1999) and 12 months (Rodriquez-Merchan 1997), respectively. From 6 to 12 months follow-up, there was an increasing number of patients in the group treated conservatively found to be in the scoring category fair/poor (increased by 44 %), whereas in the percutaneous pinning group a slight decrease was seen. At 1 year follow-up, there were 312 fewer patients per 1000 patients with the scoring fair/poor in the percutaneous pinning group compared with those who had received conservative treatment. The pinning group also suffered significantly less from pain (VAS) at rest (Azzopardi et al. 2005) and from time-to-time (Rodriquez-Merchan 1997). SF-36 mental and physical scores yielded no significant differences (Azzopardi et al. 2005). The five studies included in the meta-analysis of DHMA had not collected and recorded complications systematically. The DHMA therefore extracted the reported complications, and found more serious complications in the form of malunion and need for operative treatment due to re-dislocation in the group with conservative treatment. A small portion of the patients who had been treated with pinning also experienced re-dislocation, but the risk of re-operation was considerably less if pinning had been performed initially. These data are according to the findings from the meta-analyses performed by the Guideline Panel/NOKC.

The studies are including patient aged 18- 80 years, except from the study of Azzopardi and co-workers from 2005 which includes patients > 60 years.

### PICO (4.2)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** External fixation

**Comparator:** Conservative treatment**Outcomes:** Function score, Pain, Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	External fixation	Difference with	Participants (studies), Follow-up
Functional grading fair or poor - independent on length of follow up-period	Low <i>Risk of bias (systematic errors)</i>	RR: 0.73 <i>(CI 0.55 - 0.98)</i>	273 <i>per 1000</i>	199 <i>per 1000</i>	74 fewer <i>(CI 123 fewer - 5 fewer )</i>	612 (11 RCT)
Remaining pain after 1 year	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 1.56 <i>(CI 0.44 - 5.5)</i>	67 <i>per 1000</i>	105 <i>per 1000</i>	38 more <i>(CI 38 fewer - 302 more )</i>	108 (1 RCT)
Change of profession due to the injury	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 1.22 <i>(CI 0.59 - 2.52)</i>	193 <i>per 1000</i>	235 <i>per 1000</i>	42 more <i>(CI 79 fewer - 293 more )</i>	108 (1 RCT)
Re-dislocation needing operative correction	Moderate <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.17 <i>(CI 0.09 - 0.32)</i>	151 <i>per 1000</i>	26 <i>per 1000</i>	125 fewer <i>(CI 137 fewer - 103 fewer )</i>	694 (9 RCT)
Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)	Low <i>Risk of bias (systematic errors) and few participants</i>	RR: 0.5 <i>(CI 0.21 - 1.15)</i>	63 <i>per 1000</i>	32 <i>per 1000</i>	31 fewer <i>(CI 50 fewer - 9 more )</i>	508 (6 RCT)
Complex regional pain syndrome	Low	RR: 1.31 <i>(CI 0.74 - 2.32)</i>	49 <i>per 1000</i>	64 <i>per 1000</i>	15 more <i>(CI 13 fewer - 65 more )</i>	731 (11 RCT)
Grip strength	Very Low <i>Not possible to estimate effect-estimates</i>	RR:				4 studies, not pooled

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	External fixation	Difference with	Participants (studies), Follow-up
Anatomical grading fair or poor	Very Low <i>Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)</i>	RR: 0.17 (CI 0.11 - 0.26)	516 <i>per 1000</i>	88 <i>per 1000</i>	428 fewer (CI 459 fewer - 382 fewer)	400 (6 RCT)

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### **PICO Summary**

The evidence for the research question is a Cochrane review (Handoll, Huntley and Madhok 2007) which pooled the results of 15 RCTs with a total of 1022 adult patients, and compared external fixation with conservative treatment of unstable, mainly dorsally displaced fractures. The evidence includes new meta-analyses of these outcomes performed by the Knowledge Centre (Frønsdal et al. 2013). The Knowledge Centre's report found wide variation in the type of external fixation that was used. Some of the studies are fairly old, the oldest being from 1988. The studies did not use PROM in the form of DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Eleven RCTs did not evaluate functional outcomes. Eight of them detected an improved functional outcome in the external fixation group, while 7 studies showed no significant differences. Although the studies reported an improved function grade for patients who had undergone external fixation, some studies had a heavy drop-out rate. The results were not pooled in any meta-analyses, and the quality of the outcome assessment was usually assessed as being low. The results of sensitivity analyses were non-significant. There was a higher share of patients with a function score of excellent in the external fixation group than with conservative treatment. In other words, a smaller share of those in the external fixation group did not have an excellent function score. Nine of the included RCTs showed that external fixation maintains the reduction significantly better than conservative treatment. Only 2 % of the fractures in the external fixation group re-dislocated, while 15 % re-dislocated in the conservatively treated group. External fixation is associated with numerous complications, even though they are described as minor, for example pin infections. No statistically significant difference was found for more serious complications, such as complex regional pain syndrome. However, there was a considerable and significant difference in the number of re-dislocations requiring treatment, in favour of external fixation. No conclusion was reached as to which subgroups of patients and fractures should be treated.

The functional scoring systems used in the above studies classify the patients in the groups as excellent, good and fair/poor. However, in the NOKC's meta-analyses (Frønsdal et al. 2013), follow-up time is not consistently 1 year. The evidence therefore also includes a meta-analyses performed by the

Danish Health and Medicines Authority (DHMA 2014) which has conducted new meta-analyses of these three functional scoring categories to follow-up times of 3–6 months (ur Rahman et al. 2012, Roumen et al. 1991, Stein et al. 1990) and 1-10 år (Foldhazy and Ahrengart 2010, Howard et al. 1989, Horne et al. 1990, Abbaszadegan og Jonsson 1990, Kapor et al. 2000, Hegeman et al. 2004, Zheng et al. 2003, Young et al. 2003, Merchan et al. 1992). As these studies did not use DASH or PRWE but the same older scoring systems mentioned above, most weight has been attached to the studies that have used scoring systems that have subsequently been compared and validated in relation to DASH (Kwok, Leung and Yuen 2011). After 3–6 months there were significantly less patients with fair/poor scores among those treated conservatively, whereas after 1–10 years, this had changed in favour of external fixation. Complications were not recorded systematically. The DHMA therefore extracted the reported complications, and found no difference between the groups for serious complications, but there were more superficial infections in the group of external fixation.

Age is no variable in these studies. In most of the studies, patient aged > 65 years are included.

### PICO (4.3)

**Population:** Adult patients > 65 years with unstable distal radius fractures

**Intervention:** Volar locking plates

**Comparator:** Conservative treatment

**Outcomes:** Patient reported outcome measures (DASH/PRWE), Pain (VAS) at rest and at activity

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Volar locking plates	Difference with	Participants (studies), Follow-up
DASH after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	DASH 0-100:	mean 23.2	mean 13.3	MD 9.9 fewer (CI 2 fewer - 17.8 fewer )	73 (1 RCT)
DASH after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	DASH 0-100:	mean 8	mean 5.7	MD 2.3 fewer (CI 7 fewer - 2.4 more )	73 (1 RCT)
PRWE after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	PRWE 0-100:	mean 54.4	mean 33.7	MD 20.7 fewer (CI 35.3 fewer - 6.1 fewer )	73 (1 RCT)



Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Volar locking plates	Difference with	Participants (studies), Follow-up
PRWE after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study</i>	PRWE 0-100:	mean 14.6	mean 12.8	MD 1.8 fewer (CI 1.3 fewer - 0.5 more )	73 (1 RCT)
Pain at rest after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study</i>	VAS pain 0-10:	mean 0.3	mean 0.2	MD 0.1 fewer (CI 0 fewer - 0.4 fewer )	73 (1 RCT)
Pain at rest after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-10:	mean 0.1	mean 0.1	MD 0 fewer (CI 0 fewer - 0.2 fewer )	73 (1 RCT)
Pain at activity after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-100:	mean 1.8	mean 1.4	MD 0.4 fewer (CI 1.3 fewer - 0.5 more )	73 (1 RCT)
Pain at activity after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-10:	mean 0.6	mean 0.7	MD 0.1 fewer (CI 0.5 fewer - 0.7 more )	73 (1 RCT)

### PICO References

Rohit Arora, Martin Lutz, Christian Deml, Dietmar Krappinger, Luzian Haug, Markus Gabl A prospective randomized trial comparing nonoperative treatment with volar locking plate fixation for displaced and unstable distal radial fractures in patients sixty-five years of age and older. [22159849](#) 10.2106/JBJS.J.01597

### PICO Summary

There are no systematic reviews that have compared treatment with volar locking plates with conservative treatment, and only one RCT (Arora et al. 2011) on unstable distal radius fractures. The trial was conducted on patients  $\geq 65$  years. The inclusion criteria for the trial (= instability criteria) were those published in 2003 by Beumer and McQueen for "low demand elderly dependent or demented patients" where reduction was regarded as acceptable if volar or dorsal tilt did not exceed 10 degrees, radial shortening was not more than 3 mm and there was carpal alignment. Seventy three patients were included and randomised to either open reduction and volar locking plates (n = 36) or closed reduction and plaster cast immobilisation (n = 37). The outcome measures were Patient-Rated Wrist Evaluation (PRWE) score, Disabilities of the Arm Shoulder and Hand (DASH) score, the pain level, range

of motion (ROM), number of complications and radiological parameters such as dorsal tilt, radial inclination and ulnar variance.

The results showed significant, clinically relevant differences in patient-reported outcome measures such as DASH and PRWE favouring volar locking plates after 3 months (DASH score 13.3 points in the plate group compared with 23.2 points in the conservatively treated group), but there were no significant differences between the groups after 6 and 12 months. The result must be viewed with some reservations because the patient material is limited to 73 patients.

At 12 months follow-up examination, malunion (defined as  $\geq 10$  degrees of dorsal tilt,  $\geq 2$  mm of radial shortening, and  $\geq 1$  mm of articular incongruity) occurred in all patients (100 %) in the non-operative treatment group, whereas the same parameters were significantly better, and loss of reduction was significantly lower, in the operative treatment group. In the operative treatment group, 35 % with intra-articular fractures developed stage-1 osteoarthritis compared to 48 % in the non-operative group, 15 % with intra-articular fractures developed stage-2 osteoarthritis compared to 28 % in the non-operative group, and 30 % with extraarticular fractures developed stage-1 osteoarthritis compared to 33 % in the non-operative group.

The number of other complications was significantly higher in the operative group (13 compared with 5,  $p < 0.05$ ). However, the complications were not purely uniform, as only malunion and CRPS were reported in the conservatively treated group, the latter was noted in 5 of the conservatively treated group compared to 2 in the operatively treated group. If the complications in this study are compared with the complications with conservative treatment in the two groups above (pinning and external fixation vs conservative treatment), the complications are considered to be comparable. Dorsal tilt, radial inclination and radial shortening were significantly better in the operation group than in the conservatively treated group at all times post-operatively ( $p < 0.5$ ). The results revealed no significant differences between the groups for ROM or pain level through the follow-up period ( $p > 0.05$ ).

No literature has been found that describes the differences between volar locking plates and conservative treatment for younger patients. On the other hand, there is a good deal of literature comparing volar locking plates with external fixation. The guideline panel has therefore concluded that the results of the study of patients aged over 65 can be extrapolated to also apply to younger patients. This is consistent with the conclusion of the working group that drew up the DHMA guideline (DHMA 2014).

#### Weak Recommendation

We suggest operative treatment of patients with unstable distal radius fractures in adult patients > 65 years.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

## Practical Advice

Operative treatment with percutaneous pinning is a relatively simple and brief procedure, but presupposes reasonable bone quality.

Operative treatment with external fixation requires pin care, and the external fixator may cause discomfort. The method presupposes reasonably good bone quality.

Operative treatment with volar locking plates permits earlier mobilisation than the other treatment methods. This points to plate osteosynthesis in cases where special needs indicate a need for rapid mobilisation, for example walking with a rollator. However, the method requires correct positioning of the plate to reduce the risk of long-term complications. On suspicion of too long screws or suboptimal positioning of the plate with screw penetration into the radiocarpal joint, the patient should be informed, and re-operation should be considered. To avoid these complications, the procedure should therefore be carried out during daytime, so that an experienced surgeon can perform the surgery.

## Key Info

### Benefits and harms

Given 1000 patients with unstable distal radius fracture treated with pinning compared with conservative treatment, we find 257 fewer with the function grading fair or poor with pinning, 143 fewer re-dislocations requiring treatment with pinning and 500 more with 50 % reduced grip strength in the conservatively treated group. In addition 440 fewer had a poor anatomical outcome with pinning. There are no significant differences for CTS, CRPS, infections, damage to the sensory radial nerve.

For 1000 patients with unstable distal radius fracture treated with external fixation compared with conservative treatment, we find 74 fewer with the function grading fair or poor with pinning, 125 fewer re-dislocations requiring treatment and 420 fewer with a poor anatomical outcome with external fixation. There are significantly more infections (155 vs 0) and cases of injury to the radial sensory nerve (80 vs 0) with external fixation compared with conservative treatment, but there are no significant differences for CTS or CRPS. Irritation and pin infection are not serious complications and do not affect the outcome of the treatment. They may cause patients concern nonetheless, and require extra resources compared with conservative treatment.

Only 1 RCT has considered volar locking plates. The study included only patients > 65. There are significant and clinically relevant differences in patient-reported outcome measures such as DASH and PRWE favouring volar locking plates after 3 months (DASH score 18.8 points in the plate group compared with 34.4 points in the conservatively treated group) and after 3 months (DASH 13.3 and 23.2 points, respectively, while the differences after six and 12 months are not significant. The result must be viewed with some reservations since the patient material is limited to 73 patients. However, the complications were not necessarily of a similar nature, as only complications of operative treatment were reported, not those affecting the conservatively treated patient group except for malunion. If the complications in this study are compared with the complications associated with conservative treatment for the two groups above (pinning and external fixation vs conservative treatment), the complications are considered to be comparable.

### Quality of evidence

The quality of the documentation is generally low. The evidence is very largely old and has been downgraded because of the risk of bias, lack of blinding, lack of analysis of patient dropout and failure to use patient-reported outcome measures. Outdated function gradings have been used instead, and the plaster-casting position in the group of conservatively treated patients is outdated (wrist with volar flexion and ulnar deviation).

The quality of the one included study for comparing volar locking plates with conservative treatment is very low all in all. Although the trial was well conducted, the evidence has been downgraded because of the risk of bias, lack of blinding, lack of reporting of patient dropout. In addition, there is only one study, which implies a risk of lack of precision.

### **Preference and values**

There are no studies of the patient's values and preferences. Although patients are not expected to be unanimous in their values and preferences, given a choice of operative or conservative treatment patients are expected to favour surgical treatment of unstable fractures because of the better functional outcome and reduced risk of serious complications compared with conservative treatment. However, some patients will undoubtedly choose conservative treatment rather than pinning and external fixation, for example to avoid problems caused by the implant. With regard to plate osteosynthesis with volar locking plates, it is expected that most patients will feel it is important to return rapidly to a normal functional level and will therefore choose volar locking plates rather than any alternative, and that this will make up for the drawback of the operation.

### **Resources and other considerations**

No studies have considered the problem. It is difficult to make definite estimates of the resources spent on the one treatment as compared with the other.

