BSSH

The British Society for Surgery of the Hand

Best practice for management of Distal Radial Fractures (DRFs)

Published by British Orthopaedic Association and British Society for Surgery of the Hand, 2018.

The British Orthopaedic Association and the British Society for Surgery of the Hand

Best practice for management of distal radial fractures (DRFs)

The British Orthopaedic Association (BOA) and the British Society for Surgery of the Hand (BSSH) have collaborated to commission a committee to produce best practice guidelines on the management of distal radial fractures (DRFs).

The Guideline Development Group (GDG) is made up as follows:

Charles Pailthorpe	Chairman	Consultant Orthopaedic Surgeon, Royal Berkshire Hospital, Reading
Joe Dias		Professor Hand and Orthopaedic Surgery, University Hospitals of Leicester
Adam Brooks		Consultant Orthopaedic Surgeon, Great Western Hospital, Swindon, BOA Professional Practice Committee representative
Tim Chesser	Fragility fracture chapter	Consultant Trauma and Orthopaedic Surgeon, North Bristol NHS Trust, Past-Chairman BOA Trauma Group
Claire Pulford		Consultant Physician Oxford University Hospitals NHS Foundation Trust
Ian McNab		Consultant Hand Surgeon, Nuffield Orthopaedic Centre, Oxford
Jamie Brosch		General Practitioner; GPwSI Orthopaedics; Medical Director, Medvivo Group, Chippenham
Pida Ripley		Patient representative, British Orthopaedic Association Patient Liaison Group
Claire Granville		Trauma Outpatient Department Sister, John Radcliffe Hospital, Oxford University Hospitals
Shivkumar Gopal	Emergency chapter	Consultant Trauma and Orthopaedic Surgeon, Hull and East Yorkshire NHS Trust
Nick Johnson		Speciality Registrar, University Hospitals of Leicester
Lisa Leonard	Fracture clinic chapter	Consultant Orthopaedic Hand Surgeon, Brighton and Sussex University Hospitals NHS Trust, Royal Sussex County Hospital
James White		Speciality Registrar, Northwest Thames Deanery, St Mary's Hospital, Paddington
Adam Watts	Surgery chapter	Consultant Upper Limb Surgeon, Wrightington Hospital. Visiting Professor, Department of Materials, University of Manchester
Andrew Duckworth		Specialty Registrar, Department of Orthopaedics and Trauma, Royal Infirmary of Edinburgh
Joelle Chalmer	Rehabilitation chapter	Highly Specialised Physiotherapist at Guy's and St Thomas' NHS Foundation Trust, London
Zoe Clift		Extended Scope Practitioner, The Pulvertaft Hand Unit, Royal Derby Teaching Hospitals
Helen Hedley	Outcomes chapter	Consultant Hand and Wrist Surgeon University Hospitals Coventry and Warwickshire NHS Trust
Alexia Karantana		Clinical Associate Professor in Hand Surgery, University of Nottingham

DISCLAIMER

The recommendations in this guideline represent the view of the GDG, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The application of the recommendations in this guideline is not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or their carer or guardian.

Table of Contents

1. SUMMARY OF AUDIT STANDARDS

Emergency Department

Anaesthesia techniques for manipulation

The GDG supports the NICE guidelines to consider intravenous regional anaesthesia (IVRA) when reducing dorsally displaced DRFs in adults (16 or over) in the emergency department. This should be performed by healthcare professionals trained in the technique, not necessarily anaesthetists. However, as there are known complications of IVRA, if suitably qualified and trained personnel are not available to perform IVRA, then haematoma block is a safe and viable option to reduce the fracture. The use of gas and air (nitrous oxide and oxygen) on its own is not recommended. Given that IVRA, through superior pain relief when compared to haematoma block, allows the manipulator to achieve a better quality of fracture reduction, when clinically appropriate patients should be offered the opportunity to wait up to 72 hours for availability of suitably qualified personnel.

Does manipulation affect functional outcome?

Manipulation may not improve outcome in patients aged 65 years or older with moderately displaced fractures.

Full cast versus back slab immobilisation?

Immobilisation can be adequately achieved by either the use of a full plaster of Paris (POP) cast or a back slab depending on the expertise of the personnel carrying out the application of the splint and the preference of the patient. The GDG recommends that the patient is provided with a written care sheet with emergency contact numbers as per Fracture Clinic Services BOAST guidelines.

The effect of Vitamin C in preventing complex regional pain syndrome?

Vitamin C is not recommended for the prevention of CRPS in patients with distal radius fractures.

Which radiological parameters affect functional outcome?

There is insufficient evidence to demonstrate an association between any measured radiological parameters and patient rated outcome. As most practitioners currently use radiological parameters in their decision-making a Delphi study of experts in the treatment of distal radius fractures was carried out. The panel of experts agreed that in patients under the age of 65 years, ulnar variance and dorsal tilt are the most

important extra-articular parameters whilst the presence of the step is the most important intra-articular parameter. Seven patient factors were considered important in the decision making regarding surgery and rank order of importance was agreed.

Fracture Clinic

Risk factors for re-displacement?

Elderly patients with a DRF that is displaced on their initial films and/or have comminution are likely to be at increased risk of re-displacement. If this re-displacement could affect management more vigilant follow-up in clinic may be required.

Does this fracture need a plaster cast?

Patients with a stable fracture of the distal radius should be considered for early mobilisation with a removable support, once pain allows.

In what position should a fractured distal radius be immobilised?

When using a moulded plaster cast or back slab to treat a distal radius fracture, the wrist should be positioned in neutral flexion with three-point moulding used to hold the fracture, rather than forced palmar flexion.

Should further radiographs be taken at 2-3 weeks following injury?

No evidence can be found to support a benefit of radiographs at 2-3 weeks, but, as a best practice point, the GDG recommend repeat radiographs of the wrist between 1-2 weeks after injury (or manipulation) where it is thought that the fracture pattern is unstable AND when subsequent displacement will lead to surgical intervention.

When should immobilisation be discontinued?

When using a plaster cast to treat a distal radius fracture, consideration should be given to removing the plaster and starting wrist mobilisation four weeks after the injury rather than six weeks.
The GDG agreed that this represented a balanced approach between the risk of further radiographic displacement and earlier return to function.

Will the anxious patient recover less well?

No recommendation can be made regarding this issue on the currently available evidence. Best practice recommendation is that patients who seem more anxious or concerned following a distal radius fracture are followed more closely to provide adequate support whilst recovering from their injury.

Radiographs at the time of removing immobilisation?

A radiograph of the patient's wrist at the time of removing immobilisation is not required unless there is clinical concern.

Surgery

Timing of surgery

When surgery is indicated, the patient is best served by prompt intervention by an appropriately trained surgeon, as delay confers no benefit to the patient's recovery. Surgical intervention should be performed within 72 hours of injury for intra-articular fractures and within one week for extra-articular fractures. When operative management is required for re-displacement following manipulation, surgery should be undertaken within 72 hours of the decision to operate. The patient must be fully involved in the decision to operate and informed of all common options, recommended guidelines and potential risks.

Non-operative versus operative management

In patients 65 years of age or older, non-operative treatment can be considered as a primary treatment for a displaced distal radius fracture. However, other factors such as activity level, medical comorbidities and fractures characteristics should be considered and discussed with the patient.

Manipulation under anaesthesia with K-wires versus open reduction and internal fixation

When surgery is needed for dorsally displaced distal radius fractures that can be reduced closed, offer K-wire fixation and cast. For DRFs that require open reduction, or for those with an intra-articular step or gap which cannot be reduced closed, open fixation can be considered.

External fixation versus open reduction and internal fixation

External fixation should not be used as the definitive treatment of closed DRFs where open reduction and internal fixation of the fracture fragments is possible.

Concomitant distal ulnar styloid fracture management

Stability of the distal radio-ulnar joint (DRUJ) should be assessed and recorded after surgical treatment of distal radius fractures. In the presence of a DRF with a clinically stable DRUJ, it is not necessary to surgically fix an ulnar styloid fracture.

Rehabilitation

The impact of providing rehabilitation during the immobilisation period

The impact of providing rehabilitation after definitive treatment implementation (surgically and non-surgically managed patients)

Information regarding the signs and symptoms of common complications should be given along with a simple self-directed management plan. Patients should be provided with advice and education to manage pain and oedema and to prevent loss of limb motion. Immobilisation should allow for a full fist with the fingers. The patient should be encouraged to use the injured limb for light functional activities. Patients with disproportionate levels of pain, oedema, loss of movement or delayed functional recovery should be referred to the hand therapy for further treatment.

The type of rehabilitation intervention

The mode of rehabilitation delivery

The discipline of the rehabilitation provider

Patients who have ongoing pain, loss of movement and/or delayed functional recovery should be referred for rehabilitation. This should be delivered by a health care specialist with the appropriate level of knowledge and skills to address complications including complex regional pain syndrome. Choice of intervention should consider the patient's roles and responsibilities and physical impairments. Education and rehabilitation programmes should be delivered in a timely manner and in a variety of forms to suit the patient's specific needs.

Outcome Measures

There is insufficient evidence to recommend the optimal Patient Reported Outcome Measure (PROM) for capturing outcome in studies of adult patients with DRFs. However, pending future research, an interim recommendation can be made for the use of either the PRWE or the DASH, based on available evidence for responsiveness in this setting.

Conclusions

The view of the GDG is that the management of DRFs is based on patient factors. The personality of the fracture, the patient's views and the experience of the clinician are all factors that should be considered in the decision to treat either non-operatively or by surgery. In each case the patient needs to have an informed discussion on the treatment options but it may be acceptable to avoid operative treatment of moderately displaced fractures in selected older patients. All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work, education and driving. Patients

should be able to self-refer to the Fracture Service if progress is not as anticipated and Hospitals should provide this mechanism.

2. FOREWORD

Adult DRFs are common injuries at any age but particularly in the older person where they may be associated with osteoporosis or osteopaenia and so are considered fragility fractures. The treatment of patients with DRFs remains controversial. There are many published studies analysing specific parameters of their treatment however there is a need for a guide to summarise the treatment options for both specialist and non-specialist clinicians. This document collates the current evidence from English language journals that considers the management of patients with DRFs from presentation to rehabilitation with reference to Patient Reported Outcome Measures (PROMs). These guidelines have been produced in collaboration between the BOA and BSSH and complement the BOAST on DRFs.

3. INTRODUCTION

3.1. The GDG consists of consultant and trainee orthopaedic and trauma surgeons, a physician/orthogeriatrician, a general practitioner, extended scope practitioners, a nurse with plaster room experience and a patient representative.

3.2. The production of Guidelines promoting optimum standards of care is key to the achievement of both the BOA's and the BSSH's charitable objectives. No external funding has been sought for the production of these guidelines.

3.3. Definition of a Guideline

3.3.1. Clinical practice guidelines are systematically developed statements to assist surgeon and patient decisions about appropriate health care for specific clinical circumstances.

3.3.2. These guidelines have been developed by researching the pathway of the patient with a DRF through the Emergency Department (ED) to the Fracture Clinic, to Surgery (if required) and then Rehabilitation. A separate study into Outcome Measures was performed. Fragility fractures are discussed but not include in the search questions.

3.3.3. Fractures of the distal radius are amongst the commonest fractures with which adult patients present to ED. Many DRFs will be seen and treated in the ED and then discharged to specialist follow up. Patients may attend with displaced fractures or neurovascular problems which require urgent treatment and so appropriate initial assessment and management is essential. The mechanism of injury and clinical findings, including skin

integrity, assessment of circulation and sensation, should be documented at presentation. Radiographic assessment should be postero—anterior and lateral views centred at the wrist.

3.3.4. Open fractures should undergo surgical debridement and stabilisation in accordance with the Open Fracture BOAST.

Emergency Department

3.3.5. Displaced DRFs have traditionally been treated with initial manipulation on presentation to the ED. Manipulation is not only a first aid measure to minimise the risk of developing neurological symptoms, but for many patients can be the definitive treatment. The following aspects of management in ED were studied:

- Anaesthetic techniques for manipulation
- Methods of fracture reduction
- Types of cast immobilisation outcome following reduction
- Whether manipulation affects functional outcome
- Full cast versus back slab immobilisation
- The effect of Vitamin C preventing complex regional pain syndrome
- The effect of radiological parameters on functional outcome

Fracture Clinic

3.3.6. The Fracture Clinic Services BOAST guidelines outline general standards of care in fracture clinic. It is assumed that those guidelines are being followed. The review questions in this section further assumed the following factors:

- The fracture configuration on that particular day in clinic was deemed likely to provide that patient with an acceptable functional outcome, if the fracture healed as it was.
- Associated injuries that would further impair the functional outcome in that patient had also been evaluated.
- Any further imaging required to assist in the decision-making process had been acquired.
- The patient's opinion regarding the various treatment options available and their desired functional outcome had been sought.