## **Rationale**

November 14, 2014 a new RCT came out that illuminate operative versus conservative treatment of unstable distal radiusfraktur in patients > 65 years (Bartl et al 2014). The study by Bartl and coworkers is due publication date not included in this version of the guidelines. Bartl and coworkers, however, conducted a meta-analysis of their own data and the data to Arora and coworkers from 2011, which are the only two present RCT problem to be addressed in this age group. By their Forest plot sees that data DASH scores are statistically significant in favor of volare locking plates both after 3 and 12 months, but the difference is not considered clinically relevant (DASH difference 7.1 and 3.3 points after 3 and 12 months, respectively, while a difference of 10 points is considered to be the limit for a clinically relevant difference). Likewise goes quality of life data in favor of volare locking plates, with statistically significant values at 1 year follow-up, while other parameters are marginal and inconsistent.

Recommendation for operative rather than conservative treatment of patients > 65 years with an unstable distal radius fracture granted on this basis as a weak recommendation, despite the fact that there is no RCT that is in favor of conservative treatment. The rationale for this weak strength of the recommendation is that this difference may not be of a clinically relevant size.

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#### PICO (4.1)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Percutaneous pinning

**Comparator:** Conservative treatment

**Outcomes:** Function score, Pain, Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Percutaneous pinning	Difference with	Participants (studies), Follow-up
Functional grading fair or poor - independent on length of follow up-period	Moderate <i>Due to risk of bias (systematic error)</i>	RR: 0.31 <i>(CI 0.15 - 0.64)</i>	373 <i>per 1000</i>	116 <i>per 1000</i>	257 fewer <i>(CI 317 fewer - 134 fewer )</i>	135 (3 RCT)
Functional grading fair or poor after 12 months follow-up	Very Low <i>No blinding, no "intention to treat" analysis, lost to follow-up badly described, and the functional-grading is not a good patient important outcome measure</i>	RR: 0.31 <i>(CI 0.14 - 0.69)</i>	452 <i>per 1000</i>	140 <i>per 1000</i>	312 fewer <i>(CI 389 fewer - 140 fewer )</i>	85 (2 RCT)
Re-dislocation needing surgical correction	Moderate <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.09 <i>(CI 0.02 - 0.37)</i>	143 <i>per 1000</i>	13 <i>per 1000</i>	130 fewer <i>(CI 140 fewer - 90 fewer )</i>	269 (4 RCT)

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Percutaneous pinning	Difference with	Participants (studies), Follow-up
Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.53 <i>(CI 0.19 - 1.46)</i>	54 <i>per 1000</i>	29 <i>per 1000</i>	25 fewer <i>(CI 44 fewer - 25 more )</i>	363 (5 RCT)
Complex regional pain syndrome	Low <i>Risk of bias (systematic errors) and few participants</i>	RR: 0.84 <i>(CI 0.45 - 1.59)</i>	168 <i>per 1000</i>	141 <i>per 1000</i>	27 fewer <i>(CI 99 fewer - 92 more )</i>	188 (3 RCT)
Grip strength	Low <i>Risk of bias (systematic errors), few participants</i>	RR: 0.04 <i>(CI 0 - 0.67)</i>	500 <i>per 1000</i>	0 <i>per 1000</i>	500 fewer <i>(CI 165 fewer - 0 more )</i>	45 (1 RCT)
Anatomical grading fair eller poor	Low <i>Risk of bias (systematic errors)</i>	RR: 0.2 <i>(CI 0.05 - 0.82)</i>	400 <i>per 1000</i>	80 <i>per 1000</i>	320 fewer <i>(CI 380 fewer - 72 fewer )</i>	50 (1 RCT)
Functional grading fair or poor after 6 months	Very Low <i>No blinding, no "intention to treat" analysis, lost to follow-up badly described, and the functional-grading is not a good patient important outcome measure</i>	RR: 0.76 <i>(CI 0.41 - 1.4)</i>	253 <i>per 1000</i>	193 <i>per 1000</i>	60 fewer <i>(CI 149 fewer - 101 more )</i>	148 (2 RCT)

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### PICO Summary

The evidence for the research question is a Cochrane review (Handoll, Vaghela and Madhok, 2007) which included 5 RCTs with a total of 420 adult patients and compared percutaneous pinning with conservative treatment of unstable or potentially unstable distal radius fractures, the outcomes of which are summarised in new meta-analyses by the NOKC (Frønsdal et al. 2013), and a similar summary from the Danish Health and Medicines Authority (DHMA 2014) in which account was also taken of follow-up time. The studies in the NOKC's report are fairly old, the oldest being from 1992. The studies did not use PROM in the form of DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Two of the RCTs included only intra-articular fractures, and three of them only extra-articular fractures. Only two of the included RCTs defined radiological criteria for unstable fractures, i.e. what dislocation degree was necessary for inclusion in the trials. In the one study, this was  $\geq 10^\circ$  dorsal tilt and/or  $\geq 3$ mm shortening and in the other  $\geq 20^\circ$  dorsal tilt and/or comminution in the fracture area.

Cross-pinning was used in five of the studies. NOKC performed meta-analyses of these studies (Frønsdal et al. 2013). Meta-analyses of three of these studies which looked at functional scores found that percutaneous pinning was significantly superior to conservative treatment. It is noted in particular that re-dislocation resulting in secondary treatment occurred in 0 % of the group with pinning compared with 14.3 % of the group with conservatively treated fractures. There was a higher risk of complications with Kapandji pinning, on the other hand. No conclusion was reached as to which sub-groups of patients and fractures should be treated.

The functional scoring systems used in the above studies graded the results as excellent, good and fair/poor. However, the NOKC's meta-analyses did not consistently present results only after 1 year follow-up. The DHMA has conducted further meta-analyses of studies of these three functional scoring categories at the follow-up times of 6 months (Shankar and Crawford 1992, Gupta et al. 1999) and 12 months (Rodriquez-Merchan 1997), respectively. From 6 to 12 months follow-up, there was an increasing number of patients in the group treated conservatively found to be in the scoring category fair/poor (increased by 44 %), whereas in the percutaneous pinning group a slight decrease was seen. At 1 year follow-up, there were 312 fewer patients per 1000 patients with the scoring fair/poor in the percutaneous pinning group compared with those who had received conservative treatment. The pinning group also suffered significantly less from pain (VAS) at rest (Azzopardi et al. 2005) and from time-to-time (Rodriquez-Merchan 1997). SF-36 mental and physical scores yielded no significant differences (Azzopardi et al. 2005). The five studies included in the meta-analysis of DHMA had not collected and recorded complications systematically. The DHMA therefore extracted the reported complications, and found more serious complications in the form of malunion and need for operative treatment due to re-dislocation in the group with conservative treatment. A small portion of the patients who had been treated with pinning also experienced re-dislocation, but the risk of re-operation was considerably less if pinning had been performed initially. These data are according to the findings from the meta-analyses performed by the Guideline Panel/NOKC.

The studies are including patient aged 18- 80 years, except from the study of Azzopardi and co-workers from 2005 which includes patients > 60 years.

### PICO (4.2)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** External fixation

**Comparator:** Conservative treatment**Outcomes:** Function score, Pain, Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	External fixation	Difference with	Participants (studies), Follow-up
Functional grading fair or poor - independent on length of follow up-period	Low <i>Risk of bias (systematic errors)</i>	RR: 0.73 <i>(CI 0.55 - 0.98)</i>	273 <i>per 1000</i>	199 <i>per 1000</i>	74 fewer <i>(CI 123 fewer - 5 fewer )</i>	612 (11 RCT)
Remaining pain after 1 year	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 1.56 <i>(CI 0.44 - 5.5)</i>	67 <i>per 1000</i>	105 <i>per 1000</i>	38 more <i>(CI 38 fewer - 302 more )</i>	108 (1 RCT)
Change of profession due to the injury	Low <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 1.22 <i>(CI 0.59 - 2.52)</i>	193 <i>per 1000</i>	235 <i>per 1000</i>	42 more <i>(CI 79 fewer - 293 more )</i>	108 (1 RCT)
Re-dislocation needing operative correction	Moderate <i>Risk of bias (systematic errors) and unprecise effect-estimates</i>	RR: 0.17 <i>(CI 0.09 - 0.32)</i>	151 <i>per 1000</i>	26 <i>per 1000</i>	125 fewer <i>(CI 137 fewer - 103 fewer )</i>	694 (9 RCT)
Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)	Low <i>Risk of bias (systematic errors) and few participants</i>	RR: 0.5 <i>(CI 0.21 - 1.15)</i>	63 <i>per 1000</i>	32 <i>per 1000</i>	31 fewer <i>(CI 50 fewer - 9 more )</i>	508 (6 RCT)
Complex regional pain syndrome	Low	RR: 1.31 <i>(CI 0.74 - 2.32)</i>	49 <i>per 1000</i>	64 <i>per 1000</i>	15 more <i>(CI 13 fewer - 65 more )</i>	731 (11 RCT)
Grip strength	Very Low <i>Not possible to estimate effect-estimates</i>	RR:				4 studies, not pooled

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	External fixation	Difference with	Participants (studies), Follow-up
Anatomical grading fair or poor	Very Low <i>Carpal tunnel syndrome (median nerve compression/ neuropathy/ contusion)</i>	RR: 0.17 (CI 0.11 - 0.26)	516 <i>per 1000</i>	88 <i>per 1000</i>	428 fewer (CI 459 fewer - 382 fewer)	400 (6 RCT)

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### **PICO Summary**

The evidence for the research question is a Cochrane review (Handoll, Huntley and Madhok 2007) which pooled the results of 15 RCTs with a total of 1022 adult patients, and compared external fixation with conservative treatment of unstable, mainly dorsally displaced fractures. The evidence includes new meta-analyses of these outcomes performed by the Knowledge Centre (Frønsdal et al. 2013). The Knowledge Centre's report found wide variation in the type of external fixation that was used. Some of the studies are fairly old, the oldest being from 1988. The studies did not use PROM in the form of DASH or PRWE, but rather various older function-grading systems based on a combination of pain, grip strength, radiological parameters and a few questions of a more functional nature. Eleven RCTs did not evaluate functional outcomes. Eight of them detected an improved functional outcome in the external fixation group, while 7 studies showed no significant differences. Although the studies reported an improved function grade for patients who had undergone external fixation, some studies had a heavy drop-out rate. The results were not pooled in any meta-analyses, and the quality of the outcome assessment was usually assessed as being low. The results of sensitivity analyses were non-significant. There was a higher share of patients with a function score of excellent in the external fixation group than with conservative treatment. In other words, a smaller share of those in the external fixation group did not have an excellent function score. Nine of the included RCTs showed that external fixation maintains the reduction significantly better than conservative treatment. Only 2 % of the fractures in the external fixation group re-dislocated, while 15 % re-dislocated in the conservatively treated group. External fixation is associated with numerous complications, even though they are described as minor, for example pin infections. No statistically significant difference was found for more serious complications, such as complex regional pain syndrome. However, there was a considerable and significant difference in the number of re-dislocations requiring treatment, in favour of external fixation. No conclusion was reached as to which subgroups of patients and fractures should be treated.

The functional scoring systems used in the above studies classify the patients in the groups as excellent, good and fair/poor. However, in the NOKC's meta-analyses (Frønsdal et al. 2013), follow-up time is not consistently 1 year. The evidence therefore also includes a meta-analyses performed by the

Danish Health and Medicines Authority (DHMA 2014) which has conducted new meta-analyses of these three functional scoring categories to follow-up times of 3–6 months (ur Rahman et al. 2012, Roumen et al. 1991, Stein et al. 1990) and 1-10 år (Foldhazy and Ahrengart 2010, Howard et al. 1989, Horne et al. 1990, Abbaszadegan og Jonsson 1990, Kapor et al. 2000, Hegeman et al. 2004, Zheng et al. 2003, Young et al. 2003, Merchan et al. 1992). As these studies did not use DASH or PRWE but the same older scoring systems mentioned above, most weight has been attached to the studies that have used scoring systems that have subsequently been compared and validated in relation to DASH (Kwok, Leung and Yuen 2011). After 3–6 months there were significantly less patients with fair/poor scores among those treated conservatively, whereas after 1–10 years, this had changed in favour of external fixation. Complications were not recorded systematically. The DHMA therefore extracted the reported complications, and found no difference between the groups for serious complications, but there were more superficial infections in the group of external fixation.

Age is no variable in these studies. In most of the studies, patient aged > 65 years are included.

### PICO (4.3)

**Population:** Adult patients > 65 years with unstable distal radius fractures

**Intervention:** Volar locking plates

**Comparator:** Conservative treatment

**Outcomes:** Patient reported outcome measures (DASH/PRWE), Pain (VAS) at rest and at activity

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Volar locking plates	Difference with	Participants (studies), Follow-up
DASH after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	DASH 0-100:	mean 23.2	mean 13.3	MD 9.9 fewer (CI 2 fewer - 17.8 fewer )	73 (1 RCT)
DASH after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	DASH 0-100:	mean 8	mean 5.7	MD 2.3 fewer (CI 7 fewer - 2.4 more )	73 (1 RCT)
PRWE after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study.</i>	PRWE 0-100:	mean 54.4	mean 33.7	MD 20.7 fewer (CI 35.3 fewer - 6.1 fewer )	73 (1 RCT)

Outcomes	Confidence in effect estimates	Relative effect	Conservative treatment	Volar locking plates	Difference with	Participants (studies), Follow-up
PRWE after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study</i>	PRWE 0-100:	mean 14.6	mean 12.8	MD 1.8 fewer (CI 1.3 fewer - 0.5 more )	73 (1 RCT)
Pain at rest after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, wide confidence intervals, only one study</i>	VAS pain 0-10:	mean 0.3	mean 0.2	MD 0.1 fewer (CI 0 fewer - 0.4 fewer )	73 (1 RCT)
Pain at rest after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-10:	mean 0.1	mean 0.1	MD 0 fewer (CI 0 fewer - 0.2 fewer )	73 (1 RCT)
Pain at activity after 3 months	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-100:	mean 1.8	mean 1.4	MD 0.4 fewer (CI 1.3 fewer - 0.5 more )	73 (1 RCT)
Pain at activity after 1 year	Very Low <i>No blinding, no data on patients lost to follow-up, only one study</i>	VAS pain 0-10:	mean 0.6	mean 0.7	MD 0.1 fewer (CI 0.5 fewer - 0.7 more )	73 (1 RCT)

### PICO References

Rohit Arora, Martin Lutz, Christian Deml, Dietmar Krappinger, Luzian Haug, Markus Gabl A prospective randomized trial comparing nonoperative treatment with volar locking plate fixation for displaced and unstable distal radial fractures in patients sixty-five years of age and older. [22159849](#) 10.2106/JBJS.J.01597

### PICO Summary

There are no systematic reviews that have compared treatment with volar locking plates with conservative treatment, and only one RCT (Arora et al. 2011) on unstable distal radius fractures. The trial was conducted on patients  $\geq 65$  years. The inclusion criteria for the trial (= instability criteria) were those published in 2003 by Beumer and McQueen for "low demand elderly dependent or demented patients" where reduction was regarded as acceptable if volar or dorsal tilt did not exceed 10 degrees, radial shortening was not more than 3 mm and there was carpal alignment. Seventy three patients were included and randomised to either open reduction and volar locking plates (n = 36) or closed reduction and plaster cast immobilisation (n = 37). The outcome measures were Patient-Rated Wrist Evaluation (PRWE) score, Disabilities of the Arm Shoulder and Hand (DASH) score, the pain level, range

of motion (ROM), number of complications and radiological parameters such as dorsal tilt, radial inclination and ulnar variance.

The results showed significant, clinically relevant differences in patient-reported outcome measures such as DASH and PRWE favouring volar locking plates after 3 months (DASH score 13.3 points in the plate group compared with 23.2 points in the conservatively treated group), but there were no significant differences between the groups after 6 and 12 months. The result must be viewed with some reservations because the patient material is limited to 73 patients.