The GDG considered several further factors that were deemed to have possible relevance to ongoing management of such patients:

- Re-displacement and initial displacement
- Re-displacement and age of patient
- Re-displacement and comminution
- Does this fracture need a plaster cast?
- What position should a fractured distal radius be immobilised in?
- Should further radiographs be taken at 2-3 weeks following injury?
- When should immobilisation be discontinued?
- Will the anxious patient recover less well?
- Radiographs at the time of removing immobilisation

Surgery

The baseline functional demands of the patient, the consequences of mal-union and the potential risks of surgery need to be considered and discussed with the patient when assessing the role of surgical intervention. The following factors should be considered:

- Timing of surgery
- Non-operative versus operative management
- Manipulation under anaesthesia with K-wires versus open reduction and internal fixation
- External fixation versus open reduction and internal fixation
- Concomitant distal ulnar styloid fracture management

Rehabilitation

Many patients are referred to a rehabilitation provider following a DRF to optimise return to function. The questions consider how functional outcome after DRF is affected by:

- The impact of providing rehabilitation during the immobilisation period
- The impact of providing rehabilitation after definitive treatment implementation (surgically and non-surgically managed patients)
- The type of rehabilitation intervention
- The mode of rehabilitation delivery
- The discipline of the rehabilitation provider

Outcome Measures

The aim was to appraise critically the evidence concerning the measurement properties of questionnaires used to capture self-reported outcome in the setting of adult patients with DRFs.

4. METHODOLOGY

4.1. The guideline has been developed using the Scottish Intercollegiate Guidelines Network (SIGN) guidance in association with the **A**ppraisal of **G**uidelines for **RE**search & **E**valuation (AGREE) Instrument. All searches were conducted in MEDLINE, Embase, and the Cochrane Library, and were updated for the final time on 21 September 2015. No further papers were added to the databases after this date.

Papers published in the English language were only included. Further details can be viewed here.

5. EMERGENCY DEPARTMENT

5.1. ANAESTHESIA TECHNIQUES for MANIPULATION

5.1.1 Introduction

Different anaesthesia techniques have been used to reduce DRFs in the Emergency Department. Local factors, such as the capability of the on-duty personnel in the Emergency Department and availability of resources to undertake any particular technique, dictates to a large extent which of the methods is commonly employed in each individual department. The aim is to review the anaesthetic techniques used to reduce the fracture and/or stabilise it.

5.1.2 Review Question

How does manipulation performed under general anaesthesia compared to wide awake manipulation (using either a haematoma block or IVRA) affect quality of reduction / functional outcome?

Population	Adults ≥16yrs of age or older requiring manipulation in the emergency department for a fracture of the distal radius
Intervention	Manipulation under Regional Anaesthesia
Comparison	Manipulation under General Anaesthesia
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

5.1.3 Evidence

There is a Cochrane review of the various methods of anaesthesia used for treating distal radius fractures. It includes the only randomised controlled trial comparing general anaesthesia with haematoma block with or without sedation.
Due to the paucity of RCTs comparing general with regional anaesthesia, evidence was also sought from studies comparing different techniques of wide awake anaesthesia. The available studies have been reviewed under the following categories:

A) General Anaesthesia versus haematoma block - one trial. View here

B) Intravenous regional anaesthesia (IVRA) versus haematoma block- five trials. View here

5.1.4 Evidence Statement

Level 1:
Primary question (GA vs haematoma block)- Extremely limited evidence which suggests that there is no difference in the quality of reduction for GA versus haematoma block with patients in the latter group reporting more pain during manipulation, whereas patients undergoing manipulation under GA experienced more post- manipulation pain.

Level 1:

Secondary question (IVRA vs haematoma block)- IVRA is associated with better correction of the deformity with less pain when compared to manipulation under haematoma block.

5.1.5 Recommendation

Grade of Recommendation: Grade C

Best Practice Point:
The GDG supports the NICE guidelines to consider intravenous regional anaesthesia (Bier's block) when reducing dorsally displaced DRFs in adults (16 or over) in the emergency department. As there are known complications of IVRA, this should be performed by healthcare professionals trained in the technique, who need not necessarily be anaesthetists. (NICE non-complex fracture guidelines: https://www.nice.org.uk/guidance/NG38/chapter/Recommendations#ongoing-orthopaedic-management

If suitably qualified and trained personnel are not available to perform IVRA, haematoma block is a safe and reasonable option to reduce the fracture. However, given that IVRA, through superior pain relief, allows the manipulator to achieve a better quality of fracture reduction, patients should be offered the opportunity to wait up to 72 hours for the availability of suitably qualified personnel. The use of gas and air (nitrous oxide and oxygen) on its own provides inadequate pain relief and is not recommended.

5.2 DOES MANIPULATION AFFECT FUNCTIONAL OUTCOME?

5.2.1 Introduction

Displaced DRFS are frequently manipulated in the emergency department to improve the position of the fracture. The aim is to review whether manipulation of a fracture of the distal radius compared to no manipulation affects patient reported or functional outcome scores.

5.2.2 Review Question

How does intervention with manipulation compared with no manipulation affect the patient reported outcome/functional outcome of the patient?

Population	Adults ≥16yrs of age who have sustained a displaced fracture of the distal radius

Intervention	Manipulation
Comparison	No manipulation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

5.2.3 Evidence

A total of five papers were reviewed for this question, including one systematic review, 1 RCT and three case series. Two met our inclusion criteria. View here.

5.2.4 Evidence Statement

Level 1
For fractures of the distal radius in patients aged ≥50 years with moderately displaced fractures there is evidence for those over the age of 65 years that manipulation may not improve functional outcome, stiffness, final radiological position or cosmesis compared to no manipulation.
There is no evidence available for patients under 65 years.

5.2.5 Recommendation

Grade of Recommendation: Grade C
Manipulation may not improve outcome in patients aged 65 years or older with moderately displaced fractures.

5.3 FULL CAST VERSUS BACK SLAB IMMOBILISATION

5.3.1 Introduction

The aim is to review how a full cast compares to a back slab in maintaining reduction and in terms of maintenance of reduction and patient reported or functional outcome scores.

5.3.2 Review Question

How does a full cast compared to a back slab affect the maintenance of the reduction and patient reported outcome / functional outcome?

Population	Adults ≥16yrs of age who have sustained a dorsally displaced fracture of the distal radius
Intervention	Immobilisation in a full cast after closed reduction
Comparison	Immobilisation in a back slab after closed reduction reduction
Outcomes	Maintenance of reduction PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

5.3.3 Evidence

There is only one randomised controlled trial that fulfils the exact criteria set out in the question i.e. immobilisation in a full cast is compared to a back slab. View here.

5.3.4 Evidence Statement

Level 3:

The number of patients in the only RCT available for review is not sufficient to draw meaningful conclusions.

5.3.5 Recommendation

Best Practice Point:
Immobilisation can be adequately achieved either by the use of a full cast or by use of a back slab depending on the expertise of the personnel carrying out the application of the splint and the preference of the patient. The GDG recommends that the patient is provided with a written care sheet with emergency contact numbers as per the Standards for Trauma BOAST guidelines.

5.4 VITAMIN C FOR PREVENTION OF COMPLEX REGIONAL PAIN SYNDROME (CRPS)

5.4.1 Introduction

CRPS is a complication which may be seen after a distal radius fracture characterised by severe pain, swelling and skin changes. Vitamin C has been advocated as a cheap, safe and effective treatment to prevent CRPS following injury or surgery. The aim is to review whether treatment with Vitamin C compared with placebo prevents CRPS in patients with a fracture of the distal radius.

5.4.2 Review Question

How does Vitamin C compared to placebo affect rates of CRPS?

Population	Adults ≥16yrs of age who have sustained a fracture of the distal radius
Intervention	Oral Vitamin C therapy
Comparison	Placebo
Outcomes	CRPS PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

5.4.3 Evidence

A total of 38 papers were reviewed for this question, including three meta analyses and three RCTs. Six papers met the inclusion criteria. View here.

5.4.4 Evidence Statement

Level 1++:
For adult patients with a distal radius fracture, there is no evidence that treatment with Vitamin C prevents CRPS when compared to placebo.

5.4.5 Recommendation

Grade of Recommendation: Grade A
Vitamin C is not recommended for the prevention of CRPS in patients with DRFs.

5.5 RADIOLOGICAL PARAMETERS AND OUTCOME

5.5.1 Introduction

Several parameters are commonly measured on radiographs of DRFs. The aim is to review whether any of these parameters seen on radiographs influence the patient reported or functional outcome of the patient.

5.5.2 Review Question

Which radiological parameters affect the patient reported outcome/functional outcome of the patient?

Population	Adults ≥16yrs of age or older with a fracture of the distal radius
Intervention	not applicable
Comparison	Radiological parameters; dorsal tilt, radial inclination, radial length, ulnar variance, intra-articular step and gap
Outcomes	PROMs Functional outcome
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies, case series

5.5.3 Evidence

No randomised controlled trials or cohort studies were found for this review question. 42 papers met the inclusion criteria. All were case series and many were retrospective. The study findings are varied with no strong evidence that any radiological parameter affects outcome. View here.

5.5.4 Evidence Statement

Level 3:
There is insufficient evidence in the literature to determine a meaningful association between any of the radiological parameters and patient rated outcome.

5.5.5 Recommendation

Grade of Recommendation: Grade D

Currently there is insufficient evidence to demonstrate a clear association between any measured radiological parameters and patient rated outcome. Further high quality research is required to answer this question.

The review has identified that the most commonly measured parameters were radial height, radial inclination, volar tilt, ulnar variance and intra articular step and gap. To investigate the influence of these radiological parameters on treatment decision making further, a Delphi study was organised. The Delphi method solicits the opinions of experts through a series of carefully designed questionnaires interspersed with information and opinion feedback in order to establish a convergence of opinion.

5.5.6 Delphi Study aims

- To identify which radiographic parameters are clinically important
- To quantify the threshold of displacement at which surgical intervention should take place for the commonly measured parameters
- To determine which patient factors influence the decision to intervene

5.5.7 Method

A Delphi study was completed with a panel of national and international experts who are experienced in the treatment of acute DRFs and their longer-term sequelae and/or have published clinical research investigating outcome after DRF.

Full ethical approval was obtained from the University of Leicester (Ethics Reference: 9559-nj94- healthsciences). The study protocol was registered with ClinicalTrials.gov (Identifier NCT03126474).

5.5.8 Delphi panel recruitment

The panel was composed of three groups of expert surgeons. Blue Book committee members were excluded. Many panel members fitted the criteria to belong in more than one of the following groups:

- Hand and wrist specialists – these surgeons would have considerable experience dealing with acute injuries and longer term problems after DRF.

Participants were identified by sampling from UK BSSH members geographically.

- Trauma surgeons - those who deal acutely with patients with DRF and operate on them regularly. An email invitation was sent via the Orthopaedic Trauma Society (OTS) asking for volunteers to take part who fulfilled the above criteria.
- International researchers - surgeons who are also researchers and have published studies investigating outcome in patients with DRFs in the last 2 years so have a comprehensive understanding of the nature of the injury and likely outcome. A literature review of major orthopaedic and hand journals was carried out to identify potential participants.

5.5.9 Questions

Questions were based around six short case vignettes regarding a displaced extra-articular fracture in a 38, 58 and 75 year old patient, followed by a displaced intra-articular fracture in the same age groups. Those age groups were selected as it was considered that they would stimulate greater thought about decision making than if more extremes of age had been used.

Intervention was defined as any type of reduction and stabilisation, including manipulation and cast application.

Participants were asked to consider the functional outcome for each patient at three months after injury.

Question 1: Importance of parameters

Participants were asked to rank the parameters in order of importance on a visual analogue scale of 0 to 10 (0 = extremely unimportant, 10 = extremely important). Parameters were then ranked by median score and the results presented to the panel. Participants were asked if they agreed with the ranking. Consensus was defined as at least 70% agreement between participants.

Question 2: Thresholds for intervention

For each case vignette, panellists were asked at what measurement of displacement for each parameter they would intervene surgically. Agreement was then sought on the value at which intervention is required for each parameter by presenting the median value (from those scores independently offered in round one) alongside a scale of greater or lesser values. Where 70% agreed we accepted this as the point at which intervention should take place.

Question 3: Patient factors influencing decision making

Ten factors were presented to participants and they were asked to rate how important the factor is when deciding to intervene on a visual analogue scale of 0 to 10 (0 = extremely unimportant, 10 = extremely important). Factors were then ranked in order

of importance by median score. A factor with a median score of three or less was accepted to be not important. A median score with an inter-quartile range of two or less was accepted as consensus for that score according to RAND criteria. Participants were asked if they agreed with the ranking. Consensus of the ranking was defined as at least 70% agreement between participants. Qualitative analysis was performed on the free text answers and comments. Stability of participants' answers was analysed individually and between the three groups of panel members.

5.5.10 Results

Participant responses

56 surgeons were invited to take part. One declined and there was no response from nine after repeat reminders. 46 agreed to take part. 43 of those completed round one. All 43 who took part in round one then completed all rounds of the Delphi study.