At 12 months follow-up examination, malunion (defined as  $\geq 10$  degrees of dorsal tilt,  $\geq 2$  mm of radial shortening, and  $\geq 1$  mm of articular incongruity) occurred in all patients (100 %) in the non-operative treatment group, whereas the same parameters were significantly better, and loss of reduction was significantly lower, in the operative treatment group. In the operative treatment group, 35 % with intra-articular fractures developed stage-1 osteoarthritis compared to 48 % in the non-operative group, 15 % with intra-articular fractures developed stage-2 osteoarthritis compared to 28 % in the non-operative group, and 30 % with extraarticular fractures developed stage-1 osteoarthritis compared to 33 % in the non-operative group.

The number of other complications was significantly higher in the operative group (13 compared with 5,  $p < 0.05$ ). However, the complications were not purely uniform, as only malunion and CRPS were reported in the conservatively treated group, the latter was noted in 5 of the conservatively treated group compared to 2 in the operatively treated group. If the complications in this study are compared with the complications with conservative treatment in the two groups above (pinning and external fixation vs conservative treatment), the complications are considered to be comparable. Dorsal tilt, radial inclination and radial shortening were significantly better in the operation group than in the conservatively treated group at all times post-operatively ( $p < 0.5$ ). The results revealed no significant differences between the groups for ROM or pain level through the follow-up period ( $p > 0.05$ ).

No literature has been found that describes the differences between volar locking plates and conservative treatment for younger patients. On the other hand, there is a good deal of literature comparing volar locking plates with external fixation. The guideline panel has therefore concluded that the results of the study of patients aged over 65 can be extrapolated to also apply to younger patients. This is consistent with the conclusion of the working group that drew up the DHMA guideline (DHMA 2014).

## 5 - Supplementary CT in the radiological assessment of distal radius fractures

The research question was asked and answered by the Guideline Panel for the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel:

The research question was:

What is the effect on the indication for surgery of a supplementary CT scan after a conventional X-ray examination of the wrist?

Background to choice of research question:

CT scans are more accurate than an ordinary X-ray examination of the wrist at determining the scope and complexity of intra-articular distal radius fractures in particular. In some departments it is standard procedure to perform a supplementary CT scan for intra-articular distal radius fractures. In view of this, the specialist panel of the DHMA wished to answer whether preoperative CT scans can provide extra information that has consequences for the choice of operative method and technique, and whether the fracture classification changes when a conventional X-ray examination is supplemented by a CT scan.

Literature:

A literature review of existing guidelines and systematic reviews, and an extended broad search of randomised controlled trials and cohort studies back to 2003 did not reveal studies that were appropriate for answering the research question. A broad review of diagnostic studies and cross-reference searches turned up three studies (Harness et al. 2006, Arora et al. 2010, Hunt et al. 2013) which indirectly answered the research question. All the studies investigated whether the implied operating methods of surgeons change depending on available diagnostic imaging. The studies have investigated whether there is a shift between the different treatment groups (conservative treatment, percutaneous pinning, external fixation, and open reduction and plate osteosynthesis). It has not been investigated whether a change of operative technique occurs within one group. Thus three cross-sectional studies that indirectly evaluate outcome by investigating intra-observer consistency between findings on X-ray examinations and CT scans of the wrist contribute to the answer to the research question.

The studies are all cohort studies where the quality of the evidence is low at the outset. However, the differences between the studies make separate data synthesis impossible. Thus grading of the quality of evidence according to the GRADE method has not been carried out for these studies.

Two studies (Harness et al. 2006, Hunt et al. 2013) have investigated the consistency between inter- and intra-observer with respect to diagnostics and fracture patterns. However, they did not use AO classification. The results of these two studies are not unambiguous, but all three studies conclude consensually that a supplementary CT scan with multiplanar reconstructions and possibly 3D reconstructions determines more details of the fracture. These supplementary details change some surgeons' indication for treatment in favour of open reduction and internal fixation.

### Practice Statement

It is not good practice to perform CT examination routinely before operative treatment of all distal radius fractures.



If the assessment of conventional radiographs gives doubt regarding the choice of treatment or there is need for better preoperative mapping of complex intra-articular distal radius fractures, it is good practice to perform supplementary CT examination.

### Practical Advice

None.

### Key Info

	<p><b>Benefits and harms</b></p> <p>CT scans of the wrist cause no known harm of any significance (Biswas et al. 2009). A CT scan may add supplementary value to an ordinary X-ray examination if there is any doubt about fracture type and treatment method.</p>
	<p><b>Quality of evidence</b></p> <p>There is only indirect evidence, and as a result no evaluation of evidence has been conducted.</p>
	<p><b>Preference and values</b></p> <p>Patients' preferences are expected to be very largely the same. Most patients will probably consider an extra examination acceptable as long as it is regarded as necessary for diagnosis and planning of surgery.</p>
	<p><b>Resources and other considerations</b></p> <p>Supplementary CT scans entail extra costs and only add value with respect to choice of treatment method when there is doubt about the type of fracture.</p>

### Rationale

The existing literature confirms that a CT scan may be of significance for the choice of procedure. At the same time, the examination is not regarded as being uncomfortable for the patient. The Guideline Panel of the Danish Health and Medicines Authority (DHMA 2014) has therefore concluded that it is advisable in some cases to carry out a CT scan of distal radius fractures following an assessment of the X-ray images if there is doubt about the choice of treatment method. Because of the extra costs associated with a CT scan, bearing in mind that it only adds extra value in terms of determining the treatment method, it is not recommended that CT scans be used as a matter of routine.

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- Joshua J Hunt, William Lumsdaine, John Attia, Zsolt J Balogh AO type-C distal radius fractures: the influence of computed tomography on surgeon's decision-making. [23088619](#) 10.1111/j.1445-2197.2012.06311.x

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

### PICO (5.1)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Ordinary X-ray examination of the wrist

**Comparator:** CT scan of the wrist

**Outcomes:** Patient-reported outcomes are not evaluated, but the importance of a preoperative CT scan for choice of operative method and technique was evaluated, as well as whether the classification changed when a conventional X-ray examination was supplemented by a CT scan.

Outcomes	Confidence in effect estimates	Relative effect	CT scan of the wrist	Ordinary X-ray examination of the wrist	Difference with	Participants (studies), Follow-up
No Outcomes						

### PICO References

Neil G Harness, David Ring, David Zurakowski, Gordon J Harris, Jesse B Jupiter The influence of three-dimensional computed tomography reconstructions on the characterization and treatment of distal radial fractures. [16757766](#)

Sumit Arora, Shabnam B Grover, Sumit Batra, Vinod K Sharma Comparative evaluation of postreduction intra-articular distal radial fractures by radiographs and multidetector computed tomography. [21048172](#) 10.2106/JBJS.I.01617

Joshua J Hunt, William Lumsdaine, John Attia, Zsolt J Balogh AO type-C distal radius fractures: the influence of computed tomography on surgeon's decision-making. [23088619](#) 10.1111/j.1445-2197.2012.06311.x

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

### PICO Summary

The research question has been put to and answered by the guideline panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian guideline panel.

A literature review performed by the Danish Health and Medicines Authority of existing guidelines and systematic reviews, and an extended broad search of randomised controlled trials and cohort studies back to 2003 did not reveal studies that were appropriate for answering the research question (DHMS 2014). A broad review of diagnostic studies and cross-reference searches turned up three studies (Harness et al. 2006, Arora et al. 2010, Hunt et al. 2013) which indirectly answered the research question. All the studies investigated whether the implied operating methods of surgeons change depending on available diagnostic imaging. The studies have investigated whether there is a shift between the different treatment groups (conservative treatment, percutaneous pinning, external fixation, and open reduction and plate osteosynthesis). It has not been investigated whether a change of surgical technique occurs within one group. Thus three cross-sectional studies that indirectly evaluate outcome by investigating intra-observer consistency between findings on X-ray examinations and CT scans of the wrist contribute to the answer to the research question.

The studies are all cohort studies where the quality of the evidence is low at the outset. However, the differences between the studies make separate data synthesis impossible. Thus grading of the quality of evidence according to the GRADE method has not been carried out for these studies.

Two studies (Harness et al. 2006, Hunt et al. 2013) have investigated the consistency between inter- and intra-observer with respect to diagnostics and fracture patterns. However, they did not use AO classification. The results of these two studies are not unambiguous, but all three studies conclude consensually that a supplementary CT scan with multiplanar reconstructions and possibly 3D reconstructions determines more details of the fracture. These supplementary details change some surgeons' indication for treatment in favour of open surgery.

## 6 - Choice of time for operative treatment

The research question has been put to and answered by the guideline panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel.

### *The research question was:*

What is the outcome of and the risk associated with operative treatment within 48 hours compared with operative treatment more than 48 hours after the indication for operation has been made, assessed on the basis of patient-reported outcome measures and complications?

### *Background to choice of research questions:*

At some departments, surgery on distal radius fractures is often postponed for several days, instead of being carried out acutely in the course of the first 24 hours. The reason for postponement is often a shortage of emergency operating capacity, or patients' wish for a more experienced surgeon. At some hospitals, patients are handled in a sub-acute outpatients or day surgery system.

A large group of patients get an indication for operation of a reduced fracture at a check-up a full 9-12 days afterwards if the fracture has re-dislocated; cf. the research question in Chapter 4.

The Guideline Panel has therefore wanted to answer whether delayed operative treatment on a distal radius fracture (more than 48 hours after the indication has been made) may have a negative outcome for patients in terms of a poorer final result measured by patient-reported outcome measures or more frequent complications.

### *Literature:*

A literature review of existing guidelines and systematic reviews, and an extended broad search for randomised controlled trials and follow-up studies back to 1983 did not reveal studies that could shed light on the question.

No studies were found, and hence no evidence of a better functional result and fewer complications if operative treatment is performed on an unstable distal radius fracture within 48 hours.

The Norwegian Guideline Panel therefore agree with DHMA that it is not necessary to perform emergency operative treatment on an unstable distal radius fracture in adults. This unless other circumstances warrant emergency surgery. If, on the other hand, the operation is carried out as planned surgery, it enables planning for the operation to be carried out by an experienced surgeon and for the patient to be thoroughly informed of the upcoming treatment. In some cases, acute surgery will entail many interrupted fasts and more uncertainty for the patient.

### Practice Statement

When operation indication is set, it is good practice that the operation is carried out on a date agreed with the patient and without unnecessary fasting and latency. This unless other circumstances warrant emergency surgery.

*A planning of the operation allows the patient to be operated by an experienced surgeon or the patient may optionally be reallocated to a department with necessary expertise. Likewise, the patient may be fully informed about the impending treatment.*

### Practical Advice

The Panel's viewpoint is that surgery can advantageously take place during the daytime, for example as an outpatients procedure or day surgery, where the necessary calm and expertise is available. Patients with compressed nerves, luxations and other concurrent disorders that indicate emergency operation should be treated accordingly.

### Key Info

<b>Benefits and harms</b>	There is no evidence shedding light on the balance between benefits and drawbacks. A planned waiting period is regarded as not harmful to the patient provided sound information is provided about the course, good pain relief and plaster casting during the waiting period.
<b>Quality of evidence</b>	There is no evidence for the recommendation, and the recommendation is therefore based on consensus on good practice among the panel members.
<b>Preference and values</b>	Patient's preferences are considered not to be unanimous. Some patients will prefer surgery at an agreed time, provided they have adequate pain relief, are given thorough information and have a dialogue concerning the recommended treatment. Other patients will prefer to have the surgery as soon as possible.
<b>Resources and other considerations</b>	There are no studies of costs and use of resources.

### Rationale

No studies were found, and hence no evidence of a better functional result and fewer complications if surgery is performed on an unstable distal radius fracture within 48 hours. The Panel's view is therefore that it is not necessary to perform emergency surgery on an unstable distal radius fracture in adults. This unless other circumstances warrant emergency surgery. If, on the other hand, the procedure is carried out as planned surgery, it enables planning for the procedure to be carried out by an experienced surgeon and for the patient to be thoroughly informed of the upcoming treatment. In some cases, emergency surgery will entail many interrupted fastings and more uncertainty for the patient.

### References

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

**PICO (6.1)****Population:** Adult patients with unstable distal radius fractures, irrespective of age**Intervention:** Surgery performed < 48 hours after the indication for surgery has been made**Comparator:** Surgery performed > 48 hours after the indication for surgery has been made**Outcomes:** Patient Reported Outcome Measure (DASH, PRWE), Pain (VAS), Complications

Outcomes	Confidence in effect estimates	Relative effect	Surgery performed > 48 hours after the indication for surgery has been made	Surgery performed < 48 hours after the indication for surgery has been made	Difference with	Participants (studies), Follow-up
No Outcomes						

**PICO References**

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

**PICO Summary**

The research question has been put to and answered by the Guideline Panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel, with an addendum that the operative treatment may be planned, unless other circumstances warrant emergency surgery.

A literature review of existing guidelines and systematic reviews, and an extended broad search for randomised controlled trials and follow-up studies back to 1983 did not reveal studies that could shed light on the question (DMHA 2014).

No studies were found, and hence no evidence of a better functional result and fewer complications if surgery is performed on an unstable distal radius fracture within 48 hours.

The Norwegian Guideline Panel therefore agree with DHMA that it is not necessary to perform emergency surgery on an unstable distal radius fracture in adults. This unless other circumstances warrant emergency surgery. If, on the other hand, the operation is carried out as planned surgery, it enables planning for the operation to be carried out by an experienced surgeon and for the patient to be thoroughly informed of the upcoming treatment. In some cases, acute surgery will entail many interrupted fasts and more uncertainty for the patient.

## 7 - Operative treatment

For the past hundred years, the majority of distal radius fractures have been treated conservatively, with reduction if the fracture was displaced followed by plaster cast immobilisation. Clinicians have been aware for many years now that this conservative treatment does not yield consistently satisfactory results, and the proportion who have operative treatment has increased. A change has also taken place regarding type of operative treatment performed, as a larger proportion of distal radius fractures are operated by use of volar locking plates rather than percutaneous pinning or external fixation.

In order to help assure patients of consistent, optimal treatment, irrespective of the doctors or hospital at which the patient is treated, we have wanted to give an overall recommendation for choice of operative treatment. We have therefore reviewed the literature and considered the evidence base for volar locking plates compared with percutaneous pinning and external fixation, and considered whether pinning of fracture fragments in connection with external fixation yields a better result than external fixation alone, whether Kapandji pinning is superior to ordinary percutaneous transstyloid pinning, whether biodegradable pins are superior to metal pins, whether supplementing with bone transplant yields a better result than not using bone transplant. The various methods and outcomes are described in the sections below.

### 7.1 - Volar locking plates versus external fixation or pinning

#### **Volar locking plates vs external fixation**

*The research question was:*

For adult patients  $\geq 18$  years with an unstable distal radius fracture, what are the treatment outcome and risk associated with operative treatment using volar locking plates compared with external fixation, assessed on the basis of patient-reported outcome measures?

The Guideline Panel has supplemented the research question with the secondary question of the Danish guidelines for treating wrist fractures (DHMA 2014): Are there special factors applying to patients with a low functional level, defined as permanent inability to deal independently with the activities of daily living, or for patients more than 65 years old?

*Background to the research question:*

Conservative treatment, with reduction of the fracture if needed, stabilising bandaging and subsequent follow-ups to check whether the fracture reduction has been maintained, has an important place in the treatment of non-displaced and slightly displaced distal radius fractures. For displaced fractures, there has been increasing use of operative treatment in the last couple of decades. This is attributable to studies providing substantiation for a relationship between anatomical and functional outcome, both by demonstrating that a good anatomical outcome means a good functional outcome (McQueen and Caspers 1998, Jupiter and Lipton 1993) and indirectly by showing that patients with malunion achieve a better functional outcome by having corrective osteotomy (Amadio and Botte 1987, Krukhaug et al. 2007).