Question 1: Importance of parameters

Ulnar variance was consistently rated as the most important extra-articular parameter with dorsal tilt rated as the second most important for all age groups.

Intra-articular step (joint surfaces not aligned properly) was rated as the most important intra-articular parameter for all age groups. The panel agreed with these ranking orders for all parameters.

The following traffic light system is used to illustrate agreement and importance:

Agreed and important
Agreed but considered less important
No agreement

Ranking of importance of radiographic parameters:

Parameter Ranking	Extra-articular	Intra-articular
1	Ulnar variance	Step
2	Dorsal tilt	Gap
3	Radial inclination	
4	Radial height	

Question 2: Thresholds for intervention

Agreement denotes the percentage of the expert panel who would intervene at this radiographic threshold.

Parameter Age	Ulnar variance	Dorsal tilt	Radial inclination	Radial height
38	3mm	10^0	10^0	5mm
agreement	84%	79%	90%	85%
58	3mm	10^0	10^0	5mm
agreement	74%	87%	82%	90%
75	4 / >5mm	20^0	10^0	5mm
agreement	50% / 42%	87%	91%	88%

Parameter Age	Step	Gap
38	2mm	3mm
	81%	84%
58	2mm	3mm
	76%	87%
75	3mm	4mm
	76%	79%

Consensus was obtained for all thresholds for intervention except ulnar variation in a 75 year old patient. For this case half of the panel would intervene at 4mm of positive ulnar variance whereas 42% would accept over 5mm of displacement.

Agreed thresholds were the same for all parameters for patients aged 38 and 58. There was no difference seen in thresholds between the three groups of participants

Question 3: Patient factors influencing decision making

Seven parameters were identified as important by the panel. Consensus was gained on the following rank order:

1. Mental capacity
2. Function
3. Medical co-morbidities
4. Age
5. Compliance with rehabilitation
6. Occupation

7. Fragility

Consistency was seen between rounds indicating that panel members did not significantly change their choices throughout the rounds. There was no difference seen in preferences between the three groups of participants.

5.5.11 Qualitative review

Analysis of free text and comments revealed the following themes:

- Restoring function is the main aim of treatment.
- Establishing pre-injury function is consequently a significant factor in decision making.
- Assessment of function is multidimensional and will involve discussion with patient and carers, subjective judgement by clinician, and may include some standard assessment tools.
- Occupation is sometimes a factor.
- Comorbidities and mental capacity may illustrate functional level but are not influential in their own right.
- Independence is an important threshold in this assessment.
- Age may suggest broad treatment modalities but is less significant than function in individual cases.
- Assessment of compliance is sometimes a factor and mental capacity is a factor in this.
- Fragility may influence type of treatment but not the need for treatment.

5.5.12 Recommendation

Through this Delphi process our panel of experts agreed that ulnar variance and dorsal tilt are the most important extra-articular parameters and step is the most important intra-articular parameter. Consensus was gained on thresholds for intervention for all parameters for the three age groups except ulnar variance in a 75 year old patient. Seven patient factors were thought to be important regarding whether to intervene surgically and rank order of importance was agreed reflecting the preinjury functional state.

6. FRACTURE CLINIC

6.1 RE-DISPLACEMENT AND INITIAL DISPLACEMENT

6.1.1 Introduction

The aim is to review whether the degree of initial radiographic displacement affected the likelihood of a DRF to displace over time. Radiographic outcomes were used in this review rather than functional outcome scores.

6.1.2 Review Question

Are patients with displacement on their initial radiographs and whose fractures are reduced more likely to displace than those whose fractures are not displaced on presentation?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius
Intervention	Conservative management
Comparison	Initial radiographic displacement
Outcomes	Radiographic displacement on follow up
Study Designs	Only case series available

6.1.3 Evidence

A total of 22 papers were reviewed for this question all of which were case series.
11 papers met the inclusion criteria. View here.

6.1.4 Evidence Statement

Level 3:
All 11 studies included found that initial displacement increased the chance of later displacement of a DRF.

6.1.5 Recommendation

Grade of recommendation: Grade D

Patients with a DRF that is displaced on their initial films may merit more vigilant follow up in clinic after reduction as they are at increased risk of subsequent re-displacement.

6.2 RE-DISPLACEMENT AND AGE OF PATIENT

6.2.1 Introduction

The aim is to review whether patient age affected the likelihood of a DRF to displace over time. Radiographic outcomes were used in this review rather than functional outcome scores.

6.2.2 Review Question

Are DRFs in patients over 50 years of age more likely to displace again than those under 50 years of age?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius
Intervention	Conservative management
Comparison	Age of patient
Outcomes	Radiographic displacement on follow up
Study Designs	Only case series available

6.2.3 Evidence

A total of 15 papers were reviewed for this question all of which were case series. Ten met the inclusion criteria. View here.

6.2.4 Evidence Statement

Level 3:
All ten studies included found that increasing age increased the chance of later displacement of a DRF.

6.2.5 Recommendation

Grade of recommendation: Grade D

Elderly patients with a DRF may merit more vigilant follow up in clinic as they are at increased risk of displacement if treated non-operatively.

6.3 RE-DISPLACEMENT AND COMMINUTION

6.3.1 Introduction

The aim is to review whether radiographic comminution predicted the likelihood of DRF displacement over time. Radiographic outcomes were used in this review rather than functional outcome scores.

6.3.2 Review Question

Are those with radiographic signs of comminution more likely to displace than those without?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius
Intervention	Conservative management
Comparison	Radiographic comminution *same comment as above*
Outcomes	Radiographic displacement on follow up
Study Designs	Only case series available

6.3.3 Evidence

A total of 19 papers were reviewed for this question all of which were case series. Seven papers met the inclusion criteria. View here.

6.3.4 Evidence Statement

Level 3 evidence.
Five of the seven studies included found that comminution correlated with final radiographic outcome.

6.3.5 Recommendation

Grade of recommendation: Grade D

Patients with a comminuted DRF may merit more vigilant follow up in clinic as they are likely to be at increased risk of subsequent displacement if treated non-operatively.

6.4 DOES THIS FRACTURE NEED A PLASTER CAST?

6.4.1 Introduction

The aim is to review whether fractures which were deemed by the treating surgeon to be stable would be better treated in a plaster or a removable splint.

6.4.2 Review Question

Is the functional outcome better with the use of a removable splint compared to standard plaster immobilisation?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius deemed to be stable radiographically

Intervention	Wrist immobilisation
Comparison	POP vs removable splint
Outcomes	Functional outcome scores
Study Designs	Randomised Controlled Trials

6.4.3 Evidence

A total of 11 papers were reviewed for this question.
Four papers met the inclusion criteria. View here.

6.4.4 Evidence Statement

Level 1:
Early functional scores better with removable splint but no difference in later scores.

6.4.5 Recommendation

Grade of recommendation: Grade B

Patients with a stable fracture of the distal radius should be considered for early mobilisation with a removable support once pain allows.

6.5 IN WHAT POSITION SHOULD A FRACTURED DISTAL RADIUS BE IMMOBILISED?

6.5.1 Introduction

The aim is to review the evidence for immobilising the fractured distal radius in any particular wrist position.

6.5.2 Review Question

Is the functional outcome better with a POP cast holding the wrist in neutral flexion compared to a POP cast holding the wrist in palmar flexion?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius.
Intervention	Plaster treatment
Comparison	Wrist position neutral vs palmar flexed in POP
Outcomes	Functional outcome scores

Study Designs	No study was of sufficient quality to be included

6.5.3 Evidence

A total of two papers were reviewed for this question.
Both failed to meet the inclusion criteria.

6.5.4 Evidence Statement

No evidence.

6.5.5 Recommendation

Best Practice Point:
When using a moulded POP cast or back slab to treat a DRF the wrist should be in neutral flexion with three-point moulding used to hold the fracture, rather than forced palmar flexion. This is supported by evidence that a palmar flexed position increases pressure in the carpal tunnel. In addition, a wrist that becomes stiff in palmar flexion is functionally less useful than one that is stiff in neutral or dorsiflexion. Reference: view here.

6.6 SHOULD FURTHER RADIOGRAPHS BE TAKEN AT 2-3 WEEKS FOLLOWING INJURY?

6.6.1 Introduction

The aim is to review whether radiographs of the wrist at two to three weeks following injury influenced the functional outcome of the patient.

6.6.2 Review Question

Do radiographs at two to three weeks following injury compared with no radiographs at that time, affect the patient reported outcome/functional outcome of the patient?

Population	Adults ≥16yrs of age who have sustained a dorsally displaced fracture of the distal radius
Intervention	Wrist radiographs at 2-3 weeks following injury
Comparison	No wrist radiographs at 2-3 weeks following injury
Outcomes	Functional outcome
Study Designs	No study was of sufficient quality to be included

6.6.3 Evidence

No evidence.

6.6.4 Evidence Statement

No evidence.

6.6.5 Recommendation

Best Practice Point:
No evidence can be found to support a benefit of radiographs at 2-3 weeks, but, as a best practice point, the GDG recommend repeat radiographs of the wrist between 1-2 weeks after injury (or manipulation) where it is thought that the fracture pattern is unstable AND when subsequent displacement will lead to surgical intervention.

6.7 WHEN SHOULD IMMOBILISATION BE DISCONTINUED?

6.7.1 Introduction

The aim of this question was to review the evidence regarding the best time to discontinue immobilisation of the wrist following a DRF.

6.7.2 Review Question

In patients with an unstable DRF is the functional outcome better if wrist mobilisation starts four weeks after the injury or six weeks after the injury?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius.
Intervention	Plaster treatment
Comparison	Earlier vs later mobilisation after plaster application
Outcomes	Functional outcome scores
Study Designs	No study was of sufficient quality to be included

6.7.3 Evidence

A total of five papers were reviewed for this question.
None of the studies met the inclusion criteria.

6.7.4 Evidence Statement

No evidence.

6.7.5 Recommendation

Best Practice Point:
When using a plaster cast to treat a DRF, consideration should be given to removing the plaster and starting wrist mobilisation four weeks after the injury rather than six.

The GDG felt this represented a balanced approach between the risk of further radiographic deterioration and earlier return to function.

6.8 WILL THE ANXIOUS PATIENT RECOVER LESS WELL?

6.8.1 Introduction

The aim is to review whether anxiety or catastrophising scores affected the functional recovery after a DRF.

6.8.2 Review Question

Does a high catastrophising/anxiety score affect the functional outcome?

Population	Adults ≥16yrs of age or older who have a fracture of the distal radius
Intervention	Any treatment modality
Comparison	Initial catastrophising or anxiety score
Outcomes	Functional outcome scores
Study Designs	Case series only

6.8.3 Evidence

A total of ten papers were reviewed for this question.
One paper met the inclusion criteria. View here.

6.8.4 Evidence Statement

Level 3 evidence.
No correlation between anxiety and catastrophising scores and poor functional outcomes after DRFs was found in the one study included.

6.8.5 Recommendation

Best Practice Point:

No recommendation can be made regarding this issue on the currently available evidence. Best practice would suggest that patients who seem more anxious or concerned following a DRF are given adequate support whilst recovering from their injury.

6.9 RADIOGRAPHS AT THE TIME OF REMOVING IMMOBILISATION

6.9.1 Introduction

The aim of this question was to determine whether radiographs of the wrist at the time of removing immobilisation for a non-operatively managed DRF influence the patient reported or functional outcome of the patient.

6.9.2 Review Question

How do radiographs at the time of removing immobilisation, compared with no radiographs at this time, affect the patient reported outcome?

Population	Adults ≥16yrs of age who have undergone non-operative management for a fracture of the distal radius
Intervention	Wrist radiographs at the time of removing immobilisation
Comparison	No wrist radiographs at the time of removing immobilisation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

6.9.3 Evidence

No randomised controlled trials or cohort studies were found for this review question.

6.9.4 Evidence Statement

No evidence was found on the effect of radiographs at the time of immobilisation removal and the functional or patient reported outcome following a non-operatively managed fracture of the distal radius.

6.9.5 Recommendation

Best Practice Point:

A radiograph of the patient's wrist at the time of removing immobilisation is not required unless there is clinical concern.

7. SURGERY

The baseline functional demands of the patient, the consequences of mal-union, and the potential risks of surgery need to be considered when assessing the role of surgical intervention. The following factors are considered:

- Early surgical intervention.
- Non-operative management.
- The outcome following mal-union.
- The indications and benefits of various surgical techniques.
- The effect of a concomitant distal ulnar styloid fracture.

7.1 TIMING OF SURGERY

7.1.1 Introduction

It is possible that a delay in surgery for a DRF may lead to complications e.g. pain or CRPS, and subsequently an inferior outcome for the patient. The aim is to review whether the timing of surgical intervention for a DRF influences the patient reported outcome score. A time cut-off of two weeks was chosen by consensus with the GDG.

7.1.2 Review Question

How does early surgical intervention (up to 2 weeks following injury) compare with delayed surgical intervention (>2 weeks following injury) in terms of the PROMs?