In parallel with rapid product development, there has been a concomitant change in treatment strategy. Volar locking plates have become particularly popular, despite the scarcity of documentation before these plates were used on a large scale rather than external fixation and percutaneous pinning. The increased use of operative treatment of assumed unstable high-energy fractures in younger age groups has also influenced the treatment of elderly, cognitively unimpaired patients with displaced fractures who are now receiving operative treatment in increasing numbers.

*Literature:*

The evidence base for the recommendation is a meta-analysis performed by the NOKC for the Guideline Panel. It covers three randomised, controlled trials (Egol et al. 2008, Wei et al. 2009), Wilcke et al. 2011) with a total of 174 patients. The trials included only AO type A2-3 and C1-3, as well as three AO type B fractures, which deviate from the patient population in the guidelines. However, the Guideline Panel does not consider these three fractures to be of major significance for the transfer of results. The three RCTs used the patient-reported outcome measure DASH as the primary outcome parameter. DASH scores after 3, 6 and 12 months were significantly better for volar locking plates than for external fixation, but a clinically important difference was only seen after 3 months (15.6 points difference in favour of volar locking plates), as compared with DASH scores after 6 and 12 months of 6.4 and 8 points, respectively. The minimal clinically important difference for DASH is specified as 10 points (Sorensen et al. 2013). In other words, DASH scores when plates are used are always significantly higher than for external fixation, but of a clinically significant magnitude shown only up to the 6-month follow-up.

Complications were defined as minor complications (transient extensor tendon irritation, superficial infection, and finger stiffness) and major complications (loss of reduction, malunion, nonunion, deep infection, neuropathy, tendon rupture, need of plate removal). After comparing the seriousness of the complications, the Guideline Panel concluded that there was no essential difference between volar locking plates and external fixation in this respect.

There is after our meta-analysis published 1 RCT (Williksen et al. 2013) that includes 104 patients age 20-84 years. There is not performed updated meta-analysis since the study of Williksen and co-workers uses the outcome measures Q-DASH and Mayo Wrist score. The first follow-up is at 4 months, and then after 6 and 12 months. The study is the only one, which has evaluated pain at activity. There are no significant differences between volar locking plates and external fixation in Q-DASH at any follow-up, but better Mayo wrist score after 1 year in favor of the volar locking plates. There were 29 and 30 % complications for volar locking plates and external fixation, respectively. However, a significantly greater proportion of the complications in the volar locking plate group will be decreased by better surgical technique compared with the external fixation group. There were significantly better supination after 1 year in the group with volar locking plates as well as less radial shortening at all follow-ups, and most pronounced for AO type C2- and C3-fractures, where the supination was 90 degrees vs. 76 degrees, in the favor of volar locking plates. Likewise, the grip strength was significantly better for plating at 6 months follow-up, but not after 1 year. Pain at activity was less with plating, although not significant.

The age range in the trials was 18–87 years; one of the trials excluded patients aged > 70 years. One subsequently published RCT (Williksen et al., 2013) included 94 patients aged 20–84. Our conclusion, like that of the treatment guidelines of the DHMA (2014), is that in view of the wide age range in the dataset, the results can be extrapolated to apply to patients aged > 65 years.

**Volar locking plates vs percutaneous pinning***The research question was:*

For adult patients ≥ 18 years with an unstable distal radius fracture, what are the treatment outcome and risk associated with operative treatment using volar locking plates compared with percutaneous pinning, assessed on the basis of patient-reported outcome measures?

The Guideline Panel has supplemented the research question with the secondary question of the Danish guidelines for treating wrist fractures (DHMA 2014): Are there special factors applying to patients with a low



functional level, defined as permanent inability to deal independently with the activities of daily living, or for patients > 65 years old?

*Background to the research question:*

In recent years, volar locking plate osteosynthesis has been the preferred operative method in a number of departments, and has thus to a large extent replaced implants with percutaneous pinning. It is therefore important to know which is the most useful treatment method for patients in terms of outcome and risk.

*Literature:*

No systematic reviews were found to answer the research question. The evidence base for the recommendation is a meta-analysis performed by the NOKC for the Guideline Panel. It covers four RCT (Rozenal et al. 2009, Marcheix et al. 2010, Hollevoet et al. 2011, McFadyen et al. 2011).

Populations and fracture types covered by these guidelines are included in all four studies. After 3 and 6 months, DASH score and complications were noted, although 2 studies had a follow-up at 3 and 6 months, and 2 at 3 and 6 months. Statistically significantly better DASH scores were achieved for patients treated using volar locking plate osteosynthesis. After 3 months the difference was 9.3 points, while a clinically important difference, which some authors claim is being 10 points (Sorensen et al. 2013). After 12 months, the DASH score for plate osteosynthesis tended to be better, but the difference was not significant.

In general, there were both less minor (transient extensor tendon irritation, superficial infection, and finger stiffness) and major complications (loss of reduction, malunion, non-union, deep infection, neuropathy, tendon rupture, need of plate removal) in the volar locking plate group compared to pinning. Due to the short follow-up time in two of the studies, there may be more complications which still not is manifested.

One additional study (Goehre et al. 2014) was found by the search performed by DMHA (2014), which is not included in the meta-analyses. Goehre and co-workers looked at the > 65 years patient cohort. In this small RCT of 40 patients, the same DASH and PRWE scores were found after both 3 and 12 months, while those treated with a volar locking plate were able to resume ADL earlier.

The age range in the trials was 18–80 years; two included patients 18-80 years, and two of the trials included patients aged > 50 years. Our conclusion, like that of the treatment guidelines of the DHMA (2014), is that in view of the wide age range in the dataset, the results can be extrapolated to apply to patients aged > 65 years.

**Volar locking plates yield a better early post-operative outcome than external fixation in adults, irrespective of age**

Weak Recommendation

We suggest using volar locking plates rather than external fixation for adult patients irrespective of age who meet the indication for operation.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### Practical Advice

Operative treatment with volar locking plates requires correct positioning of the plate to reduce the risk of short- and long-term complications. The operative procedure should therefore be carried out during daytime, so that an experienced surgeon can perform the procedure. If correct plate positioning, serious complications hardly exists. On suspicion of suboptimal positioning of the plate and screws, the patient should be informed, and offered later follow-up for consideration of need of plate or screw removal.

Treatment with volar locking plates permits earlier mobilisation than the other treatment methods. This points to plate osteosynthesis in cases where special needs indicate a need for rapid mobilisation, for example for patient with bilateral fractures or for patients in need of a walker.

### Key Info

#### Benefits and harms

Volar locking plates yield significantly better DASH scores 3, 6 and 12 months post-operatively than external fixation of unstable distal radius fractures. The clinically relevant difference between the methods diminishes with time, however (volar locking plates result in 16 points better function than external fixation after 3 months, while after 6 and 12 months the outcomes are only 6.4 and 8 points better).

The Guideline Panel considers that the complications associated with the two treatment methods are comparable.

#### Quality of evidence

Both the meta-analyses and the RCT that is not included in the meta-analyses are of generally good quality. The quality of the documentation across the studies is regarded as moderate. The patient population corresponds to that covered by the guidelines.

#### Preference and values

There are no studies of patient's values and preferences. Values and preferences may differ in different patient populations. However, the Guideline Panel believes that the majority of patients will prefer treatment with volar locking plates to external fixation since treatment with volar locking plate osteosynthesis allows earlier start-up of functional retraining, and many patients may find the external fixator uncomfortable.

#### Resources and other considerations

No studies have considered the problem. It is difficult to make definite estimates of the resources spent on the one treatment as compared with the other. However, external fixation patients will need extra follow-up for pin care.

## Rationale

Volar locking plates are significantly better than external fixation after both 3, 6 and 12 months postoperatively. Even though the clinically important difference decreases over time, we assume the patients will choose treatment with volar locking plates instead of external fixation due to quicker rehabilitation and discomfort from the fixator early in the postoperative period.

Subsequent our meta-analyses is the same meta-analyses conducted by Walenkamp and co-workers (Walenkamp et al. 2013) and where they came to the same result. Likewise, there are online a study by Zhang and colleagues (Zhang et al. 2014 - in press, and therefore not included) for which has included six RCTs, 4 of which have used volare locking plates. In this meta-analyses there are significant results in favor of plates both after 3, 6 and 12 months, although the difference is clinically relevant only after 3 months (15.6 DASH points in favor of plates), while the difference after 6 and 12 months are not clinically relevant. As with the results for volar locking plates versus conservative treatment, all RCTs that compare volar locking plates and external fixation are in favor of plates.

## References

- K Egol, M Walsh, N Tejwani, T McLaurin, C Wynn, N Paksima Bridging external fixation and supplementary Kirschner-wire fixation versus volar locked plating for unstable fractures of the distal radius: a randomised, prospective trial. [18757963](#) 10.1302/0301-620X.90B9.20521
- David H Wei, Noah M Raizman, Clement J Bottino, Charles M Jobin, Robert J Strauch, Melvin P Rosenwasser Unstable distal radial fractures treated with external fixation, a radial column plate, or a volar plate. A prospective randomized trial. [19571078](#) 10.2106/JBJS.H.00722
- Maria K T Wilcke, Hassan Abbaszadegan, Per Y Adolphson Wrist function recovers more rapidly after volar locked plating than after external fixation but the outcomes are similar after 1 year. [21281262](#) 10.3109/17453674.2011.552781
- John H Williksen, Frede Frihagen, Johan C Hellund, Hebe D Kvernmo, Torstein Husby Volar locking plates versus external fixation and adjuvant pin fixation in unstable distal radius fractures: a randomized, controlled study. [23890493](#) 10.1016/j.jhsa.2013.04.039
- Monique M J Walenkamp, Abdelali Bentohami, M Suzan H Beerekamp, Rolf W Peters, Remy van der Heiden, J Carel Goslings, Niels W L Schep Functional outcome in patients with unstable distal radius fractures, volar locking plate versus external fixation: a meta-analysis. [23892535](#) 10.1007/s11751-013-0169-4

## PICO (7.1)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Volar locking plates

**Comparator:** External fixation

**Outcomes:** Patient Reported Outcome Measure (DASH), Pain (VAS) at rest and at activity, Complications

Outcomes	Confidence in effect estimates	Relative effect	External fixation	Volar locking plates	Difference with	Participants (studies), Follow-up
Complications at 1 year follow-up	Low <i>Few studies, few complications, wide confidence interval</i>	RR: 0.9 <i>(CI 0.49 - 1.68)</i>	289 <i>per 1000</i>	260 <i>per 1000</i>	29 fewer <i>(CI 197 fewer - 147 more )</i>	173 (3 RCT)
Serious complications after 1 year	Low <i>Few studies, few complications, wide confidence interval</i>	RR: 1.38 <i>(CI 0.51 - 3.74)</i>	92 <i>per 1000</i>	67 <i>per 1000</i>	25 fewer <i>(CI 252 fewer - 45 more )</i>	173 (3 RCT)
Mild complications after 1 year	Low <i>Few studies, few complications, wide confidence interval</i>	RR: 0.54 <i>(CI 0.22 - 1.29)</i>	144 <i>per 1000</i>	78 <i>per 1000</i>	66 fewer <i>(CI 112 fewer - 42 more )</i>	173 (3 RCT)
DASH after 3 months follow-up Meta-analyses and GRADING performed by the guideline group/The Norwegian Knowledge Centre	Moderate <i>Wide confidence intervals, no blinding, few participants</i>		mean 27.1	mean 11.8	MD 15.3 fewer <i>(CI 23.5 fewer - 7.1 fewer )</i>	169 (3 RCT)
DASH after 6 months follow-up Meta-analyses and GRADING performed by the guideline group/The Norwegian Knowledge Centre	Moderate <i>Risk of bias: studies with few participants</i>		mean 19.2	mean 11.3	MD 7.9 fewer <i>(CI 8.9 fewer - 6.8 fewer )</i>	170 (3 RCT)
DASH after 1 year follow-up Meta-analyses and GRADING performed by the guideline	Moderate <i>Small studies</i>		mean 19.9	mean 12.4	MD 7.5 fewer <i>(CI 15 fewer - 7 fewer )</i>	171 (3 RCT)

Outcomes	Confidence in effect estimates	Relative effect	External fixation	Volar locking plates	Difference with	Participants (studies), Follow-up
group/The Norwegian Knowledge Centre						
Pain (VAS) at activity after 4 months follow-up Meta-analyses and GRADING performed by the guideline panel/The Norwegian Knowledge Centre	Low <i>1 small study</i>		mean 21	mean 15	MD 6 fewer (CI 14 fewer - 1 more )	104 (1 RCT)
Pain (VAS) at activity after 1 year follow-up Meta-analyses and GRADING performed by the guideline group/The Norwegian Knowledge Centre	Low <i>1 study, few participants</i>		mean 12	mean 9	MD 3 fewer (CI 9 fewer - 3 more )	104 (1 RCT)
PRWE after 3 months follow-up	Low <i>1 study, few participants</i>		mean 31	mean 14	MD 17 fewer (CI 18.9 fewer - 15.1 fewer )	58 (1 RCT)
PRWE after 6 months follow-up	Low <i>1 study, few participants</i>		mean 17	mean 9	MD 8 fewer	59 (1 RCT)
PRWE after 1 year	Low <i>1 study, few participants</i>		mean 15	mean 11	MD 4 fewer	63 (1 RCT)

## PICO References

K Egol, M Walsh, N Tejwani, T McLaurin, C Wynn, N Paksima Bridging external fixation and supplementary Kirschner-wire fixation versus volar locked plating for unstable fractures of the distal radius: a randomised, prospective trial. [18757963](#) 10.1302/0301-620X.90B9.20521

David H Wei, Noah M Raizman, Clement J Bottino, Charles M Jobin, Robert J Strauch, Melvin P Rosenwasser Unstable distal radial fractures treated with external fixation, a radial column plate, or a volar plate. A prospective randomized trial. [19571078](#) 10.2106/JBJS.H.00722

Maria K T Wilcke, Hassan Abbaszadegan, Per Y Adolphson Wrist function recovers more rapidly after volar locked plating than after external fixation but the outcomes are similar after 1 year. [21281262](#) 10.3109/17453674.2011.552781

John H Williksen, Frede Frihagen, Johan C Hellund, Hebe D Kvernmo, Torstein Husby Volar locking plates versus external fixation and adjuvant pin fixation in unstable distal radius fractures: a randomized, controlled study. [23890493](#) 10.1016/j.jhsa.2013.04.039

Monique M J Walenkamp, Abdelali Bentohami, M Suzan H Beerekamp, Rolf W Peters, Remy van der Heiden, J Carel Goslings, Niels W L Schep Functional outcome in patients with unstable distal radius fractures, volar locking plate versus external fixation: a meta-analysis. [23892535](#) 10.1007/s11751-013-0169-4

## PICO Summary

The evidence base for the recommendation is a meta-analysis performed by the Knowledge Centre for the Guideline Panel. It covers three randomised, controlled trials (Egol et al. 2008, Wei et al. 2009), Wilcke et al. 2011) with a total of 174 patients. The trials included only AO type A2-3 and C1-3, as well as three AO type B fractures, which deviate from the patient population in the guidelines. However, the Guideline Panel does not consider these three fractures to be of major significance for the transfer of results.

The three RCTs used the patient-reported outcome measure DASH as the primary outcome parameter. DASH scores after 3, 6 and 12 months were significantly better for volar locking plates than for external fixation, but clinically significant only after 3 months, at 15.6 points, as compared with DASH scores after 6 and 12 months of 6.4 and 8 points, respectively. The minimal clinically important difference for DASH is specified as 10 points (Sorensen et al. 2013). In other words, DASH scores when plates are used are always significantly higher than for external fixation, but of a clinically significant magnitude shown only up to the 6-month follow-up.

After comparing the seriousness of the complications, the Guideline Panel concluded that there was no essential difference between volar locking plates and external fixation in this respect.

The age range in the trials was 18–87 years; one of the trials excluded patients aged > 70 years. One subsequently published RCT (Williksen et al., 2013) included 94 patients aged 20–84. Our conclusion, like that of the treatment guidelines of the DHMA (2014), is that in view of the wide age range in the dataset, the results can be extrapolated to apply to patients aged > 65 years.

## Volar locking plates yield a better early post-operative outcome than percutaneous pinning in adults, irrespective of age

### Weak Recommendation

We suggest using volar locking plates rather than percutaneous pinning for adult patients irrespective of age who meet the indication for operation.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### Practical Advice

Treatment with volar locking plates requires correct positioning of the plate to reduce the risk of long-term complications. The procedure should therefore be carried out during daytime, so that an experienced surgeon can perform the surgery.

On suspicion of too long screws or suboptimal positioning of the plate with screw penetration into the radiocarpal joint, the patient should be informed, and offered a follow-up for consideration of need for plate or screw removal.

Operation with volar locking plates permits earlier mobilisation than the other treatment methods. This points to plate osteosynthesis in cases where special needs indicate a need for rapid mobilisation, for example for patient with bilateral fractures or for patients in need of a walker. Surgery with percutaneous pinning is a relatively simple and brief procedure, but presupposes reasonable bone quality.

### Key Info

#### Benefits and harms

Volar locking plate osteosynthesis results in better patient-reported outcome parameters and more rapid effects than percutaneous pinning, even though the difference in DASH scores is only borderline clinically relevant after 3 months (9.3 points), while the minimal clinically important difference for DASH is defined as 10 points. After 6 and 12 months, the differences are only 6 and 3 points, respectively.

#### Quality of evidence

The quality of the documentation is generally low. The quality level of the evidence is downgraded because of lack of blinding and lack of evaluation of patient dropout. The return to work parameter is only reported in one study, which means that the evidence from this study is further downgraded because of risk of inadequate precision.

#### Preference and values

Patients' preferences are expected to be very largely unequivocal. Volar locking plate osteosynthesis makes it possible to start functional retraining earlier, which is expected to be a high priority for most patients.

### Resources and other considerations

No studies have considered the problem. Pinning osteosynthesis is cheaper than plate osteosynthesis. However, percutaneous pinning patients will need extra follow-up for pin care and pin removal.

### Rationale

Volar locking plate osteosynthesis are significantly better than percutaneous pinning both after 3, 6 and 12 months postoperatively. The difference is clinically important only after 3 and 6 months. There were, however, more serious complications in the group of percutaneous pinning. Due to this, together with more rapid mobilisation and quicker return to ADL for patients treated with volar locking plates, the Guideline Panel agree with the conclusion of the DMHA (2014) from present evidence that patients should be offered treatment with volar locking plates instead of percutaneous pinning.

A new RCT is, however, published after we performed our search. Costa et al (<http://www.bmj.com/content/349/bmj.g4807>, 5th August 2014) have compared the use of volare locking plates with percutaneous pinning. The study has admitted a pragmatic design. It provides a degree of uncertainty with regard to selection bias and may also have missing transferability due to lack of inclusion criteria. The study is still the largest study to date that illustrate the theme. DASH scores after 12 months are in favor of volare locking plates, however, although not significantly. We have requested the first author of supplementary data to update the meta-analyses ours. We've got to answer that these are likely to be published at the end. We will when available do a meta-analyses to see if the study to Costa is changing our present recommendation. If it does, we will to do it formally correct to do updated search to include also any other RCT that has come after our last search. The study is therefore not included in the current version of the guidelines. We will now give a weak recommendation for volare locking plates above percutaneous pinning, but the conclusion of a future meta-analyses could result in changes of the recommendation.

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- F Goehre, W Otto, S Schwan, T Mendel, P P Vergroesen, L Lindemann-Sperfeld Comparison of palmar fixed-angle plate fixation with K-wire fixation of distal radius fractures (AO A2, A3, C1) in elderly patients. [23677960](#) 10.1177/1753193413489057
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- P-S Marcheix, A Dotzis, P-E Benkö, J Siegler, J-P Arnaud, J-L Charissoux Extension fractures of the distal radius in patients older than 50: a prospective randomized study comparing fixation using mixed pins or a palmar fixed-angle plate. [20237186](#) 10.1177/1753193410364179
- I McFadyen, J Field, P McCann, J Ward, S Nicol, C Curwen Should unstable extra-articular distal radial fractures be treated with fixed-angle volar-locked plates or percutaneous Kirschner wires? A prospective randomised controlled trial. [20691441](#) 10.1016/j.injury.2010.07.236
- Tamara D Rozental, Philip E Blazar, Orrin I Franko, Aron T Chacko, Brandon E Earp, Charles S Day Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. [19651939](#) 10.2106/JBJS.H.01478



National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

### PICO (7.2)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Volar locking plates

**Comparator:** Percutaneous pinning

**Outcomes:** Patient Reported Outcome Measure (DASH), Pain (VAS) at rest and at activity, Complications

Outcomes	Confidence in effect estimates	Relative effect	Percutaneous pinning	Volar locking plates	Difference with	Participants (studies), Follow-up
Total complications after 6 months - 1 year	Low <i>Few participants, few events (complications)</i>	RR: 0.24 <i>(CI 0.05 - 1.05)</i>	262 <i>per 1000</i>	63 <i>per 1000</i>	199 fewer <i>(CI 249 fewer - 13 more )</i>	236 (4 RCT)
Serious complications after 6 months - 1 year	Very Low <i>few participants, few events (complications)</i>	RR: 0.19 <i>(CI 0.04 - 1.06)</i>	108 <i>per 1000</i>	21 <i>per 1000</i>	87 fewer <i>(CI 104 fewer - 6 more )</i>	145 (2 RCT)
Mild complications after 1 year	Low <i>Few participants, few events (complications)</i>	RR: 0.58 <i>(CI 0.05 - 1.05)</i>	124 <i>per 1000</i>	72 <i>per 1000</i>	52 fewer <i>(CI 118 fewer - 6 more )</i>	176 (3 RCT)
DASH after 3 months	Moderate <i>Small studies.</i>	DASH 0-100:	mean <i>28.7</i>	mean <i>18.9</i>	MD 9.8 fewer <i>(CI 15.9 fewer - 3.6 fewer )</i>	236 (4 RCT)
DASH after 6 months	Low <i>Small studies.</i>	DASH 0-100:	mean <i>22</i>	mean <i>10</i>	MD 12 fewer <i>(CI 19.1 fewer - 4.9 fewer )</i>	159 (2 RCT)
DASH after 12 months	Low <i>Only 1 study, few participants.</i>	DASH 0-100:	mean <i>16.3</i>	mean <i>13.2</i>	MD 3.1 fewer <i>(CI 10 fewer - 3.9 fewer )</i>	75 (2 RCT)

## PICO References

F Goehre, W Otto, S Schwan, T Mendel, P P Vergroesen, L Lindemann-Sperfeld Comparison of palmar fixed-angle plate fixation with K-wire fixation of distal radius fractures (AO A2, A3, C1) in elderly patients. [23677960](#) 10.1177/1753193413489057

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Tamara D Rozental, Philip E Blazar, Orrin I Franko, Aron T Chacko, Brandon E Earp, Charles S Day Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. [19651939](#) 10.2106/JBJS.H.01478

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

## PICO Summary

After 3 and 6 months, significantly better DASH scores were achieved for patients treated using volar locking plate osteosynthesis. After 12 months, the DASH score for plate osteosynthesis tended to be higher, but the difference was not significant.

In general, there were few serious complications in both treatment groups. Fracture displacement, operation and deep infection occurred more frequently in patients treated with percutaneous pinning, however.

A small number of patients treated with volar locking plates will later require elective plate removal. Our conclusion, like that of the treatment guidelines of the DHMA (2014), is that in view of the wide age range in the dataset, the results can be extrapolated to apply to patients aged > 65 years.

## 7.2 - Other treatments or additional treatments

### External fixation vs external fixation with percutaneous pinning of the fracture fragment

*The research question was:*

For adult patients  $\geq 18$  with an unstable distal radius fracture, what are the effect and risk associated with operative treatment with external fixation compared with external fixation with adjuvant percutaneous pinning of the fracture fragment, assessed on the basis of patient-reported outcome measures?

*Literature:*

A small RCT with 50 patients found significantly better function (only 28 % with not excellent function compared to 76 % when not using supplementary pinning of fracture fragments) and grip strength (74% compared to 44% when not using supplementary pinning of fracture fragments) as a result of external

fixation supplemented with adjuvant pinning. However, there were no significant differences when it came to mobility and pain.

The included RTC found no significant differences in complications, and there were no reported incidents of faulty fixation, loosening of pins, tendon rupture, nerve damage or complex regional pain syndrome. Nor did the trial look at infections. The RCT was small, and therefore did not provide an adequate basis for reaching conclusions on differences in complications between the two treatment methods.

In this one RCT, the ulnar variance outcome was significantly better in patients who had adjuvant pinning. However, there were no differences in mobility measures (flexion, extension, radial deviation, ulnar deviation, pronation and supination). The duration of the operation was significantly shorter without adjuvant pinning.

### **Kapandji pinning compared with transstyloid fixation**

*The research question was:*

For adult patients  $\geq 18$  with an unstable distal radius fracture, what are the treatment outcome and risk associated with operative treatment involving Kapandji pinning compared with transstyloid fixation, assessed on the basis of patient-reported outcome measures?

*Literature:*

Three trials compared different pinning methods. Two of these trials observed a higher number of complications as a result of Kapandji pinning compared with two alternative methods of fixation over the fracture line. The third trial did not provide an adequate basis for reaching any conclusion regarding the outcome of a modified variant of Kapandji fixation compared with Willenegger fixation.

The two small trials also compared immobilisation (with a plaster cast) for one week compared with immobilisation for six weeks following surgery. One of the trials found that the duration of the immobilisation after transstyloid fixation did not affect the outcome, while in the trial with Kapandji pinning, several complications arose in patients who had been mobilised early (one week of immobilisation).

One RCT compared Kapandji pinning with transstyloid fixation with respect to different types of complications. The trial included 120 patients (68 % women, average age 57 years) with either extra- or intra-articular dorsally dislocated fractures. 24 of the patients in the trial dropped out, and were not included in the analyses. The trial reported only outcomes associated with complications from the treatment, and there were no significant differences for any of the measured outcomes.

### **Biodegradable pins compared with metal pins/K-wire.**

*The research question was:*

For adult patients  $\geq 18$  with an unstable distal radius fracture, what are the treatment outcome and risk associated with operative treatment involving biodegradable pins compared with metal pins, assessed on the basis of patient-reported outcome measures?

*Literature:*

Two small RCTs analysed the effect of biodegradable pins compared with traditional metal pins/K-wire. The trials included a total of 70 patients (77 % women, average age 61) with intra- and extraarticular fractures. Because different techniques were used, the two RCTs were evaluated separately and not pooled in a metaanalysis. The trials found no significant differences in mobility or complications between the two treatments, with the exception of osteolytic reactions (reactions that cause breakdown of the bone mass), which were reported significantly more often by patients treated with biodegradable pins (osteolytic reactions occurred in 60 % of those treated with biodegradable pins, but there were no osteolytic reactions among those treated with metal pins).

## Bone grafting

*The research question was:*

For adult patients  $\geq 18$  with an unstable distal radius fracture, what are the treatment outcome and risk associated with bone grafting/bone substitutes compared with operative treatment without bone grafting/bone substitutes or conservative treatment, on the basis of patient-reported outcome measures?

Literature:

A systematic review from 2008 (search 1966–2007) considered various types of bone grafts and bone substitutes. Ten RCTs with a total of 874 adults with unstable distal radius fractures were grouped in six comparisons. None of the trials had hidden distribution between the treatment groups. Four of the studies with 239 participants found that implantation of an autograft (one study), Norian SRS bone substitute (two studies) and methyl methacrylate cement (one study) resulted in a better anatomical outcome than plaster casting alone, while two of the studies found better function. Complications resulted in temporary discomfort due to depositing of Norian SRS cement in the soft parts and pin infection. One trial with 323 participants compared Norian SRS bone substitute with plaster casting or external fixation and found no differences with respect to functional or anatomical outcome after one year. Three trials with 180 participants found that bone implant using autograft (one study), Norian SRS (one study) and methyl methacrylate cement (one study) did not result in significant differences in functional outcome, but gave some indication that anatomical outcome was superior with external fixation. Most of the reported complications were associated with external fixation, while deposition of Norian SRS in the soft parts occurred in one study. One study with 93 patients with dorsal plate fixation found that use of autograft resulted to some extent in improved wrist function compared with allograft, but there were complications associated with autograft.

One RCT with a total of 48 patients evaluated external fixation combined with bone graft compared with only external fixation. There were no significant differences between the two treatment for the outcomes analysed, which included functional grading, complications, anatomical results. The confidence intervals were wide.

## External fixation combined with percutaneous pinning yield a better functional result than external fixation alone

Weak Recommendation

If you choose to treat an unstable distal radius fracture in an adult patient with external fixation, we suggest the treatment combined with percutaneous fixation of the fracture fragment(s), since this yields a better functional result irrespective of the patients' age .

*There is insufficient documentation to be able to draw any conclusions about the relative outcome of the different methods of external fixation in the treatment of distal radius fractures in adults.*

### Practical Advice

The fracture should be reduced and then fixated with pinning using two K-wires from the radial direction and one from the ulnar direction before the external fixator is applied and fixed.

### Key Info

<b>Benefits and harms</b>	A small RCT with 50 patients found significantly better function and grip strength as a result of external fixation supplemented with extra pinning. However, there were no significant differences with respect to mobility and pain. The included RCT found no significant differences in complications, either, and there were no reported incidents of faulty fixation, loosening of pins, tendon rupture, nerve damage or complex regional pain syndrome.
<b>Quality of evidence</b>	There was only one RCT with only 50 patients available, which does not make it possible to conclude whether there are differences in the complications associated with the two treatment methods.
<b>Preference and values</b>	Although there is only one low quality study available, it must be assumed that the majority of patients will prefer the treatment with the best functional results, i.e. external fixation combined with pins rather than external fixation alone.
<b>Resources and other considerations</b>	There are no studies on use of resources, but since pins are relatively cheap and the procedure time will be only marginally extended if supplementary pins are used, it must be assumed that the methods are fairly similar with respect to use of resources.

### Rationale

Although there is only one study available and which is of low-quality, it must be assumed that the majority of patients will prefer the treatment with the best functional results, i.e. external fixation combined with pinning rather than external fixation alone.

### References

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO (7.1)****Population:** Adult patients with unstable distal radius fractures, irrespective of age**Intervention:** External fixation**Comparator:** External fixation with pinning of the fracture fragment**Outcomes:** Function score, Pain, Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	External fixation with pinning of the fracture fragment	External fixation	Difference with	Participants (studies), Follow-up
Poor functional end result	Low <i>Risk of bias, only 1 RCT</i>	RR: 0.37 <i>(CI 0.19 - 0.72)</i>	280 <i>per 1000</i>	760 <i>per 1000</i>	480 more <i>(CI 213 more - 616 more )</i>	50 patients (1 RCT)
Poor anatomical end-result (ulna plus)	Low <i>Risk of bias, only 1 RCT</i>	RR: 0.15 <i>(CI 0.05 - 0.45)</i>	127 <i>per 1000</i>	783 <i>per 1000</i>	656 more <i>(CI 121 more - 70 more )</i>	48 patients (1 RCT)
Grip strength (% of uninjured hand)	Low <i>Risk of bias, only 1 RCT</i>		mean 74	mean 44	MD 30 fewer <i>(CI 20 fewer - 40 fewer )</i>	50 patients (1 RCT)

**PICO References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO Summary**

A small RCT with 50 patients found significantly better function (only 28 % with not excellent function compared to 76 % when not using supplementary pinning of fracture fragments) and grip strength (74% compared to 44% when not using supplementary pinning of fracture fragments) as a result of external fixation supplemented with adjuvant pinning. However, there were no significant differences when it came to mobility and pain.