Population	Adults ≥16yrs of age or older requiring surgical intervention for a fracture of the distal radius
Intervention	Surgery more than 2 weeks following injury
Comparison	Surgery up to 2 weeks following injury
Outcomes	PROMs Functional outcome Complications

Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

7.1.3 Evidence

No randomised controlled trials or cohort studies or case series were found for this review question.

7.1.4 Evidence Statement

No evidence was found on the effect of timing of surgical intervention and the functional or patient reported outcome following a DRF.

The NICE Guidelines recommend surgical intervention is performed within 72 hours of injury for intra-articular fractures and within one week for extra-articular fractures. When operative management is required for re-displacement following manipulation, surgery should be undertaken within 72 hours of the decision to operate. (NICE Non-complex Fracture Guidelines https://www.nice.org.uk/guidance/NG38/chapter/Recommendations#ongoing-orthopaedic-management)

7.1.5 Recommendation

Best Practice Point:
When surgery is indicated the patient is best served by prompt intervention by the appropriate surgeon, as delay confers no benefit to the patient's recovery. The patient is to be fully involved and informed of all options, recommended guidelines and potential risks.

7.2 NON-OPERATIVE VERSUS OPERATIVE MANAGEMENT

7.2.1 Introduction

The aim is to review how non-operative management compared with surgery for a dorsally displaced fracture of the distal radius in terms of the patient reported outcome. Studies were categorised according to age following discussion within the committee – up to 50 years of age and over 50 years of age were the two categories.

7.2.2 Review Question

How does surgical intervention (volar plate fixation, (non-) bridging external fixation, K-wires) compare with non-operative management (including closed reduction) in terms of the patient reported outcome?

Population	Adults ≥16yrs of age who have sustained a dorsally displaced fracture of the distal radius

Intervention	Surgery (volar plate fixation, (non-)bridging external fixation, K-wires)
Comparison	Non-operative management (including closed reduction)
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

7.2.3 Evidence

A total of 27 papers were reviewed for this question, including 20 RCTs and seven cohort studies. Of these, five met our inclusion criteria and were graded acceptable. View here.

7.2.4 Evidence Statement

Level 1+:
Based on the current literature, there is no evidence supporting any treatment option for the population under the age of 50 years and up to 65 years. However, for patients over the age of 65 years, there is evidence that operative intervention does not provide a superior outcome to non-operative management when measured by PROMs at one year.

7.2.5 Recommendation

Grade of Recommendation: Grade A
In patients 65 years of age or older, non-operative treatment can be considered as a primary treatment for displaced DRFs. However, other factors such as pre-injury function, medical comorbidities and fracture characteristics should be considered and options discussed with the patient.

7.3 MANIPULATION UNDER ANAESTHESIA WITH K-WIRES VERSUS OPEN REDUCTION AND INTERNAL FIXATION

7.3.1 Introduction

The aim is to review how manipulation and K-wire fixation compared with open reduction internal fixation for a dorsally displaced DRF in terms of the PROMs. Studies were categorised according to age following discussion within the committee – up to 50 years of age and over 50 years of age.

7.3.2 Review Question

How does surgical intervention with manipulation and K-wire fixation compare with open reduction internal fixation in terms of the PROM?

Population	Adults ≥16yrs of age who have sustained a dorsally displaced fracture of the distal radius
Intervention	Manipulation and K-wire fixation
Comparison	Open reduction internal fixation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

7.3.3 Evidence

A total of 16 papers were reviewed for this question, including one meta-analysis, nine RCTs, five cohort studies and one economic evaluation. Of these, three were high quality and three were acceptable and met the inclusion criteria. However, as four of these studies were included as part of the high-quality meta-analysis, the details of only two studies can be reviewed. View here.

7.3.4 Evidence Statement

Level 1+:
In dorsally displaced DRFS that can be reduced closed and where surgery might be considered, there is evidence that open reduction internal fixation does not provide a superior outcome to K-wire fixation when measured by PROMs at one year. There is insufficient evidence to draw conclusions about the best management of unstable DRFs which cannot be satisfactorily reduced closed.

7.3.5 Recommendation

Grade of Recommendation: Grade A
When surgery is needed for dorsally displaced DRFs that can be reduced closed, offer K-wire fixation and cast.

Best Practice Point:
For DRFs that require open reduction, or for those with an intra-articular step or gap which is unable to be satisfactorily reduced closed, open reduction and fixation can be considered.

7.4 EXTERNAL FIXATION VERSUS OPEN REDUCTION AND INTERNAL FIXATION

7.4.1 Introduction

The aim is to review how external fixation compared with open reduction internal fixation for a dorsally displaced DRF in terms of the PROM. Studies were categorised according to age following discussion within the committee – up to 50 years of age and over 50 years of age.

7.4.2 Review Question

How does surgical intervention with external fixation compare with open reduction internal fixation in terms of the patient reported outcome?

Population	Adults ≥16yrs of age who have sustained a dorsally displaced fracture of the distal radius
Intervention	External fixation
Comparison	Open reduction internal fixation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

7.4.3 Evidence

A total of 25 papers were reviewed for this question, including 13 RCTs, seven cohort studies, four meta-analyses/systematic reviews and one economic evaluation. Of these, three were high quality and ten were acceptable and met the inclusion criteria. However, as five of these studies were included as part of the high-quality meta-analyses, the details of only eight studies can be reviewed. View here.

7.4.4 Evidence Statement

Level 1+++:
Open reduction and internal fixation is associated with better early functional outcomes and a lower risk of complications when compared with external fixation.

7.4.5 Recommendation

Grade of Recommendation: Grade A

External fixation should not be used as the definitive treatment of closed DRFs where open reduction and internal fixation of the fracture fragments is possible.

7.5 CONCOMITANT DISTAL ULNAR STYLOID FRACTURE MANAGEMENT

7.5.1 Introduction

The aim is to review how non-operative management compared with surgery for a concomitant fracture of the distal ulna in patients with a surgically managed DRF in terms of the PROM.

7.5.2 Review Question

How does concomitant distal ulnar styloid fracture fixation compare with no treatment in terms of the PROM?

Population	Adults ≥16yrs of age with a surgically managed distal radius fracture and a concomitant fracture of the distal ulna
Intervention	Non-operative management
Comparison	Surgery
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

7.5.3 Evidence

A total of four papers were reviewed for this question, all of which were cohort studies. Of these, two met the inclusion criteria. View here.

7.5.4 Evidence Statement

Level 2:
Non-operative treatment of an ulnar styloid fracture associated with a DRF and a stable DRUJ produces the same outcome as an isolated DRF.

7.5.5 Recommendation

Grade of Recommendation: Grade D
In the presence of a DRF with a stable DRUJ it is not necessary to fix an ulnar styloid fracture.

Best Practice Point:
Stability of the DRUJ should be assessed and recorded after surgical treatment of DRFs.

8. REHABILITATION

Many patients are referred to a rehabilitation provider following a DRF in order to optimise return to function.

The questions are divided into two sections with recommendations at the end and will consider how functional outcome after DRF is affected by:

1. The impact of providing rehabilitation during the immobilisation period
2. The impact of providing rehabilitation after definitive treatment implementation (surgically and non-surgically managed patients)
   And then:
3. The type of rehabilitation intervention
4. The mode of rehabilitation delivery
5. The discipline of the rehabilitation provider

8.1 REHABILITATION WHILST IN CAST

8.1.1 Introduction

The aim is to review whether rehabilitation provided during the casting period for patients with non-operatively managed DRFs impacted on patient reported and functional outcome.

8.1.2 Review Question

How does rehabilitation whilst in cast versus no rehabilitation affect functional outcome?

Population	Adults ≥16yrs of age who have sustained a distal radius fracture and managed non-operatively
Intervention	Rehabilitation during period in cast
Comparison	No rehabilitation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.1.3 Evidence

Three studies were examined for this question. Two studies were randomised controlled trials and were described and evaluated in the third study, a systematic review. View here.

8.1.4 Evidence Statement

Level 1:
There is insufficient evidence for or against any form of rehabilitation whilst the patient is being managed with wrist immobilisation (in cast or external fixator) after DRF.

8.2 REHABILITATION FOLLOWING DEFINITIVE TREATMENT OF DRFs

8.2.1 Introduction

The aim is to review whether rehabilitation following definitive management (wrist immobilisation for non-surgically or surgically managed patients) impacted on patient reported or functional outcome when compared to no rehabilitation provision.

8.2.2 Review Question – non-surgically managed patients

How does rehabilitation following cast removal versus no rehabilitation affect functional outcome?

Population	Adults ≥16yrs of age with a non-surgically managed DRF
Intervention	Rehabilitation following cast removal
Comparison	No rehabilitation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.2.3 Evidence

Three studies were examined for this question. Two studies were randomised controlled trials and were described and evaluated in the third study, a systematic review. View here.

8.2.4 Evidence Statement

Level 1:
There is insufficient evidence for or against any form of rehabilitation after removal of cast for patients with DRFs managed non-operatively.

8.3 REHABILITATION IN SURGICALLY MANAGED PATIENTS

8.3.1 Introduction

The aim is to review if there was any functional difference in these patients treated surgically with rehabilitation or without rehabilitation.

8.3.2 Review Question

How does rehabilitation versus no rehabilitation affect functional outcome?

Population	Adults ≥16yrs of age with a surgically managed DRF
Intervention	Rehabilitation
Comparison	No rehabilitation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.3.3 Evidence

No randomised controlled trials or cohort studies were found for this review question.

8.3.4 Evidence Statement

No evidence was found on the effect of rehabilitation provision on patient reported and functional outcome following surgical management of a DRF when compared to no rehabilitation provision.

8.3.5 Recommendation

Best Practice Point:
It is not uncommon for pain and oedema to occur following distal radius fracture whether treated non-operatively or operatively. Information regarding the signs and symptoms of common complications should be given along with a simple self-directed

management plan. Patients should be provided with advice and education to manage pain and oedema, and to prevent loss of motion at the fingers, thumb, elbow and shoulder. Immobilisation casting should allow a full fist to be achieved with the fingers and the patient can be encouraged to use the injured limb whilst the wrist is immobilised for light functional activities, including self-care and tasks such as typing.

Patients who experience disproportionate levels of pain / oedema / loss of motion or delayed functional recovery should be referred to physiotherapy / occupational therapy after clinical assessment for further instruction and treatment.

8.4 TYPE OF REHABILITATION INTERVENTION, MODE OF DELIVERY AND DISCIPLINE OF DELIVERER

8.4.1 Introduction

The aim is to review if any particular type of intervention, mode in which rehabilitation was delivered, or the discipline of the provider influenced patient reported or functional outcome.

8.4.2 Review Question – Type of Intervention

Does any single rehabilitation intervention affect functional outcome more than any other rehabilitation intervention?

Population	Adults ≥16yrs of age or older with a DRF
Intervention	Any rehabilitation intervention
Comparison	Any other rehabilitation intervention
Outcomes	PROMs Functional outcome
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.4.3 Evidence

Six papers were identified for this question. Five papers reported randomised controlled trials and one was a systematic review. One of the randomised controlled trials was included in the systematic review. The remaining five studies and the systematic review can be viewed here.

8.4.4 Evidence Statement

Level 1:

There is insufficient evidence to suggest any one rehabilitation intervention is superior to any other rehabilitation intervention to restore function following an acute DRF.

8.4.5 Review Question – Mode of Delivery

Does any form of rehabilitation delivery affect functional outcome more than any other form of rehabilitation delivery?

Population	Adults ≥16yrs of age who have sustained a DRF
Intervention	Any one form of rehabilitation
Comparison	Any other form of rehabilitation
Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.4.6 Evidence

Seven studies were reviewed for this question. Of these, five were randomised controlled trials and two were systematic reviews. All of the randomised controlled trials were reported in the systematic reviews can be viewed here.

8.4.7 Evidence Statement

Level 1:
There is insufficient evidence that formal physiotherapy or occupational therapy is more likely to restore function versus a home exercise or group programme in patients that have sustained uncomplicated DRFs.

8.4.8 Review Question – Discipline of Provider

Does provision of rehabilitation by any one health discipline affect functional outcome more than any other health discipline?

Population	Adults ≥16yrs of age who have sustained a DRF
Intervention	Rehabilitation provided by any one health discipline
Comparison	Rehabilitation provided by any other health discipline

Outcomes	PROMs Functional outcome Complications
Study Designs	Meta-analyses, systematic reviews, RCTs, cohort studies

8.4.9 Evidence

No randomised controlled trials or cohort studies were found for this review question.

8.4.10 Evidence Statement

There is no evidence that rehabilitation provided by one health professional over another affects patient reported outcome or function following a DRF.