The included RTC found no significant differences in complications, and there were no reported incidents of faulty fixation, loosening of pins, tendon rupture, nerve damage or complex regional pain syndrome. Nor did the trial look at infections. The RCT was small, and therefore did not provide an adequate basis for reaching conclusions on differences in complications between the two treatment methods.

In this one RCT, the ulnar variance outcome was significantly better in patients who had adjuvant pinning. However, there were no differences in mobility measures (flexion, extension, radial deviation, ulnar deviation, pronation and supination). The duration of the operation was significantly shorter without adjuvant pinning.

**PICO (7.3)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Pinning with biodegradable pins

**Comparator:** Pinning with metal pins

**Outcomes:** Function score, Pain (VAS), Complications

Outcomes	Confidence in effect estimates	Relative effect	Pinning with metal pins	Pinning with biodegradable pins	Difference with	Participants (studies), Follow-up
No Outcomes						

**PICO References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO Summary**

Two small RCTs analysed the effect of biodegradable pins compared with traditional metal pins/K-wire. The trials included a total of 70 patients (77 % women, average age 61) with intra- and extraarticular fractures. Because different techniques were used, the two RCTs were evaluated separately and not pooled in a meta-analysis. The trials found no significant differences in mobility or complications between the two treatments, with the exception of osteolytic reactions (reactions that cause breakdown of the bone mass), which were reported significantly more often by patients treated with biodegradable pins (osteolytic reactions occurred in 60 % of those treated with biodegradable pins, but there were no osteolytic reactions among those treated with metal pins).

**Kapandji pinning probably results in more complications than regular pinning**

Practice Statement

If you choose to treat an unstable distal radius fracture in adult patients with percutaneous pinning, we suggest you use regular pinning technique rather than Kapandji pinning because of fewer complications, irrespective of the patient’s age.

**Practical Advice**

It may be somewhat simpler to reduce the fracture using the Kapandji method rather than transstyloid pinning, since the actual pinning can contribute to the reduction. However, it should be possible to perform the actual reduction properly using manual techniques irrespective of the pinning method.

**Key Info**

<b>Benefits and harms</b>	Functional outcomes have not been found to be better when the Kapandji method is used; on the contrary, the method tends to result in more complications.
<b>Quality of evidence</b>	There are few studies and their quality is very low.
<b>Preference and values</b>	There are no studies of the patient's values and preferences. Although patients are not expected to be unanimous in their values and preferences, they are expected to favour transstyloid rather than Kapandji pinning since transstyloid pinning tends to result in fewer complications.
<b>Resources and other considerations</b>	There are no studies of resource considerations, but there is assumed to be no difference between the two methods.

**Rationale**

We assume that patients will be best served by treatment with transstyloid pinning rather than Kapandji pinning, since there are fewer complications associated with transstyloid pinning.

**References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO (7.2)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Traditional percutaneous pinning

**Comparator:** Kapandji pinning

**Outcomes:** Patient Reported Outcome Measures (PROM), Pain, Complications, ROM, Anatomical end-result



Outcomes	Confidence in effect estimates	Relative effect	Kapandji pinning	Traditional percutaneous pinning	Difference with	Participants (studies), Follow-up
	Not Set	RR:				

### PICO References

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

### PICO Summary

Three trials compared different pinning methods. Two of these trials observed a higher number of complications as a result of Kapandji pinning compared with two alternative methods of fixation over the fracture line. The third trial did not provide an adequate basis for reaching any conclusion regarding the outcome of a modified variant of Kapandji fixation compared with Willenegger fixation.

The two small trials also compared immobilisation (with a plaster cast) for one week compared with immobilisation for six weeks following surgery. One of the trials found that the duration of the immobilisation after transstyloid fixation did not affect the outcome, while in the trial with Kapandji pinning, several complications arose in patients who had been mobilised early (one week of immobilisation).

One RCT compared Kapandji pinning with transstyloid fixation with respect to different types of complications. The trial included 120 patients (68 % women, average age 57 years) with either extra- or intra-articular dorsally dislocated fractures. 24 of the patients in the trial dropped out, and were not included in the analyses. The trial reported only outcomes associated with complications from the treatment, and there were no significant differences for any of the measured outcomes.

## Use of biodegradable pins results in osteolytic lesions

### Practice Statement

If you choose to treat an unstable distal radius fracture in adult patients with percutaneous pinning, we suggest you use regular metal pins rather than biodegradable pins to avoid osteolytic lesions, irrespective of the patient's age.

### Practical Advice

None.

**Key Info**

<b>Benefits and harms</b>	<p>The trials found no significant differences in functional outcome or complications between the two treatment methods, with the exception of osteolytic reactions (reactions that cause breakdown of the bone mass), which were reported significantly more often by patients treated with biodegradable pins (osteolytic reactions occurred in 60% of those treated with biodegradable pins, but in none of those treated with metal pins). The long-term effects of the osteolytic lesions are not known.</p> <p>The advantage of using biodegradable pins is that they do not have to be removed. However biodegradable pins may be palpable, and may potentially cause discomfort for a longer period than the 4 to 6 weeks that the metal pins are usually retained. Biodegradable pins are also more expensive.</p>
<b>Quality of evidence</b>	<p>The quality of the existing literature is low. There are only two RCTs with few patients, and the studies use different processing techniques which make meta-analyses impossible.</p>
<b>Preference and values</b>	<p>It must be assumed that at the outset patients will be virtually indifferent to the choice of type of pin, but that potential discomfort caused by the biodegradable pins that are not removed may cause some patients not to want these used in the procedure, even though it can be uncomfortable to remove the metal pins that are the alternative form of treatment.</p>
<b>Resources and other considerations</b>	<p>Biodegradable pins are more expensive than metal pins.</p>

**Rationale**

We assume that patients will be better served by treatment with transstyloid pinning rather than Kapandji pinning, since there are fewer complications associated with transstyloid pinning.

**References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO (7.3)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Pinning with biodegradable pins

**Comparator:** Pinning with metal pins

**Outcomes:** Function score, Pain (VAS), Complications

Outcomes	Confidence in effect estimates	Relative effect	Pinning with metal pins	Pinning with biodegradable pins	Difference with	Participants (studies), Follow-up
No Outcomes						

### PICO References

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

### PICO Summary

Two small RCTs analysed the effect of biodegradable pins compared with traditional metal pins/K-wire. The trials included a total of 70 patients (77 % women, average age 61) with intra- and extraarticular fractures. Because different techniques were used, the two RCTs were evaluated separately and not pooled in a meta-analysis. The trials found no significant differences in mobility or complications between the two treatments, with the exception of osteolytic reactions (reactions that cause breakdown of the bone mass), which were reported significantly more often by patients treated with biodegradable pins (osteolytic reactions occurred in 60 % of those treated with biodegradable pins, but there were no osteolytic reactions among those treated with metal pins).

## Bone grafts or bone substitutes provides probably no better functional outcome than operative fixation alone

### Practice Statement

We suggest bone grafts or bone substitutes are not used in the treatment of unstable distal radius fractures in adult patients, neither as sole treatment or as a substitute to operative treatment, irrespective of the patient's age.

### Practical Advice

None.

### Key Info

#### Benefits and harms

It may be simpler to maintain reduction with the aid of a bone graft or bone substitute, but this does not appear to give a better final outcome. If a graft, for example from the hip, is used, the patient has to go through an extra intervention with the discomfort this entails.

#### Quality of evidence

The quality of the studies is moderate.

	<p><b>Preference and values</b></p> <p>It must be assumed that some patients will prefer not to have bone bone grafting, as it is uncertain whether this yields a better result, and it results in an extra operation scar and possible discomfort. What the patients will think about using bone substitutes is more uncertain.</p>
	<p><b>Resources and other considerations</b></p> <p>It is difficult to argue for the use of bone substitutes or autograft as these will increase the costs of the treatment, the outcome of which is uncertain.</p>

**Rationale**

There is no basis for recommending the use of bone grafting or bone substitutes, which cause discomfort at the donor site, a longer surgery time and higher costs, without it having been possible to demonstrate that the functional results will be superior.

**References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

**PICO (7.4)**

- Population:** Adult patients with unstable distal radius fractures, irrespective of age
- Intervention:** Operative treatment without bonegrafting or bonesubstitutes in addition to the osteosynthesis
- Comparator:** Operative treatment with bonegrafting or bonesubstitutes in addition to the osteosynthesis
- Outcomes:** Function score, Pain (VAS), Complications, Anatomical end-result

Outcomes	Confidence in effect estimates	Relative effect	Operative treatment with bonegrafting or bonesubstitutes in addition to the osteosynthesis	Operative treatment without bonegrafting or bonesubstitutes in addition to the osteosynthesis	Difference with	Participants (studies), Follow-up
	Not Set	RR:				

**PICO References**

Frønsdal KB, Kvernmo HD, Hove LM, Husby T, Røkkum M, Odinson A, Skoglund K, Melhuus K, Williksen JH, Krukhaug Y, Finsen V, Norderhaug IN, Juvet LK, Lauvrak V, Fure B . Behandling av håndleddsbrudd (distale radiusfrakturer) hos voksne.

### PICO Summary

A systematic review from 2008 (search 1966–2007) considered various types of bone grafts and bone substitutes. Ten RCTs with a total of 874 adults with unstable distal radius fractures were grouped in six comparisons. None of the trials had hidden distribution between the treatment groups. Four of the studies with 239 participants found that implantation of an autograft (one study), Norian SRS bone substitute (two studies) and methyl methacrylate cement (one study) resulted in a better anatomical outcome than plaster casting alone, while two of the studies found better function. Complications resulted in temporary discomfort due to depositing of Norian SRS cement in the soft parts and pin infection. One trial with 323 participants compared Norian SRS bone substitute with plaster casting or external fixation and found no differences with respect to functional or anatomical outcome after one year. Three trials with 180 participants found that bone implant using autograft (one study), Norian SRS (one study) and methyl methacrylate cement (one study) did not result in significant differences in functional outcome, but gave some indication that anatomical outcome was superior with external fixation. Most of the reported complications were associated with external fixation, while deposition of Norian SRS in the soft parts occurred in one study. One study with 93 patients with dorsal plate fixation found that use of autograft resulted to some extent in improved wrist function compared with allograft, but there were complications associated with autograft.

One RCT with a total of 48 patients evaluated external fixation combined with bone graft compared with only external fixation. There were no significant differences between the two treatment for the outcomes analysed, which included functional grading, complications, anatomical results. The confidence intervals were wide.

## 7.3 - Associated distal ulna fractures

*The research question was:*

For adult patients  $\geq 18$  years with an unstable distal radius fracture with an associated distal ulna fracture, what are the effect and risk associated with operative treatment of the unstable distal radius fracture whereas the unstable is treated conservatively, compared with operative treatment of both the unstable distal radius and ulna fractures, assessed on the basis of patient-reported outcome measures?

*Background to the research question:*

Whereas 1/3 of the distal radius fractures in adults have an concomitant distal ulna fracture, only 6 % of these occur through the ulna head or neck in the elderly patients (Biyani et al. 1995), whereas they are even more rare among younger patients (Gschwentner et al. 2008). Most of the fractures are caused by a high-energy trauma, and are most often seen with widely displaced distal radius fractures (Ring et al. 2004). Thirteen percent of the combined fractures are open fractures, and most of them Grade 1, according to the Gustilo and Anderson classification (1976).

Conservative treatment of both the distal radius and ulna fracture results in "excellent" and "good" results in only 60 % of the patients (Buyani et al. 1995). Also, an association between a concomitant distal ulna fracture and the rare distal radius non-union has been reported (McKee et al. 1997, Fernandez et al. 2001, Ring 2005), leading to the knowledge that these concomitant fractures can affect stability of the forearm. Although many

associated distal ulna head and neck fractures are reported realigned and stable once the radius is realigned and secured (Ring et al. 2004, Dennison 2007), these fractures must be watched carefully for signs of failure of closed treatment due to dislocating forces in the frontal and sagittal plane (McKee et. 1997). As many as 75 % of associated ulna head or neck fractures are reported to be unstable or malaligned after reduction and operative stabilization of the distal radius fracture (Waltz et al. 2006).

*Literature:*

There are no randomised controlled trials which have answered this research question by April 2013, whereas 3 studies of lower quality (Ring et al. 2004, Dennison 2007, Lee et al. 2012) have evaluated the results in patients with concomitant treatment of the unstable distal ulna fracture with a locking plate.

The study of Ring and co-workers (2014) evaluated retrospectively 24 patients aged 18-101 years (mean age 52 years) 26 months after operation with a Condylar Blade Plate, and found 6 excellent, 15 good og 4 fair according to the Gartland and Werley-score modified by Sarmiento. There were 2 non-unions of the distal radius and 1 of the distal ulna, and 7 patients had to have the plate removed due to discomfort.

The study of Dennison (2007) evaluated retrospectively 5 patients aged 47-61 years (mean age 52 years) 12 months after the operation with a 2.0 mm Y-, T- or L-formed locking plate from the Fragment Plating System. The results were all excellent and good according to the Gartland and Werley-score. All the fractures healed and no plates had to be removed.

The study of Lee and co-workers (2012) followed 25 patients age 47-85 years (mean 62 years) 15 months prospectively after operation with a Ulna Hook Plate. Modified Mayo Wrist score was 87 points and DASH-score was 14 points. Four of the 25 patients had to have the plate removed due to discomfort.

Of the 54 patients in the 3 studies of concomitant plating of the unstable ulna head of neck fracture with a locking plate, 3 patients had transient paresthesia from either the median or ulnar nerve, 2 patients ended up with ulna malunion and developed DRUJ arthritis and pain, and there were 2 non-unions of the distal radius and 1 of the distal ulna.

### **Concomitant operative fixation of an associated unstable ulna fracture provides better functional outcome and fewer complications than conservative treatment**

#### **Practice Statement**

If a distal radius fracture is accompanied by a distal ulna fracture, operative treatment should be performed on the distal radius fracture. The stability of the distal radioulnar joint should then be tested. In case of instability or a dislocated ulna fracture, operative fixation of the ulna fracture is suggested.

*Restraint should be exhibited with respect to using operative treatment for patients with a low functional level. By low functional level is meant permanent inability to deal independently with day-to-day activities.*

### **Practical Advice**

Associated fractures of the distal ulna can be defined as injuries to the forearm complex, which consists of the two radioulnar joints and the interosseous membrane. They are most frequently seen with comminuted and displaced distal radius fractures. Some of the injuries are open fractures. Existing literature shows clearly that it is important to stabilise the fractures to minimise the complication rate. Conservative treatment has proved to yield a poor functional outcome, with rotation problems and malunion. The last decade of new technology employing locking plates has considerably improved outcomes.

Rotation of the forearm causes the distal radius to rotate around the distal ulna. Since the forearm has a frame anatomy consisting of ulna, radius, proximal and distal radioulnar joints and interosseous membrane, an injury to one of the components in this frame may restrict the function of the other parts of the forearm complex. It is therefore important to re-establish alignment, rotation and length in order to avoid malunion, rotational impairment and pain.