8.4.11 Recommendations on Type of Rehabilitation Intervention, Mode Of Delivery And Discipline Of Deliverer

Patients who identify with ongoing pain, limited range of movement and/or inability to return to function should be referred for rehabilitation. Rehabilitation should be delivered by a health care specialist with the appropriate level of knowledge and skills to address the various problems that can arise following distal radius fracture, ranging from loss of finger motion to reduced strength to complex regional pain syndrome. Choice of intervention should consider the patient's roles and responsibilities as well as physical impairments. Education and rehabilitation programmes should be delivered in a timely manner and in a variety of forms to suit the patient's specific needs.

9. FRAGILITY FRACTURES

9.1 Introduction

The vast majority of DRFs can be considered fragility fractures, and the importance of both recognising the underlying pathology (osteopenia or osteoporosis-bone health), and the cause (falling) is essential part of the treatment. This can lead to prevention of future, more debilitating injuries such as vertebral or hip fractures, which are associated with significant morbidity and mortality. The DRF is usually the first medical presentation of these, and the opportunity to prevent future injury.

Fragility fractures are low-energy fractures resulting from everyday activities, with either no trauma or a fall from standing height or less[1]. Underlying contributing factors include both bone fragility and tendency to fall, both of which can be significantly increased in older adults. With an aging population, all fracture clinics should have embedded screening for bone health and falls risk and a clear onward referral pathway to falls and fracture liaison services.

The common sites of fragility fracture are hip, spine, proximal humerus and distal forearm; they affect up to one-half of women and one-third of men over age fifty, and lead to increased disability, dependence, morbidity, mortality and poorer quality of life scores in older people.

DRF is the commonest type of fracture in perimenopausal women and is associated with an increased risk of later non-wrist fracture of up to one in five in the subsequent decade[2].

9.2 Treat the first fracture, prevent the second

Primary prevention of DRFs is possible. In a very large US study[3] examining >500,000 records from US Healthcare Management Organisations (HMOs), screening for, and pharmacologic management of, osteoporosis using a multidisciplinary team approach in a comprehensive osteoporosis management program resulted in a statistically significant decrease in the risk of distal radius fracture.

However, this primary prevention is beyond the remit of orthopaedic services who will not have contact with the patient until an index fracture has been sustained. Once a patient presents with a fragility fracture a proactive approach to secondary prevention is vital – ***treat the first fracture, prevent the second.***

When an older person sustains a DRF what additional elements should be addressed to prevent future falls and injury? The orthopaedic surgeon may be the only doctor they see – rarely will a physician or geriatrician be involved in an uncomplicated distal radius fracture – orthopaedic services thus have a vital role to play in recognising and using the first fracture as a trigger to prevention of future fractures. Many patients will be unaware of their elevated risk profile and should be fully informed of the need for preventative action and onward referral.

9.3 Bone health and fracture prevention

Fragility fractures are often associated with low bone density, but many occur in osteopaenic rather than osteoporotic bone density values.

NICE CG 146 Osteoporosis: Assessing the risk of fragility fracture[4] NICE recommends targeting risk assessment to the following groups. (Box 1).

In the case of low energy DRFs risk assessment will apply to all aged 50 or over, and younger if they have major risk factors.

The guidance now recommends that a 10-year assessment of absolute fracture risk be undertaken in addition, and prior to, Bone Mineral Density (BMD) assessment with

Box 1 NICE CG 146

TARGETING RISK ASSESSMENT

1.1 Consider assessment of fracture risk:

- In all women aged 65 years and over and all men aged 75 years and over
- In women aged under 65 years and men aged under 75 years in the presence of risk factors, for example:
  - previous fragility fracture
  - current use or frequent recent use of oral or systemic glucocorticoids
  - history of falls
  - family history of hip fracture
  - other causes of secondary osteoporosis[7]
  - low body mass index (BMI) (less than 18.5 kg/m2)
  - smoking
  - alcohol intake of more than 14 units per week for women and more than 21 units per week for men.

1.2 Do not routinely assess fracture risk in people aged under 50 years unless they have major risk factors (for example, current or frequent recent use of oral or systemic glucocorticoids, untreated premature menopause or previous fragility fracture), because they are unlikely to be at high risk.

dual–energy X-ray absorptiometry (DXA) scanning. Treatment decisions should be based on fracture risk not BMD alone. Situations where assessments may underestimate risk are noted, including age >80, multiple fractures, glucocorticoid use, alcohol, some medications, living in care home. (Box 2)

Box 2 NICE CG 146

METHODS OF FRACTURE RISK ASSESSMENT

1.1 Estimate absolute risk when assessing risk of fracture (for example, the predicted risk of major osteoporotic or hip fracture over 10 years, expressed as a percentage).

1.2 Use either FRAX[8] (without a bone mineral density [BMD] value if a dual-energy X-ray absorptiometry [DXA] scan has not previously been undertaken) or QFracture[9], within their allowed age ranges, to estimate 10-year predicted absolute fracture risk when assessing risk of fracture. Above the upper age limits defined by the tools, consider people to be at high risk.

1.3 Interpret the estimated absolute risk of fracture in people aged over 80 years with caution, because predicted 10-year fracture risk may underestimate their short-term fracture risk.

1.4 Do not routinely measure BMD to assess fracture risk without prior assessment using FRAX (without a BMD value) or QFracture.

1.5 Following risk assessment with FRAX (without a BMD value) or QFracture, consider measuring BMD with DXA in people whose fracture risk is in the region of an intervention threshold[10] for a proposed treatment, and recalculate absolute risk using FRAX with the BMD value.

1.6 Consider measuring BMD with DXA before starting treatments that may have a rapid adverse effect on bone density (for example, sex hormone deprivation for treatment for breast or prostate cancer).

1.7 Measure BMD to assess fracture risk in people aged under 40 years who have a major risk factor, such as history of multiple fragility fracture, major osteoporotic fracture, or current or recent use of high-dose oral or high-dose systemic glucocorticoids (more than 7.5 mg prednisolone or equivalent per day for 3 months or longer).

1.8 Consider recalculating fracture risk in the future:

- if the original calculated risk was in the region of the intervention threshold[11] for a proposed treatment and only after a minimum of 2 years, **or**
- when there has been a change in the person's risk factors.

1.9 Take into account that risk assessment tools may underestimate fracture risk in certain circumstances, for example if a person:

- has a history of multiple fractures
- has had previous vertebral fracture(s)
- has a high alcohol intake
- is taking high-dose oral or high-dose systemic glucocorticoids (more than 7.5 mg prednisolone or equivalent per day for 3 months or longer)
- has other causes of secondary osteoporosis[7].

1.10 Take into account that fracture risk can be affected by factors that may not be included in the risk tool, for example living in a care home or taking drugs that may impair bone metabolism (such as anti-convulsants, selective serotonin reuptake inhibitors, thiazolidinediones, proton pump inhibitors and anti-retroviral drugs).

9.4 Falls Prevention

Asking about falls is important. A current fall is a predictor of future falls, and similarly a current fragility fracture is a predictor of future fragility fractures. **NICE**

falls guidance CG161 (2013)[Error! Reference source not found.] include the following r ecommendations for older people (aged >65 years):

- Older people in contact with healthcare professionals should be asked routinely whether they have fallen in the past year and asked about the frequency, context and characteristics of the fall/s. [2004]
- Older people who present for medical attention because of a fall, or report recurrent falls in the past year, or demonstrate abnormalities of gait and/or balance should be offered a multifactorial falls risk assessment. This assessment should be performed by a healthcare professional with appropriate skills and experience, normally in the setting of a specialist falls service. This assessment should be part of an individualised, multifactorial intervention. [2004]

A history of either frequent falls or those with obvious poor balance should be highlighted to their general practitioner for onward referral to local falls services.

There is a strong evidence base for multi-factorial falls prevention interventions in reducing the risk of future falls and of reducing fear of falling whilst increasing independence and self-efficacy of fallers. The fracture clinic should have a pathway agreed with local primary care services for referring on for appropriate falls assessment and interventions. A typical evidence-based falls prevention exercise programme will last at least 4-6 months and involve participation of at least 50 hours to be effective[5].

9.5 Fracture Liaison Services

Fracture Liaison services are co-ordinator based clinical systems developed to ensure appropriate management of patients following fracture. Fracture liaison usually involves a dedicated co-ordinator to liaise between the orthopaedic team, patient and other specialities, usually arranging for BMD testing, treatment recommendation and/ or initiation and follow up. Some programmes also address falls assessments and onwards referral.

The development of effective Fracture Liaison Services in the UK is being encouraged by a national quality initiative – the Fracture Liaison Service Database (FLS-DB)[6], a new national audit commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the Falls and Fragility Fracture Audit Programme (FFFAP)[7].

A Fracture Liaison Service should submit data to the new database. Eligibility requires a service that systematically identifies eligible patients aged over 50 years who have suffered a fragility fracture and treats or refers them to appropriate services with the

aim of reducing their risk of subsequent fractures. i.e. meeting the description of a Fracture Liaison Service.

10. OUTCOME MEASURES

MEASUREMENT PROPERTIES OF PATIENT-REPORTED OUTCOME MEASURES IN THE SETTING OF ADULT PATIENTS WITH DISTAL RADIUS FRACTURES

10.1 Introduction

Assessing outcome is an inherent way of determining the comparative effectiveness of interventions. Interest in the patient's view of their treatment has increased dramatically. Questionnaires known as PROMS which elicit information from patients are becoming the mainstay of clinical studies.

The aim of this review was to critically appraise the evidence concerning the measurement properties of questionnaires used to capture self-reported outcome in the setting of adult patients with DRFs.

10.2. Review Question

In the setting of adult patients with DRFs, what is the evidence for the measurement properties of questionnaires used to capture patient self-reported symptoms and musculoskeletal disability and/or function?

The review question included four key elements. (Table 10.5.1)

Table 10.5.1 Key elements of the review question

Measurement instruments of interest	Self-reported patient questionnaires used to capture outcome in studies of adult patients with distal radius fractures.
Construct of interest	Patient self-reported symptoms and musculoskeletal disability and/or function, defined according to the developers of the instrument.
Population of interest	Adult patients with DRFs.
Measurement properties	The measurement properties are divided over three domains: reliability, validity, and responsiveness [5].

10.3. Methods

The development of an agreed standardised collection of outcomes is known as a Core Outcome Set (COS). This involves a rigorous process of stakeholder consensus, backed by reviews of existing knowledge. A COS for reporting outcome in clinical trials of DRF treatment does not as yet exist.

A core set of domains in the setting of adult distal radius fractures is reported by one group, the Distal Radius Working Group of the International Society for Fracture Repair (ISFR) and the International Osteoporosis Foundation (IOF) group [1].

Consensus within our committee was that the methodology reported by Goldhanh et al. [2] was not as robust as core outcome processes such as supported by initiatives like the Core Outcome Measures in Effectiveness Trials (COMET) or the Outcome Measures in Rheumatology (OMERACT) Initiatives. In addition, recommendations for the use of specific patient–reported measurement tools were made without critical appraisal of their measurement properties in the population of interest [1].

In order to clarify the later, a systematic review was performed with the aim to critically appraise, compare and summarise the evidence on measurement properties of patient-reported questionnaires used to capture outcome in studies of adult patients with DRFs. The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) Initiative provides a framework for this process [2-4]. Goldhahn J, Beaton D, Ladd A, Macdermid J, Hoang-Kim A. Recommendation for measuring clinical outcome in distal radius fractures: a core set of domains for standardized reporting in clinical practice and research. Arch Orthop Trauma Surg. 2014 Feb;134(2):197-205.. As part of this initiative, the COSMIN group developed a critical appraisal tool (a checklist) containing standards for evaluating the methodological quality of studies on the measurement properties of health measurement instruments (http://www.cosmin.nl/Systematic%20reviews%20of%20measurement%20properties.html). Details of the review protocol, including the quality appraisal process, are registered on PROSPERO and can be accessed at http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016029424.

Combining results of different studies on a measurement property of an instrument is only possible when the studies are sufficiently similar with regards to study population and setting, the (language) version of the questionnaire used and the form of administration. Conclusions should be drawn from studies with sufficient homogeneity.

10.4 Eligibility Criteria

Study inclusion criteria were as follows:

(a) Studies concerning questionnaires aiming to measure patient self-reported symptoms and musculoskeletal disability and/or function, according to the developers of the questionnaires.

(b) Study population (or population subgroup) concerning specifically adult patients with DRFs.

(c) Aim of the study is the development of a measurement instrument or the evaluation of one or more of its measurement properties.

(d) Studies concerning the measurement properties over any of three domains: reliability, validity, and responsiveness; measurement properties as defined by the COSMIN group [5].

(e) Questionnaires which are self-reported.

(f) Studies published as a full text original article in the English language.

Study exclusion criteria were as follows:

(a) Studies in patient populations with other hand or wrist conditions.

(b) Studies of populations which include a subgroup of patients with DRF, but do not report specific results for the subgroup.

(c) Trials or studies evaluating the effectiveness of interventions where a questionnaire is used as an endpoint (without studying the measurement properties).

(d) Studies in which the instrument of interest is used in the validation process of another instrument.

10.5 Evidence

The search strategy returned 4667 citations. 4519 studies were excluded by title/abstract and, after removal of duplicates, 66 full-text articles were retrieved for further review. Twelve studies were included in the final review. The included studies evaluated the measurement properties in the setting of adult patients with DRFs of five PROMs, including the Patient Rated Wrist Evaluation (PRWE) [6], Disability of the Arm Shoulder and Hand Outcome Measure (DASH) [7], Patient Evaluation Measure (PEM) [8], Michigan Hand Questionnaire (MHQ) [9] and Short version of MHQ [10.] Details of included studies assessing the above PROM questionnaires in the English language are found in Table 10.5.2 below. Further included studies assessing the measurement properties of the PROM questionnaires in languages other than English are found in (Table 12.6.1). The results of measurement properties found for English language PROMs in adults with a DRF are listed in (Table 12.6.2). The methodological quality per study and measurement property in accordance to the COSMIN framework [2-4] is presented in Appendix 12.5 (Table 12.6.3)

Table 10.5.2 Included studies assessing PROMs in the English Language

Study	PROM	Questionnaire Language	Patients	Measurement properties assessed
MacDermid et al. (1998)[5]	PRWE	English	Adults (n=59)	Reliability Structural Validity Criterion Validity
Waljee et al. (2011)[9]	Brief MHQ	English	Adults (n=132)	Responsiveness
MacDermid et al. (2000)[10]	PRWE DASH	English	Adults (n=64)	Responsiveness
Forward at al. (2007)[11]	PEM	English	Adults (n=200)	Internal Consistency Content Validity
Kotsis et al. (2007)[12]	MHQ	English	Adults (n=96)	Responsiveness

10.6 Evidence Statement

There is insufficient evidence to recommend one optimal PROM in the setting of adults patients with DRFs. A substantial amount of information on the measurement properties of PROMs used in this setting is still lacking or has been assessed in studies of poor methodological quality according to the COSMIN framework. No PROM questionnaire has been fully evaluated in terms of its measurement properties in our population of interest; the majority of measurement properties have yet to be assessed. Most available evidence was for questionnaire languages other than English.

In the English language, there was moderate positive evidence for the reliability and responsiveness of the PRWE and for the responsiveness of the DASH. There was limited positive evidence for the responsiveness of the MHQ and the Brief MHQ. Other measurement properties were either not examined, or the level of evidence was "unknown due to poor methodological quality". The PEM was examined only for internal consistency and content validity; the level of evidence for the PEM was "unknown due to poor methodological quality" as per the COSMIN appraisal checklist (Table 12.6.4).

Patient-reported questionnaires used for capturing outcome in the setting of adult patients with distal radius fractures should be subjected to further scrutiny. Future studies should aim to supplement existing knowledge by evaluating unknown measurement properties, utilising an appropriate quality framework, such as COSMIN, to guide study design.

10.7 Recommendation

Best Practice:

There is insufficient evidence to recommend the optimal PROM for capturing outcomes in studies of adult patients with DRFs. However, pending future research, an interim recommendation can be made for the use of either the PRWE or the DASH, based on available evidence for responsiveness in this setting.

10.8 Further Research

A UK consensus for a core outcome set for adult patients with DRFs should be developed. This process needs to be inclusive of all relevant stakeholder groups affected by DRFs or involved in their treatment and rehabilitation and use transparent methodology defined a priori via detailed protocol. The process should be informed by systematic reviews of patient-reported and performance outcome measures.

11 Methodology

Back

SIGN methodology for the development of guidelines was utilised. This involved an iterative process, including papers of sequentially lower grade, until no evidence was available. Highest grade evidence was sought from papers using the following PROMs:

Patient Rated Wrist E score (PRWE)
The Disabilities of the Arm, Shoulder and Hand (DASH) or Quick DASH score
Patient Evaluation Measure (PEM)
Gartland and Werley score

The search criteria were based on the PICO format and all searches performed on the same day:

Patients or population to which the question applies
Intervention (or diagnostic test, exposure, risk factor, etc.) being considered in relation to these patients
Comparison(s) to be made between those receiving the intervention and another group who do not receive the intervention
Outcome(s) to be used to establish the size of any effect caused by the intervention.

NICE methodology was used to categorise papers identified for review.

SIGN checklists used to grade different paper types:

Systematic reviews checklist
13 questions – 11 internal validity, 2 overall assessment
Controlled trial checklist
13 questions – 10 internal validity, 3 overall assessment
Case Control checklist
14 questions – 11 internal validity, 3 overall assessment

Cohort studies checklist

17 questions – 14 internal validity, 3 overall assessment

Paper accepted if:

Systematic review –
Controlled trial –
Case control –
Cohort studies –
Case control – score of 11 or more on the Institute of Health Economics (Canada) checklist.

11.1 Search Strategy

11.1.1 Emergency Department

1 Cochrane central register of clinical trials search strategy

#1 MeSH descriptor: [Radius Fractures] explode all trees

#2 MeSH descriptor: [Wrist Injuries] explode all trees

#3 Radius near fracture in Title, Abstract and Keywords

#4 Distal near radius in Title, Abstract and Keywords

#5 Colles in Title, Abstract and Keywords

#6 #1 OR #2 OR #3 OR #4 OR #5

2 Medline search strategy

#1 radius fracture [MeSH]

#2 wrist injuries [MeSH]

#3 Colles' fracture [MeSH]

#4 radius [tiab]

#5 wrist* [tiab]

#6 Colles' [tiab]

#7 #1 OR #2 OR #3 OR #4 OR #5 OR #6

#8 fractur*[tiab]

#9 adult [MeSH]

#10 adult [tiab]

#11 #8 OR #9 OR #10

#12 “Animals”[MeSH] NOT ”Humans”[MeSH] AND “Animals”[MeSH])

#13 #11 NOT #12

#14 #7 AND #11 AND #13

3 EMBASE search strategy

1. exp RADIUS FRACTURE/

2. exp WRIST FRACTURE/

3. exp COLLES FRACTURE/

4. (radius adj4 fracture*).ti,ab

5. (radial adj4 fracture*).ti,ab

6. (wrist adj4 fracture*).ti,ab

7. (Colles adj2 fracture*).ti,ab

8. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7

9. 8 [Limit to: (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]

4 CINAHL search strategy

1. exp RADIUS FRACTURES/

2. exp WRIST FRACTURES/

3. (radius adj4 fracture*).ti,ab

4. (radial adj4 fracture*).ti,ab

5. (wrist adj4 fracture*).ti,ab

6. (Colles adj2 fracture*).ti,ab

7. 1 OR 2 OR 3 OR 4 OR 5 OR 6

8. 7 [Limit to: (Age Groups All Adult)]

Vitamin C

"ascorbate*".ti,ab
"L-ascorbic acid*".ti,ab
"vitamin c".ti,ab;

Effect of manipulation

"manipulation*".ti,ab
“MUA” .ti,ab
“Manipulation under anaesthetic”.af
"reduction*".ti,ab
AND
"complication*".ti,ab
OR
"surgery*".ti,ab

Radiographic parameters and function
DISPLACEMENT.ti,ab;
TILT.ti,ab;
ANGULATION.ti,ab;
TRANSLATION.ti,ab;
SHORTENING.ti,ab;
ROTATION.ti,ab;
IMPACTION.ti,ab;
COMMINUTION.ti,ab;
AND
FUNCTION*.ti,ab
OR
OUTCOME*.ti,ab

11.1.2 Fracture Clinic

Anxiety

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.

4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; ANXIETY/; 15529 results.
10. CINAHL; anxi*.ti,ab; 26934 results.
11. CINAHL; catastrophi*.ti,ab; 2166 results.
12. CINAHL; 9 OR 10 OR 11; 34861 results.
13. CINAHL; 8 AND 12 [Limit to: (Age Groups All Adult)]; 6 results.

1. EMBASE; exp RADIUS FRACTURE/; 7281 results.
2. EMBASE; exp WRIST FRACTURE/; 4241 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4060 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2274 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1639 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13871 results.
9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6258 results.
10. EMBASE; CATASTROPHIS*.ti,ab; 215 results.
11. EMBASE; ANXIETY.ti,ab; 155764 results.
12. EMBASE; 10 OR 11; 155911 results.
13. EMBASE; 9 AND 12 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 15
results.
14. EMBASE; CATASTROPHISING/; 1120 results.
15. EMBASE; Catastrophi*.ti,ab; 14857 results.
16. EMBASE; ANXI*.ti,ab; 173392 results.
17. EMBASE; ANXIETY/; 122568 results.
18. EMBASE; 14 OR 15 OR 16 OR 17; 221713 results.
19. EMBASE; 13 AND 18 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 15 results.

1. MEDLINE; exp RADIUS FRACTURES/; 7455 results.
2. MEDLINE; exp WRIST INJURIES/; 5240 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34451 results.
5. MEDLINE; wrist*.ti,ab; 26591 results.
6. MEDLINE; Colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63584 results.
8. MEDLINE; fractur*.ti,ab; 177931 results.
9. MEDLINE; exp ADULT/; 5628420 results.
10. MEDLINE; adult.ti,ab; 532973 results.
11. MEDLINE; 9 OR 10; 5949245 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3879559 results.

13. MEDLINE; 11 NOT 12; 5754671 results.
14. MEDLINE; 7 AND 8 AND 13; 6672 results.
15. MEDLINE; CATASTROPHI*.ti,ab; 11693 results.
16. MEDLINE; ANXI*.ti,ab; 129027 results.
17. MEDLINE; 15 OR 16; 139987 results.
18. MEDLINE; 14 AND 17; 19 results.
19. MEDLINE; CATASTROPHISATION/; 452 results.
20. MEDLINE; 17 OR 19; 140062 results.
21. MEDLINE; 14 AND 20; 19 results.
22. MEDLINE; ANXIETY/; 54133 results.
23. MEDLINE; 20 OR 22; 156823 results.
24. MEDLINE; 14 AND 23; 19 results.

Comminution

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; DISPLACE*.ti,ab; 5929 results.
10. CINAHL; COMMINUT*.ti,ab; 472 results.
11. CINAHL; 9 AND 10; 131 results.
12. CINAHL; 8 AND 11 [Limit to: (Age Groups All Adult)]; 17 results.

1. EMBASE; exp RADIUS FRACTURE/; 7281 results.
2. EMBASE; exp WRIST FRACTURE/; 4241 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4060 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2274 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1639 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13871 results.
9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6258 results.
10. EMBASE; DISPLAC*.ti,ab; 108200 results.
11. EMBASE; COMMINUT*.ti,ab; 5010 results.
12. EMBASE; 10 AND 11; 937 results.
13. EMBASE; EARLY.ti,ab; 1305908 results.
14. EMBASE; 12 AND 13; 194 results.
15. EMBASE; 9 AND 14 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 31
results.

1. MEDLINE; exp RADIUS FRACTURES/; 7455 results.
2. MEDLINE; exp WRIST INJURIES/; 5240 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34451 results.
5. MEDLINE; wrist*.ti,ab; 26591 results.
6. MEDLINE; Colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63584 results.
8. MEDLINE; fractur*.ti,ab; 177931 results.
9. MEDLINE; exp ADULT/; 5628420 results.
10. MEDLINE; adult.ti,ab; 532973 results.
11. MEDLINE; 9 OR 10; 5949245 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3879559 results.
13. MEDLINE; 11 NOT 12; 5754671 results.
14. MEDLINE; 7 AND 8 AND 13; 6672 results.
15. MEDLINE; DISPLACE*.ti,ab; 101474 results.
16. MEDLINE; COMMINUT*.ti,ab; 4513 results.
17. MEDLINE; 15 AND 16; 885 results.
18. MEDLINE; 14 AND 17; 150 results.

Initial Displacement

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; re-displac*.ti,ab; 10 results.
10. CINAHL; (Displac* AND Again).ti,ab; 52 results.
11. CINAHL; (Displac* AND Further).ti,ab; 449 results.
12. CINAHL; (Displac* AND Initial).ti,ab; 357 results.
13. CINAHL; 9 OR 10 OR 11 OR 12; 814 results.
14. CINAHL; 8 AND 13 [Limit to: (Age Groups All Adult)]; 20 results.

1. EMBASE; exp RADIUS FRACTURE/; 7286 results.
2. EMBASE; exp WRIST FRACTURE/; 4247 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4063 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2277 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1641 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13884 results.
8. EMBASE; re-displac*.ti,ab; 62 results.

9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6268 results.
10. EMBASE; (Displac* AND Again).ti,ab; 855 results.
11. EMBASE; (Displac* AND Initial).ti,ab; 5893 results.
12. EMBASE; (Displac* AND Further).ti,ab; 9001 results.
13. EMBASE; re-diplac*.ti,ab; 0 results.
14. EMBASE; 10 OR 11 OR 12 OR 13; 14895 results.
15. EMBASE; 9 AND 14 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 121 results.