### **Clinical**

It is important to be able to diagnose these injuries in order to ensure definitive treatment. The assessment should identify any open fracture (in contrast to an abrasion or puncture from the outside, a small puncture resulting from an open fracture tends to ooze blood), neurovascular compromise (check pulses, and the median, ulnar and radial nerves for motor – and sensory disturbances), and any associated injuries (examine the entire arm including the joint above and below the fracture site). Differential diagnoses are multiple fracture patterns including combined fracture dislocations as Monteggia, Galeazzi, and Essex-Lopresti.

### **X-ray examination**

All patients with suspected forearm fractures need a true postero-anterior (PA) and lateral view of the injured forearm, including pictures of the wrist and distal humerus. Standardised X-ray pictures must be taken, with the elbow in 90 degree flexion and the forearm in neutral since the relative positions of radius and ulna change as much as 2 mm depending on forearm rotation.

It may be necessary to compare with the other wrist. In articular, partial articular or displaced fractures, an additional CT-scan is recommended.

### **Classification**

Both fractures are classified according to Comprehensive Classification of Fractures (Müller et al. 1990), where a Q-modifier is used to classify the associated distal ulna fracture. Angulation and malrotation are also noted. Open fractures are graded according to the Gustilo and Anderson classification (1976) and Gustilo et al. (1984).

### **Indication for operative treatment**

The key to a successful treatment is near anatomical reduction of the fracture. Indication for surgery are malalignment (angulation of distal ulna of  $> 10^\circ$  irrespective of direction and translation of caput ulna equivalent to half of its diameter or intra-articular dislocation) and instability of the distal ulna after the distal radius fracture has been plate-fixed.

The same criteria apply to the rare, isolated distal ulna fracture.

## Treatment

All open fractures must be irrigated and debrided. The distal radius fracture must be stabilised, most often with plating through a FCR-approach. The stability of the distal ulna fracture is tested clinically and radiologically after the radius fracture is stabilised. Surgery is performed on unstable distal ulna fractures. Stable ulna fractures can be plaster-casted, but it is mandatory to watch the fracture carefully for signs of failure during the healing period.

If the concomitant ulna fracture is unstable or malaligned, open reduction and internal fixation is advocated also for the distal ulna fracture:

After stabilising the distal radius fracture, the incision for the distal ulna fracture is made on the ulnar side of the sixth extensor compartment in the space between the ECU and the FCU.

The dorsal sensory ulnar nerve branch is identified and protected.

The ulna fracture is reduced and temporarily stabilised with K-wires.

A 2.0 mm locking plate fits the anatomy of most patients. The plate is bent and fitted to the concave form of the distal ulna. Locking pegs are fixed in the caput ulna and the plate. Avoid the use of bicortical screws to avoid penetration into the DRUJ. The plate is then fixed proximally.

When a fracture of the ulna styloid process is present as well, the styloid is reduced and secured with a figure-of-eight suture.

The extensor retinaculum is repaired.

## Post-operative treatment

The patient is instructed in active home exercises for fingers, elbow and shoulder during the treatment period, and is given a written home-exercise program. The patient is instructed to get in contact in the event of major swelling, the development of paresthesia or excessive pain. Consider whether the cast needs to be changed. If the pain and paresthesia does not improve, the possibility of a carpal tunnel syndrome needing decompression should be considered. Patients suffering a great deal of pain and swelling are at risk of developing a complex regional pain syndrome. These patients, and patients with severe swelling and poor finger function, must be monitored and taken care of by the department's hand therapists. All patients must be offered instruction in training exercises when cast and pins are removed.

## Key Info

<b>Benefits and harms</b>	Operation on a concurrent unstable distal ulna fracture is considered on the basis of existing studies to yield a better functional result for the patient and to minimise the risk of complications.
<b>Quality of evidence</b>	There are no systematic reviews or RCT that shed light on the balance between benefits and drawbacks.
<b>Preference and values</b>	The patients' preferences are considered to be unequivocal since the majority of patients will want the best possible outcome with minimal risk of complications.



## Resources and other considerations

No evidence available.

### Rationale

Operative stabilisation of a concurrent unstable distal ulna fracture has improved the functional outcomes from 60 % excellent and good for conservative treatment to outcomes today of mainly excellent and good for operative treatment. Similarly, the introduction of operative treatment of a concurrent unstable distal ulna fracture has reduced the number of nonunions of the distal radius and malunions of the distal ulna. In the few described cases of paresthesia following surgery, these have been of transient nature.

### References

- A Biyani, A J Simison, L Klenerman Fractures of the distal radius and ulna. [7561413](#)
- M D McKee, J P Waddell, D Yoo, R R Richards Nonunion of distal radial fractures associated with distal ulnar shaft fractures: a report of four cases. [8990035](#)
- D L Fernandez, D Ring, J B Jupiter Surgical management of delayed union and nonunion of distal radius fractures. [11279565](#)
- David Ring Nonunion of the distal radius. [16039455](#)
- David Ring, L Pearce McCarty, Douglas Campbell, Jesse B Jupiter Condylar blade plate fixation of unstable fractures of the distal ulna associated with fracture of the distal radius. [14751112](#)
- M Walz, B Kolbow, G Möllenhoff Fracture of the distal ulna accompanying fracture of the distal radius. Minimally invasive treatment with elastic stable intramedullary nailing (ESIN). [17123046](#)
- David G Dennison Open reduction and internal locked fixation of unstable distal ulna fractures with concomitant distal radius fracture. [17606057](#)
- Sang Ki Lee, Kap Jung Kim, Ju Sang Park, Won Sik Choy Distal ulna hook plate fixation for unstable distal ulna fracture associated with distal radius fracture. [22955402](#) 10.3928/01477447-20120822-22
- Martin Gschwentner, Rohit Arora, Markus Wambacher, Markus Gabl, Martin Lutz Distal forearm fracture in the adult: is ORIF of the radius and closed reduction of the ulna a treatment option in distal forearm fracture? [18465137](#) 10.1007/s00402-008-0645-3
- R B Gustilo, J T Anderson Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. [773941](#)
- HD Kvernmo Associated Fractures of the Distal Ulna 10.1007/978-3-642-54604-4

### PICO (7.1)

**Population:** Adult patients with unstable distal radius fractures, irrespective of age

**Intervention:** Operative stabilization of associated distal ulna fracture

**Comparator:** Non-operative stabilization of associated distal ulna fracture

**Outcomes:** Patient important Outcome measures (DASH, PRWE), Pain, Complications, Reoperation

Outcomes	Confidence in effect estimates	Relative effect	Non-operative stabilization of associated distal ulna fracture	Operative stabilization of associated distal ulna fracture	Difference with	Participants (studies), Follow-up
No Outcomes						

### PICO References

- A Biyani, A J Simison, L Klenerman Fractures of the distal radius and ulna. [7561413](#)
- M D McKee, J P Waddell, D Yoo, R R Richards Nonunion of distal radial fractures associated with distal ulnar shaft fractures: a report of four cases. [8990035](#)
- D L Fernandez, D Ring, J B Jupiter Surgical management of delayed union and nonunion of distal radius fractures. [11279565](#)
- David Ring Nonunion of the distal radius. [16039455](#)
- David Ring, L Pearce McCarty, Douglas Campbell, Jesse B Jupiter Condylar blade plate fixation of unstable fractures of the distal ulna associated with fracture of the distal radius. [14751112](#)
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- David G Dennison Open reduction and internal locked fixation of unstable distal ulna fractures with concomitant distal radius fracture. [17606057](#)
- Sang Ki Lee, Kap Jung Kim, Ju Sang Park, Won Sik Choy Distal ulna hook plate fixation for unstable distal ulna fracture associated with distal radius fracture. [22955402](#) 10.3928/01477447-20120822-22
- Martin Gschwentner, Rohit Arora, Markus Wambacher, Markus Gabl, Martin Lutz Distal forearm fracture in the adult: is ORIF of the radius and closed reduction of the ulna a treatment option in distal forearm fracture? [18465137](#) 10.1007/s00402-008-0645-3
- R B Gustilo, J T Anderson Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. [773941](#)
- HD Kvernmo Associated Fractures of the Distal Ulna 10.1007/978-3-642-54604-4

### PICO Summary

There are no randomised controlled trials which have answered this research question by April 2013, whereas 3 studies of lower quality (Ring et al. 2004, Dennison 2007, Lee et al. 2012) have evaluated the results in a patients with concomitant treatment with a locking plate of the unstable distal ulna fracture.

The study of Ring and co-workers (2014) evaluated retrospectively 24 patients aged 18-101 years (mean age 52 years) 26 months after operation with a Condylar Blade Plate, and found 6 "excellent", 15 "good" og 4 "fair" according to the Gartland and Werley-score modified by Sarmiento. There were 2 nonunions of the distal radius and 1 of the distal ulna, and 7 patients had to have the plate removed due to discomfort.

The study of Dennison (2007) evaluated retrospectively 5 patients aged 47-61 years (mean age 52 years) 12 months after the operation with a 2.0 mm Y-, T- or L-formed lockingplate from the Fragment Plating System. The results were all "excellent" and "good" according to the Gartland and Werley-score. All the fractures healed and no plates had to be removed.

The study of Lee and co-workers (2012) followed 25 patients age 47-85 years (mean 62 years) 15 months prospectively after operation with a Ulna Hook Plate. Modified Mayo Wrist score was 87 points and DASH-score was 14 points. Four of the 25 patients had to have the plate removed due to discomfort.

Of the 54 patients in the 3 studies of concomitant plating of the unstable ulna head of neck fracture with a locking plate, 3 patients had transient paresthesia from either the median or ulnar nerve, 2 patients ended up with ulna malunion and developed DRUJ arthritis and pain, and there were 2 nonunions of the distal radius and 1 of the distal ulna.

## 8 - Immobilisation period after operative treatment with volar locking plate

The research question was asked and answered by the Guideline Panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel:

*The research question was:*

What is the outcome of short (less than 2 weeks) compared with long (more than 5 weeks) plaster casting after volar locking plate surgery?

*Background to choice of research questions:*

Patients treated with percutaneous pinning or plaster cast after reduction and patients treated with external fixation are typically immobilised for five weeks. Since the introduction of volar locking plates, a less restrictive regime is often practised, where patients are allowed to start mobilising and exercising after about two weeks. Concern has been expressed as to whether this early mobilisation may result in the failure of healing of intercarpal ligaments and carpal bones that often accompany distal radius fractures but are seldom diagnosed in the acute stage (Forward et al. 2007).

The Guideline Panel has accordingly wanted initially to find an answer to whether early mobilisation is safe for patients with respect to healing of injuries to soft parts and bone in the wrist.

*Literature:*

The evidence consists of a single randomised controlled trial (Lozano-Calderon et al. 2008). In this trial, the patients were randomised into two groups. The patients in both groups had conventional plaster casts for the first two weeks after the operation. For the next four weeks, one group was instructed to take off a removable bandage daily and exercise, while the other group did not get an exercise program but was allowed to remove the bandage when bathing. However, patient compliance with the guidelines was not monitored.

No difference was found between the two groups with respect to Gartland and Werley, Mayo, pain, or DASH scores, ROM, grip strength or X-ray findings.

The follow-up time of the trial is 6 months, which is less than our chosen length of follow-up.

One patient with early mobilisation and seven with late mobilisation had AO group B fractures. These AO type B fractures are not included in this guideline. However, the study has subsequently been included, since it showed that patients with AO type B fractures who underwent surgery with volar locked plates do not have a poorer outcome than AO type C fractures (Souer et al. 2009).

The existing literature sheds no direct light on whether non-diagnosed associated injuries in the wrist heal more poorly with a short period of immobilisation and hence cause problems in the longer term. It has, however, been shown that both groups have the same outcomes with respect to patient-reported outcome parameters (DASH scores) and pain.

### Short-term post-operative immobilisation after operative treatment with volar locking plate

Weak Recommendation

Consider using short-term plaster casting (< 2 weeks) after operative treatment with a volar locking plate, rather than long-term (> 5 weeks).

### Practical Advice

If radiological examination peroperatively reveals a scapholunar instability or a distal radioulnar joint instability (DRUJ) (Kwon and Baek, 2008), the problem should be handled according to local guidelines, or hand surgery expertise should be consulted.

### Key Info

<b>Benefits and harms</b>	No measurable effects or harm have been found for a short plaster casting period.
<b>Quality of evidence</b>	The quality of the evidence is low on the whole. The quality has been downgraded owing to the difference in fracture types and the relatively short follow-up period (6 months). The quality has also been also downgraded because of the risk of lack of precision, as the evidence consists of only one study.
<b>Preference and values</b>	Patients are expected to be fairly unanimous in preferring early removal of the cast. Early removal of the cast makes early start-up of exercises possible, and will also make daily personal hygiene easier.
<b>Resources and other considerations</b>	Costs and resource consumption have not been considered.

### Rationale

In the formulation of the recommendation has patient values and preferences weighed heavily since it is considered that most patients will prefer removal of the cast and mobilisation after 2 weeks rather than waiting five weeks.

### References

- Bong Cheol Kwon, Goo Hyun Baek Fluoroscopic diagnosis of scapholunate interosseous ligament injuries in distal radius fractures. [18219544](#) 10.1007/s11999-008-0126-6
- Daren P Forward, Tommy R Lindau, David S Melsom Intercarpal ligament injuries associated with fractures of the distal part of the radius. [17974874](#)
- Santiago A Lozano-Calderón, Sebastiaan Souer, Chaitanya Mudgal, Jesse B Jupiter, David Ring Wrist mobilization following volar plate fixation of fractures of the distal part of the radius. [18519324](#) 10.2106/JBJS.G.01368
- J Sebastiaan Souer, David Ring, Jesse B Jupiter, Stefan Matschke, Laurent Audige, Marta Marent-Huber, Comparison of AO Type-B and Type-C volar shearing fractures of the distal part of the radius. [19884434](#) 10.2106/JBJS.H.01479
- National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

**PICO (8.1)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age, treated with a volar locking plate

**Intervention:** Immobilization in cast or another stabilizing bandage in < 2 weeks

**Comparator:** Immobilization in cast or another stabilizing bandage in > 5 weeks

**Outcomes:** Patient Reported Outcome Measures (DASH, PRWE), Pain, Complications, Reoperation

Outcomes	Confidence in effect estimates	Relative effect	Immobilization in cast or another stabilizing bandage in > 5 weeks	Immobilization in cast or another stabilizing bandage in < 2 weeks	Difference with	Participants (studies), Follow-up
DASH after 3 months	Low 8 patients had AO type B fractures, only 1 RCT cover the PICO-question	DASH 0-100:	mean 17	mean 19	MD 2 fewer (CI 13 fewer - 25 fewer)	56 (1 RCT)
DASH after 6 months	Very Low 8 patients had AO type B fractures, only 1 RCT covers the PICO-question, 6 months follow-up differs significantly from 1 year follow-up, which was the preferred follow-up time for this PICO-question, wide confidence interval	DASH 0-100:	mean 8.1	mean 8.5	MD 0.4 fewer (CI 2.6 fewer - 14 fewer)	54 (1 RCT)
Pain after 3 months	Very Low 8 patients had AO type B fractures, only 1 RCT covers the PICO-question	VAS 0-100:	mean 2.4	mean 2.4	MD 0 fewer (CI 1.7 fewer - 3.2 fewer)	56 (1 RCT)
Pain after 6 months	Very Low 8 patients had AO type B fractures, only 1 RCT covers the PICO-question, 6 months follow-up differs significantly from 1 year follow-up, which was the preferred follow-up time for this PICO-question, wide confidence interval	VAS 0-100:	mean 1.9	mean 1.5	MD 0.4 fewer (CI 0.7 fewer - 2.3 fewer)	54 (1 RCT)

### PICO References

Bong Cheol Kwon, Goo Hyun Baek Fluoroscopic diagnosis of scapholunate interosseous ligament injuries in distal radius fractures. [18219544](#) 10.1007/s11999-008-0126-6

Daren P Forward, Tommy R Lindau, David S Melsom Intercarpal ligament injuries associated with fractures of the distal part of the radius. [17974874](#)

Santiago A Lozano-Calderón, Sebastiaan Souer, Chaitanya Mudgal, Jesse B Jupiter, David Ring Wrist mobilization following volar plate fixation of fractures of the distal part of the radius. [18519324](#) 10.2106/JBJS.G.01368

J Sebastiaan Souer, David Ring, Jesse B Jupiter, Stefan Matschke, Laurent Audige, Marta Marent-Huber, Comparison of AO Type-B and Type-C volar shearing fractures of the distal part of the radius. [19884434](#) 10.2106/JBJS.H.01479

National Klinisk Retningslinje for behandling af håndledsnære brud (distale radiusfrakturer). ISBN: 978-87-7104-049-4

### PICO Summary

The research question was asked and answered by the Guideline Panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel:

The evidence consists of a single randomised trial (Lozano-Calderon et al. 2008). In this trial, the patients were randomised into two groups. The patients in both groups had conventional plaster casts for the first two weeks after the operation. The one group was then instructed to take off a removable bandage daily and practise movements, while the other group did not get an exercise programme and was instructed only to remove the bandage when bathing. However, patient compliance with the guidelines was not monitored.