1. MEDLINE; exp RADIUS FRACTURES/; 7464 results.
2. MEDLINE; exp WRIST INJURIES/; 5242 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34503 results.
5. MEDLINE; wrist*.ti,ab; 26636 results.
6. MEDLINE; Colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63681 results.
8. MEDLINE; fractur*.ti,ab; 178170 results.
9. MEDLINE; exp ADULT/; 5632819 results.
10. MEDLINE; adult.ti,ab; 533511 results.
11. MEDLINE; 9 OR 10; 5953961 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3881514 results.
13. MEDLINE; 11 NOT 12; 5759244 results.
14. MEDLINE; 7 AND 8 AND 13; 6679 results.
15. MEDLINE; re-displac*.ti,ab; 53 results.
16. MEDLINE; (Displac* AND Initial).ti,ab; 5372 results.
17. MEDLINE; (Displac* AND AGAIN).ti,ab; 781 results.
18. MEDLINE; (Displac* AND Further).ti,ab; 7973 results.
19. MEDLINE; 15 OR 16 OR 17 OR 18; 13486 results.
20. MEDLINE; 14 AND 19; 155 results.

Age

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; DISPLACE*.ti,ab; 5929 results.
10. CINAHL; Stability.ti,ab; 12127 results.
11. CINAHL; Age*.ti,ab; 292620 results.
12. CINAHL; Year*.ti,ab; 300093 results.
13. CINAHL; 9 OR 10; 17621 results.

14. CINAHL; 11 OR 12; 452500 results.
15. CINAHL; 8 AND 13 AND 14 [Limit to: (Age Groups All Adult)]; 69 results.

2. EMBASE; exp WRIST FRACTURE/; 4247 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4063 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2277 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1641 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13884 results.
9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6268 results.
10. EMBASE; displace*.ti,ab; 104698 results.
11. EMBASE; Stability.ti,ab; 285825 results.
12. EMBASE; AGE*.ti,ab; 3310562 results.
13. EMBASE; YEAR*.ti,ab; 3230089 results.
14. EMBASE; 10 OR 11; 385951 results.
15. EMBASE; 12 OR 13; 5039062 results.
16. EMBASE; 9 AND 14 AND 15 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+
years)]; 503 results.

1. MEDLINE; exp RADIUS FRACTURES/; 7464 results.
2. MEDLINE; exp WRIST INJURIES/; 5242 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34503 results.
5. MEDLINE; wrist*.ti,ab; 26636 results.
6. MEDLINE; Colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63681 results.
8. MEDLINE; fractur*.ti,ab; 178170 results.
9. MEDLINE; exp ADULT/; 5632819 results.
10. MEDLINE; adult.ti,ab; 533511 results.
11. MEDLINE; 9 OR 10; 5953961 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3881514 results.
13. MEDLINE; 11 NOT 12; 5759244 results.
14. MEDLINE; 7 AND 8 AND 13; 6679 results.
15. MEDLINE; Displace*.ti,ab; 101596 results.
16. MEDLINE; Stability.ti,ab; 258246 results.
17. MEDLINE; Age*.ti,ab; 2559091 results.
18. MEDLINE; Year*.ti,ab; 2467692 results.
19. MEDLINE; 15 OR 16; 355514 results.
20. MEDLINE; 17 OR 18; 3962329 results.
21. MEDLINE; 14 AND 19 AND 20; 490 results.

Splint

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; Splint*.ti,ab; 2001 results.
10. CINAHL; Plaster*.ti,ab; 500 results.
11. CINAHL; 9 OR 10; 2441 results.
12. CINAHL; 8 AND 11 [Limit to: (Age Groups All Adult)]; 39 results.

1. EMBASE; exp RADIUS FRACTURE/; 7286 results.
2. EMBASE; exp WRIST FRACTURE/; 4247 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4063 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2277 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1641 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13884 results.
9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6268 results.
10. EMBASE; Splint*.ti,ab; 11818 results.
11. EMBASE; Plaster*.ti,ab; 6327 results.
12. EMBASE; 10 OR 11; 17714 results.
13. EMBASE; 9 AND 12 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 380
results.

1. MEDLINE; exp RADIUS FRACTURES/; 7464 results.
2. MEDLINE; exp WRIST INJURIES/; 5242 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34503 results.
5. MEDLINE; wrist*.ti,ab; 26636 results.
6. MEDLINE; Colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63681 results.
8. MEDLINE; fractur*.ti,ab; 178170 results.
9. MEDLINE; exp ADULT/; 5632819 results.
10. MEDLINE; adult.ti,ab; 533511 results.
11. MEDLINE; 9 OR 10; 5953961 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3881514 results.
13. MEDLINE; 11 NOT 12; 5759244 results.
14. MEDLINE; 7 AND 8 AND 13; 6679 results.
15. MEDLINE; SPLINT*.ti,ab; 11240 results.
16. MEDLINE; PLASTER*.ti,ab; 5819 results.
17. MEDLINE; 15 OR 16; 16680 results.

18. MEDLINE; 14 AND 17; 418 results.

Flexion

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; FLEX*.ti,ab; 21738 results.
10. CINAHL; EXTEN*.ti,ab; 75363 results.
12. CINAHL; DORSIFLEX*.ti,ab; 1517 results.
13. CINAHL; DORSI-FLEX*.ti,ab; 31 results.
14. CINAHL; PALMARFLEX*.ti,ab; 0 results.
15. CINAHL; PALMAR-FLEX*.ti,ab; 11 results.
16. CINAHL; Plaster*.ti,ab; 500 results.
17. CINAHL; CAST*.ti,ab; 5371 results.
18. CINAHL; 9 OR 10 OR 12 OR 13 OR 14 OR 15; 92000 results.
19. CINAHL; 16 OR 17; 5617 results.
20. CINAHL; 8 AND 18 AND 19 [Limit to: (Age Groups All Adult)]; 18 results.

1. EMBASE; exp RADIUS FRACTURE/; 7286 results.
2. EMBASE; exp WRIST FRACTURE/; 4247 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4063 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2277 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1641 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13884 results.
9. EMBASE; 8 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6268 results.
10. EMBASE; Flex*.ti,ab; 195274 results.
11. EMBASE; EXTEN*.ti,ab; 1224191 results.
12. EMBASE; DORSIFLEX*.ti,ab; 5405 results.
13. EMBASE; DORSI-FLEX*.ti,ab; 203 results.
14. EMBASE; PALMARFLEX*.ti,ab; 12 results.
15. EMBASE; PALMAR-FLEX*.ti,ab; 188 results.
16. EMBASE; 10 OR 11 OR 12 OR 13 OR 14 OR 15; 1379870 results.
17. EMBASE; Plaster*.ti,ab; 6327 results.
18. EMBASE; CAST*.ti,ab; 79897 results.
19. EMBASE; 17 OR 18; 83733 results.
20. EMBASE; 9 AND 16 AND 19 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+

years)]; 106 results.

1. MEDLINE; exp RADIUS FRACTURES/; 7464 results.
2. MEDLINE; exp WRIST INJURIES/; 5242 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34503 results.
5. MEDLINE; wrist*.ti,ab; 26636 results.
6. MEDLINE; colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63681 results.
8. MEDLINE; fractur*.ti,ab; 178170 results.
9. MEDLINE; exp ADULT/; 5632819 results.
10. MEDLINE; adult.ti,ab; 533511 results.
11. MEDLINE; 9 OR 10; 5953961 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3881514 results.
13. MEDLINE; 11 NOT 12; 5759244 results.
14. MEDLINE; 7 AND 8 AND 13; 6679 results.
15. MEDLINE; FLEX*.ti,ab; 173966 results.
16. MEDLINE; EXTEN*.ti,ab; 1083725 results.
17. MEDLINE; DORSI-FLEX*.ti,ab; 146 results.
18. MEDLINE; DORSIFLEX*.ti,ab; 4657 results.
19. MEDLINE; PALMAR-FLEX*.ti,ab; 177 results.
20. MEDLINE; PALMARFLEX*.ti,ab; 8 results.
21. MEDLINE; PLASTER*.ti,ab; 5819 results.
22. MEDLINE; CAST*.ti,ab; 72902 results.
23. MEDLINE; 21 OR 22; 76327 results.
24. MEDLINE; 15 OR 16 OR 17 OR 18 OR 19 OR 20; 1222856 results.
25. MEDLINE; 14 AND 23 AND 24; 117 results.

Remove POP 4 or 6 weeks

1. CINAHL; exp RADIUS FRACTURES/; 909 results.
2. CINAHL; exp WRIST FRACTURES/; 389 results.
3. CINAHL; ((radius adj4 fracture*)).ti,ab; 510 results.
4. CINAHL; ((radial adj4 fracture*)).ti,ab; 372 results.
5. CINAHL; ((wrist adj4 fracture*)).ti,ab; 274 results.
6. CINAHL; ((Colles adj2 fracture*)).ti,ab; 81 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 1628 results.
8. CINAHL; 7 [Limit to: (Age Groups All Adult)]; 719 results.
9. CINAHL; MOBILI*.ti,ab; 15640 results.
10. CINAHL; IMMOBILI*.ti,ab; 3029 results.
11. CINAHL; REHAB*.ti,ab; 49777 results.
12. CINAHL; LATE.ti,ab; 20598 results.
13. CINAHL; EARLY.ti,ab; 90528 results.
14. CINAHL; 9 OR 10 OR 11; 65674 results.
15. CINAHL; 13 OR 14; 151666 results.
16. CINAHL; 8 AND 14 AND 15 [Limit to: (Age Groups All Adult)]; 104 results.

1. EMBASE; exp RADIUS FRACTURE/; 7286 results.
2. EMBASE; exp WRIST FRACTURE/; 4247 results.
3. EMBASE; exp COLLES FRACTURE/; 921 results.
4. EMBASE; ((radius adj4 fracture*)).ti,ab; 4063 results.
5. EMBASE; ((radial adj4 fracture*)).ti,ab; 2277 results.
6. EMBASE; ((wrist adj4 fracture*)).ti,ab; 1641 results.
7. EMBASE; ((Colles adj2 fracture*)).ti,ab; 866 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7; 13884 results.
9. EMBASE; 8 [limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6268 results.
10. EMBASE; MOBILI*.ti,ab; 181747 results.
11. EMBASE; IMMOBILI*.ti,ab; 102401 results.
12. EMBASE; REHAB*.ti,ab; 150184 results.
13. EMBASE; LATE.ti,ab; 365307 results.
14. EMBASE; EARLY.ti,ab; 1306815 results.
15. EMBASE; 10 OR 11 OR 12; 422991 results.
16. EMBASE; 13 OR 14; 1528206 results.
17. EMBASE; 9 AND 15 AND 16 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 266 results.

1. MEDLINE; exp RADIUS FRACTURES/; 7464 results.
2. MEDLINE; exp WRIST INJURIES/; 5242 results.
3. MEDLINE; exp COLLES' FRACTURE/; 740 results.
4. MEDLINE; radius.ti,ab; 34503 results.
5. MEDLINE; wrist*.ti,ab; 26636 results.
6. MEDLINE; colles'.ti,ab; 899 results.
7. MEDLINE; 1 OR 2 OR 3 OR 4 OR 5 OR 6; 63681 results.
8. MEDLINE; fractur*.ti,ab; 178170 results.
9. MEDLINE; exp ADULT/; 5632819 results.
10. MEDLINE; adult.ti,ab; 533511 results.
11. MEDLINE; 9 OR 10; 5953961 results.
12. MEDLINE; ANIMALS/ NOT (HUMANS/ AND ANIMALS/); 3881514 results.
13. MEDLINE; 11 NOT 12; 5759244 results.
14. MEDLINE; 7 AND 8 AND 13; 6679 results.
15. MEDLINE; Mobili*.ti,ab; 161802 results.
16. MEDLINE; IMMOBILI*.ti,ab; 88841 results.
17. MEDLINE; REHAB*.ti,ab; 111745 results.
18. MEDLINE; LATE.ti,ab; 310251 results.
19. MEDLINE; EARLY.ti,ab; 1073258 results.
20. MEDLINE; 18 OR 19; 1263345 results.
21. MEDLINE; 15 OR 16 OR 17; 354048 results.
22. MEDLINE; 14 AND 20 AND 21; 249 results.