No difference was found between the two groups with respect to patient-reported outcome measures, effects on movement, grip strength or X-ray findings.

The longest follow-up time of the trial is 6 months, which is less than the chosen starting point of 6 months.

One patient with early mobilisation and seven with late mobilisation had AO group B fractures. These AO type B fractures are not included in this guideline. However, the study has subsequently been included, since it showed that patients with AO type B fractures who underwent surgery with volar locked plates do not have a poorer outcome than AO type C fractures (Souer et al. 2009).

The existing literature sheds no direct light on whether non-diagnosed associated injuries in the wrist heal more poorly with a short period of immobilisation and hence cause problems in the longer term. It has, however, been shown that both groups have the same outcomes with respect to patient-reported outcome parameters (DASH scores) and pain.

## 9 - Rehabilitation after operative treatment

The research question was asked and answered by the Guideline Panel of the Danish Health and Medicines Authority (DHMA 2014) and the research question and conclusions have been adopted in their entirety by the Norwegian Guideline Panel:

*The research question was:*

What is the effect of independent training with the aid of a written exercise plan following simple instructions from health personnel versus supervised exercise more than once with an occupational therapist or physiotherapist?

*Background to choice of research questions:*

Once the cast is removed, a large proportion of the patients ask about functional rehabilitation. The options open to the various patient groups vary very considerably. In some places the functional rehabilitation is taken care of by occupational therapists as specialised rehabilitation under the auspices of the hospital, while in other places patients are routinely referred for rehabilitation through their municipalities. Others get instructions in the use of a home exercise programme. Considerable resources are spent on training because of the large number of patients. The working group has therefore considered it relevant to answer whether independent exercise according to a written program, or supervised exercise with a therapist, is most useful for the patient.

It is the conclusion of the Guideline Panel that the trained therapist is the specialist qualified to decide on specific training techniques or treatment modalities for the individual patient. The content the supervised training should have is therefore not specified.

*Literature:*

The evidence for the research question is based on 3 RCT (Maciel et al. 2005, Krischak et al. 2009, Souer et al. 2011). A Cochrane report has also been prepared on the subject (Handoll et al. 2006). The literature that is included is of poor quality, however, and is up to 30 years old. Two systematic reviews have also been found (Bruder et al. 2011, Valdes et al. 2014) in which some of the studies are old. These studies have therefore not been included, and the focus has been exclusively on more up to date literature. One study deals with conservatively treated patients, while two deal with patients operated with volar locking plating. The studies compare supervised training with non-supervised training, but differ with respect to the specific interventions.

In the study with conservatively treated patients (Maciel et al. 2005), two treatment options were compared: exercise and advice versus activity-focussed physiotherapy with measurement periods of 6 weeks after removal of cast and follow-up at 24 weeks. Participants allocated to the exercise and advice group consulted a physiotherapist an average of 0.9 times, while the participants allocated to the more intensive activity-focussed group consulted with physiotherapy a mean of 4.4 times. The actual contents of the training were not described in more detail.

In the one study of patients who had had surgery (Krischak et al. 2009) the non-supervised training consisted of instruction in an unassisted home exercise program and distribution of a diary in which the patient was supposed to write his or her own training. An average of 4.6 hours of training a week were recorded. This was compared with 12 sessions of supervised treatment with a therapist chosen by the patient, with training once a week. The contents of the supervised training were not described. After six and 24 weeks, no difference was found between the two groups, measured with the patient-reported outcome measure PRWE.



In the other study with operated patients (Souer et al. 2011) instruction was given in home exercises and training beyond the pain threshold by the surgeon. The surgeon also distributed a wrist bandage that the patients themselves decided the use of. This was compared with formal occupational therapy treatment. The contents and scope of this exercise program were not described in more detail.

A meta-analysis of the two studies that measured the patient-reported outcome measures DASH and PRWE after six weeks, three months and six months, found no difference between a single instruction session and independent exercise on the one hand and supervised exercise with an occupational therapist or physiotherapist on the other. Patients with complications were not included in any of the studies.

## **Routine training with an occupational therapist or physiotherapist only for patients with complicated courses**

### **Practice Statement**

It is not good practice to give training supervised by an occupational therapist or physiotherapist as a matter of routine to patients with an uncomplicated course, since there is no evidence that this gives better outcome than a single session of advice and a written exercise plan.  
It is good practice for all patients as a minimum to be offered instruction in independent exercises after a distal radius fracture, irrespective of the treatment method.

### **Practical Advice**

On discharge, all patients have a right to a medical assessment of their need for rehabilitation.

Patients need instruction and an understanding of the course of rehabilitation, and on how much daily exercise to do, and how much strain can be imposed in their day-to-day activities. Written guidelines about these matters and advice as to where further guidelines can be obtained can to advantage be given to patients in connection with removal of the cast.

Supervised training with an occupational therapist or physiotherapist with expertise in the treatment of hand problems may be considered for patients with a complicated course, for example in cases of excessive oedema, signs of incipient CRPS and/or pain.

### **Key Info**

#### **Benefits and harms**

The treatment methods referred to have no known harmful effects. However, the studies conclude that some training will improve the functional level.

#### **Quality of evidence**

The quality of the evidence is generally low.  
The studies are generally characterised by a high dropout rate, lack of blinding and a broad confidence interval, which substantially degrades the evidence.

#### **Preference and values**

Patients are considered not to be unanimous in their preferences. It is expected that most patients will ask for training. However, some patients will ask for supervised instruction, while others will prefer a single instruction session.

#### **Resources and other considerations**

No assessment has been made of costs and use of resources.

#### **Rationale**

All patients have a right to have their functional retraining needs assessed on discharge from hospital. There is a unanimous patient preference for an option of guidance in re-training and on the course of events after a distal radius fracture. The patients' needs for these measures vary quite widely, however.

The existing literature provides no evidence that all patients should be monitored in supervised exercise programmes. However, account must be taken of the individual patient's need for re-training, by the time of removal of the cast at the latest.

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H H G Handoll, R Madhok, T E Howe Rehabilitation for distal radial fractures in adults. [16856004](#)

Kristin Valdes, Nancy Naughton, Susan Michlovitz Therapist supervised clinic-based therapy versus instruction in a home program following distal radius fracture: a systematic review. [24508093](#) 10.1016/j.jht.2013.12.010

Andrea Bruder, Nicholas F Taylor, Karen J Dodd, Nora Shields Exercise reduces impairment and improves activity in people after some upper limb fractures: a systematic review. [21684488](#) 10.1016/S1836-9553(11)70017-0

#### **PICO (9.1)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age, treated with a volar locking plate

**Intervention:** Supervised training by occupational- or physiotherapist

**Comparator:** Home-exercise program after instruction by health personnel after cast removal

**Outcomes:** Patient Reported Outcome Measures (DASH/PRWE), Pain (VAS)

Outcomes	Confidence in effect estimates	Relative effect	Home-exercise program after instruction by health personnel after cast removal	Supervised training by occupational- or physiotherapist	Difference with	Participants (studies), Follow-up
DASH and PRWE after 8 weeks	Very Low <i>No blinding, many drop-outs, wide confidence intervals, only one study.</i>		mean	mean	MD 0.42 fewer (CI 0.79 fewer - 0.05 fewer)	118 participants (2 RCT)
DASH and PRWE after 6 months	Very Low <i>No blinding, many drop-outs, only one study.</i>		mean	mean	MD 1.1 fewer (CI 2.18 fewer - 4.38 fewer)	75 participants (1 RCT)
Pain after 3 months	Very Low <i>No blinding, many drop-outs, wide confidence intervals, only one study.</i>	VAS 0-100:	mean	mean	MD 0.1 fewer (CI 0.46 fewer - 0.26 fewer)	72 participants (1 RCT)
Pain after 6 months	Very Low <i>No blinding, many drop-outs, wide confidence intervals, only one study.</i>	VAS 0-100:	mean	mean	MD 0.4 fewer (CI 0.22 fewer - 1.02 fewer)	76 participants (1 RCT)

### PICO References

- J S Maciel, N F Taylor, C McIlveen A randomised clinical trial of activity-focussed physiotherapy on patients with distal radius fractures. [16136342](#)
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- Andrea Bruder, Nicholas F Taylor, Karen J Dodd, Nora Shields Exercise reduces impairment and improves activity in people after some upper limb fractures: a systematic review. [21684488](#) 10.1016/S1836-9553(11)70017-0

### **PICO Summary**

The evidence for the research question is based on 3 RCT (Maciel et al. 2005, Krischak et al. 2009, Souer et al. 2011). A Cochrane report has also been prepared on the subject (Handoll et al. 2006). The literature that is included is of poor quality, however, and is up to 30 years old. Two systematic reviews have also been found (Bruder et al. 2011, Valdes et al. 2014) in which some of the studies are old. These studies have therefore not been included, and the focus has been exclusively on more up to date literature. Two studies deal with patients operated with volar locking plating. The studies compare supervised training with non-supervised training, but differ with respect to the specific interventions.

In the first study of patients who had had surgery (Krischak et al. 2009) the non-supervised training consisted of instruction in an unassisted home exercise program and distribution of a diary in which the patient was supposed to write his or her own training. An average of 4.6 hours of training a week were recorded. This was compared with 12 sessions of supervised treatment with a therapist chosen by the patient, with training once a week. The contents of the supervised training were not described. After six and 24 weeks, no difference was found between the two groups, measured with the patient-reported outcome measure PRWE.

In the second study with operated patients (Souer et al. 2011) instruction was given in home exercises and training beyond the pain threshold by the surgeon. The surgeon also distributed a wrist bandage that the patients themselves decided the use of. This was compared with formal occupational therapy treatment. The contents and scope of this exercise program were not described in more detail.

A meta-analysis of the two studies that measured the patient-reported outcome measures DASH and PRWE after six weeks, three months and six months, found no difference between a single instruction session and independent exercise on the one hand and supervised exercise with an occupational therapist or physiotherapist on the other. Patients with complications were not included in any of the studies.

### **PICO (9.2)**

**Population:** Adult patients with unstable distal radius fractures, irrespective of age, treated conservatively (reduction and casting)

**Intervention:** Supervised training by occupational- or physiotherapist

**Comparator:** Home-exercise program after instruction by health personnel after cast removal

**Outcomes:** Patient Reported Outcome Measures (DASH, PRWE), Pain (VAS)

Outcomes	Confidence in effect estimates	Relative effect	Home-exercise program after instruction by health personnel after cast removal	Supervised training by occupational- or physiotherapist	Difference with	Participants (studies), Follow-up
PRWE after 6 weeks	Very Low <i>No blinding, only one study.</i>		mean	mean	MD 6.8 fewer <i>(CI 25.55 fewer - 11.95 fewer)</i>	35 participants (1 RCT)
PRWE after 24 weeks	Very Low <i>No blinding, 19% drop-outs, wide confidence interval, only one study.</i>		mean	mean	MD 5.1 fewer <i>(CI 24.33 fewer - 14.03 fewer)</i>	33 participants (1 RCT)
Pain after 6 weeks	Very Low <i>No blinding, wide confidence interval, only one study.</i>	VAS 0-100:	mean	mean	MD 5.5 fewer <i>(CI 23.03 fewer - 12.03 fewer)</i>	35 participants (1 RCT)
Pain after 24 weeks	Very Low <i>No blinding, 19% drop-outs, wide confidence interval, only one study.</i>	VAS 0-100:	mean	mean	MD 8.4 fewer <i>(CI 27.07 fewer - 10.27 fewer)</i>	33 participants (1 RCT)

### PICO References

J S Maciel, N F Taylor, C McIlveen A randomised clinical trial of activity-focussed physiotherapy on patients with distal radius fractures. [16136342](#)

H H G Handoll, R Madhok, T E Howe Rehabilitation for distal radial fractures in adults. [16856004](#)

Kristin Valdes, Nancy Naughton, Susan Michlovitz Therapist supervised clinic-based therapy versus instruction in a home program following distal radius fracture: a systematic review. [24508093](#) 10.1016/j.jht.2013.12.010

Andrea Bruder, Nicholas F Taylor, Karen J Dodd, Nora Shields Exercise reduces impairment and improves activity in people after some upper limb fractures: a systematic review. [21684488](#) 10.1016/S1836-9553(11)70017-0

### PICO Summary

The evidence for the research question is based on 3 RCT (Maciel et al. 2005, Krischak et al. 2009, Souer et al. 2011). A Cochrane report has also been prepared on the subject (Handoll et al. 2006). The literature that is included is of poor quality, however, and is up to 30 years old. Two systematic reviews have also been found (Bruder et al. 2011, Valdes et al. 2014) in which some of the studies are old. These studies have therefore not been included, and the focus has been exclusively on more up to date literature. One study deals with conservatively treated patients.

In the study with conservatively treated patients (Maciel et al. 2005), two treatment options were compared: exercise and advice versus activity-focussed physiotherapy with measurement periods of 6 weeks after removal of cast and follow-up at 24 weeks. Participants allocated to the exercise and advice group consulted a physiotherapist an average of 0.9 times, while the participants allocated to the more intensive activity-focussed group consulted with physiotherapy a mean of 4.4 times. The actual contents of the training were not described in more detail.

## 10 - Hearings

Please find all hearing on [www.handleddsbrudd.no](http://www.handleddsbrudd.no).

Not Set

Alle hearing responses are published on [www.handleddsbrudd.no](http://www.handleddsbrudd.no).

### Practical Advice

#### Key Info

	<b>Benefits and harms</b>
	<b>Quality of evidence</b>
	<b>Preference and values</b>
	<b>Resources and other considerations</b>

### Rationale

### References

## 11 - Acknowledgements

Not Set

We thank Norwegian Orthopaedic Association for the mandate and trust we were given in the development of this guidelines. We thank the National Knowledge Centre for Health Services and the Norwegian Medical Association which has enabled this work, both methodologically and economically. A big thanks also to Per Olav Vandvik and Linn Brandt who have consecrated us to MAGICapp and that has been an essential prerequisite for the finalization of this guidelines. Finally, a big thanks to Danish Health and Medicines Authority for approving our use of part of their guideline "National klinisk retningslinje for behandling af håndledsnære brud (distal radiusfraktur)" published on 8 October 2014.

### Practical Advice

#### Key Info

	<b>Benefits and harms</b>
	<b>Quality of evidence</b>
	<b>Preference and values</b>
	<b>Resources and other considerations</b>

### Rationale

### References



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