11.1.3 Surgery

The Cochrane Library (Wiley Online Library)

#1 MeSH descriptor: [Radius Fractures] explode all trees (296)
#2 ((radius or radial) near/3 fracture*):ti,ab,kw (Word variations have been searched) (523)
#3 #1 or #2 (554)
#4 distal:ti,ab,kw (Word variations have been searched) (5270)
#5 #3 and #4 (416)
#6 ((wrist or Colles or Smith*) near/3 fracture*):ti,ab,kw (Word variations have been searched) (335)
#7 DRF:ti,ab,kw (Word variations have been searched) (10)
#8 #5 or #6 or #7 (691)
#9 MeSH descriptor: [Orthopaedic Fixation Devices] explode all trees (2050)
#10 MeSH descriptor: [Fracture Fixation] explode all trees (1248)
#11 pin or pins or pinned or pinning or nail* or screw* or rod or rods or plate or plates or plating or plated or wire* or fix* or ORIF:ti,ab,kw (Word variations have been searched) (18268)
#12 #9 or #10 or #11 (18865)
#13 #8 and #12 in Other Reviews and Trials (347)

MEDLINE (Ovid Online)

1 exp Radius Fractures/ (7477)
2 ((radius or radial) adj3 fracture*).tw. (4451)
3 1 or 2 (8647)
4 distal.tw. (174359)
5 3 and 4 (4097)
6 ((wrist or colles or Smith*) adj3 fracture*).tw. (1916)
7 DRF.tw. (429)
8 5 or 6 or 7 (5960)
9 exp Orthopaedic Fixation Devices/ (60296)
10 exp Fracture Fixation/ (47157)
11 (pin*1 or nail* or screw*1 or rod*1 or plate*1 or wire* or plating or fix* or ORIF).tw. (523888)
12 9 and 10 and 11 (17188)
13 8 and 12 (1097)
14 Randomised controlled trial.pt. (385578)
15 Controlled clinical trial.pt. (89643)
16 randomised.ab. (305829)
17 placebo.ab. (158598)
18 Drug therapy.fs. (1732360)
19 randomly.ab. (220178)
20 trial.ab. (317691)
21 groups.ab. (1393668)
22 or/14-21 (3420134)
23 exp Animals/ not Humans/ (3993941)
24 22 not 23 (2936474)
25 13 and 24 (255)

EMBASE (Ovid Online)

1 Radius Fracture/ (7268)
2 ((radius or radial) adj3 fracture*).tw. (4995)
3 1 or 2 (8690)
4 distal.tw. (209816)
5 3 and 4 (4359)
6 Colles Fracture/ or Wrist Fracture/ (3178)
7 ((wrist or Colles or Smith*) adj3 fracture*).tw. (2319)
8 DRF.tw. (645)
9 or/5-8 (8410)
10 exp Orthopaedic Fixation Device/ (43528)
11 exp Fracture Fixation/ (66305)
12 (pin*1 or nail* or screw*1 or rod*1 or plate*1 or wire* or plating or fix* or ORIF).tw. (604756)
13 and/10-12 (14605)
14 9 and 13 (690)
15 Randomised controlled trial/ (350059)
16 Clinical trial/ (837424)
17 Controlled clinical trial/ (386288)
18 Randomisation/ (62917)
19 Single blind procedure/ (18684)
20 Double blind procedure/ (117356)
21 Crossover procedure/ (39813)
22 Placebo/ (256729)
23 Prospective study/ (258663)
24 ((clinical or controlled or comparative or placebo or prospective* or randomised) adj3 (trial or study)).tw. (776808)
25 (random* adj7 (allocat* or allot* or assign* or basis* or divid* or order*)).tw. (188506)
26 ((singl* or doubl* or trebl* or tripl*) adj7 (blind* or mask*)).tw. (168400)
27 (cross?over* or (cross adj1 over*)).tw. (72008)
28 ((allocat* or allot* or assign* or divid*) adj3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*)).tw. (248679)
29 RCT.tw. (14510)
30 or/15-29 (1942187)
31 Case Study/ or Abstract Report/ or Letter/ (944121)
32 30 not 31 (1903009)
33 14 and 32 (124)

CINAHL (Ebsco)

S1 (MH "Radius Fractures") (1,346)
S2 TX ((radius or radial) n3 fracture*) (1,679)
S3 S1 OR S2 (1,679)
S4 TX distal (11,975)

S5 S3 AND S4 (998)
S6 (MH "Wrist Fractures") (381)
S7 TX ((wrist or Colles or Smith*) n3 fracture*) (679)
S8 TX DRF (71)
S9 S5 OR S6 OR S7 OR S8 (1,648)
S10 (MH "Orthopaedic Fixation Devices") (10,732)
S11 (MH "Fracture Fixation") (6,918)
S12 TX (pin or pins or pinned or pinning or nail* or screw* or rod or rods or plate or plates or wire* or plating or fix* or ORIF) (57,237)
S13 S10 OR S11 OR S12 (57,237)
S14 S9 AND S13 (682)
S15 PT Clinical Trial 76,(472)
S16 (MH "Clinical Trials+") (178,071)
S17 TI clinical trial* OR AB clinical trial* (42,322)
S18 TI ((single blind* or double blind*)) OR AB ((single blind* or double blind*)) (20,304)
S19 TI random* OR AB random* (139,739)
S20 S15 OR S16 OR S17 OR S18 OR S19 (261,048)
S21 S14 AND S20 (110)

11.1.4 Rehabilitation

Cinahl
1. CINAHL; exp RADIUS FRACTURES/ [Limit to: (Age Groups All Adult)]; 456 results.
2. CINAHL; exp WRIST FRACTURES/ [Limit to: (Age Groups All Adult)]; 140 results.
3. CINAHL; (radius adj4 fracture*).ti,ab [Limit to: (Age Groups All Adult)]; 226 results.
4. CINAHL; (radial adj4 fracture*).ti,ab [Limit to: (Age Groups All Adult)]; 221 results.
5. CINAHL; (wrist adj4 fracture*).ti,ab [Limit to: (Age Groups All Adult)]; 138 results.
6. CINAHL; (colles adj2 fracture*).ti,ab [Limit to: (Age Groups All Adult)]; 41 results.
7. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6 [Limit to: (Age Groups All Adult)]; 748 results.
8. CINAHL; exp REHABILITATION/ [Limit to: (Age Groups All Adult)]; 53220 results.
9. CINAHL; exp EXERCISE/ [Limit to: (Age Groups All Adult)]; 24018 results.
10. CINAHL; (physio* OR rehab* OR exercis* OR therap* OR (occupational therapy) OR (physical therapy) OR (hand therapy)).ti,ab [Limit to: (Age Groups All Adult)]; 118415 results.
11. CINAHL; 8 OR 9 OR 10 [Limit to: (Age Groups All Adult)]; 154198 results.
12. CINAHL; 7 AND 11 [Limit to: (Age Groups All Adult)]; 179 results.

EMBASE

1. EMBASE; exp RADIUS FRACTURE/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 3389 results.
2. EMBASE; exp WRIST FRACTURE/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 2096 results.
3. EMBASE; exp COLLES FRACTURE/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 461 results.

4. EMBASE; (radius adj4 fracture*).ti,ab [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 2149 results.
5. EMBASE; (radial adj4 fracture*).ti,ab [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 1189 results.
6. EMBASE; (wrist adj4 fracture*).ti,ab [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 895 results.
7. EMBASE; (colles adj2 fracture*).ti,ab [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 433 results.
8. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 6650 results.
9. EMBASE; exp REHABILITATION/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 111516 results.
10. EMBASE; exp EXERCISE/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 89585 results.
11. EMBASE; exp PHYSIOTHERAPY/ [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 19951 results.
12. EMBASE; (physio* AND rehab* OR therap* OR exercis* OR (occupational therapy) OR (physical therapy) OR (hand therapy)).ti,ab [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 813497 results.
13. EMBASE; 9 OR 10 OR 11 OR 12 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 932128 results.
14. EMBASE; 8 AND 13 [Limit to: Human and (Human Age Groups Adult 18 to 64 years or Aged 65+ years)]; 1248 results.

Medline

1. Medline; RADIUS FRACTURES/ [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 53 results.
2. Medline; WRIST INJURIES/ [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 26 results.
3. Medline; COLLES' FRACTURE/ [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 0 results.
4. Medline; radius.ti,ab [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 149 results.
5. Medline; wrist*.ti,ab [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 190 results.
6. Medline; colles'.ti,ab [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 0 results.
7. Medline; 1 OR 2 OR 3 OR 4 OR 5 OR 6 [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 65999 results.
8. Medline; REHABILITATION/ [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 1077 results.
9. Medline; EXERCISE/ [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 738 results.

10. Medline; ((physio* OR rehab* OR exercis* OR therap* OR (occupational therapy) OR (physical therapy) OR (hand therapy))).ti,ab [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 20623 results.
11. Medline; 8 OR 9 OR 10 [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 271964 results.
12. Medline; 7 AND 11 [Limit to: Publication Year Current-2015 and (Language English) and Humans]; 62 results.

#2	MESH DESCRIPTOR wrist injuries EXPLODE ALL TREES
#3	(Radius near fracture):TI,AB,KY
#4	(Distal near radius):TI,AB,KY
#5	Colles:TI,AB,KY
#6	#1 OR #2 OR #3 OR #4 OR #5

11.1.5 Outcome Measures

The Search Strategy for the chapter on Outcome Measures can be found here.

12 Appendices and list of web appendices

12.1 Emergency Department

12.1.1 General Anaesthesia versus haematoma block- one trial.

Back

10. **Study**	**Intervention/ comparison**	**Patients**	**Outcomes**	**Comments**
Funk (1997) *PRCT*	GA vs haematoma +/- IV sedation	Adults (n=58)	Pain Quality of Reduction (QOR)	QOR- No difference Less pain post manipulation- haematoma block No PROMS

12.1.2 Intravenous regional anaesthesia (IVRA) versus haematoma block – five trials.

Back

Study	**Intervention/ comparison**	**Patients**	**Outcomes**	**Comments**

Abbaszadegan et al. (1990) *PRCT*	IVRA vs haematoma block	Adults (n=99)	Quality of Reduction ROM Grip Strength Pain	IVRA- Better & easier correction; Less post manipulation pain; Better grip strength Similar ROM in both groups
Cobb et al. (1985) *PRCT*	IVRA vs haematoma block	Adults (n=100)	Pain Quality of Reduction (QOR)	Pain similar in both groups Inadequate reduction rare and unrelated to method of anaesthesia
Kendall et al. (1997) *PRCT* *Add level of evidence*	IVRA vs haematoma block	Adults (n=150)	Pain Quality of Reduction (QOR)	IVRA- Better & easier correction; Less post manipulation pain
Walther-Larsen et al. (1988) *PRCT*	IVRA vs haematoma block	Adults (n=48)	Pain QOR ROM Grip Strength	IVRA- Better & easier correction No functional difference
Wardrope et al. (1985) *PRCT*	IVRA vs haematoma block	Adults (n=81)	Pain Quality of Reduction (QOR)	IVRA- Better & easier correction

12.1.3 Does manipulation affect functional outcome

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments

Kelly et al. (2009) *PRCT*	Closed reduction vs no reduction	Adults (n=60)	Gartland & Werley Grip Strength Radiological position Cosmesis CRPS	Patients aged ≥65 years with moderately displaced fractures There was no detectable difference between the groups in any of the outcome measures
Handoll et al. (2002) *Systematic Review*	Closed reduction vs no reduction	Adults (n=60)	Gartland & Werley Grip Strength Radiological position Cosmesis CRPS	Manipulation was unnecessary in selected elderly patients with only moderately displaced fractures. There is no conclusive evidence of difference in outcome between reduction or no reduction of displaced fractures Findings based on the study by Kelly et al only

12.1.4 Full cast versus back slab immobilisation

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Wik et al. (2008) *PRCT*	Complete plaster cast vs dorsal plaster splint	Adults (n=72 all females)	Pain Radiological parameters for maintenance of reduction	Pain: Day 1 more cast group; Day 10- no difference Split/Release for Tightness: equal number Reduction at Day 10: slab-better for dorsal angulation cast-better for radial length

12.1.5 The effect of Vitamin C in preventing complex regional pain syndrome (CRPS)

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Evaniew et al. (2015) *Meta-analysis*	Vitamin C v placebo	Adults (n=890)	CRPS incidence	There is no evidence for vitamin C to prevent CRPS in patients with distal radius fractures Overall quality of evidence is low
Meena et al. (2015) *Meta-analysis*	Vitamin C	Adults (n=810)	CRPS incidence	Significant reduction in the prevalence of CRPS with the use of vitamin C

Shibuya et al. (2013) *Meta-analysis*	Vitamin C(500mg+)	Adults (n=616)	CRPS incidence Complications	Meta analysis was carried out to investigate effectiveness of Vitamin C in foot and ankle surgery and trauma Three out of the four studies included looked at distal radius fracture patients only Vitamin C may be beneficial in foot and ankle surgery or injury to avoid CRPS

12.1.6 Radiological parameters and outcome

Back

Abramo A, Kopylov P, Tagil M. Evaluation of a treatment protocol in distal radius fractures: a prospective study in 581 patients using DASH as outcome. Acta Orthop. 2008 Jun;79(3):376-85.

Altissimi M, Antenucci R, Fiacca C, Mancini GB. Long-term results of conservative treatment of fractures of the distal radius. Clin Orthop Relat Res. 1986 May;(206):202-10.

Anzarut A, Johnson JA, Rowe BH, Lambert RGW, Blitz S, Majumdar SR. Radiologic and patient-reported functional outcomes in an elderly cohort with conservatively treated distal radius fractures. J Hand Surg Am. 2004 Nov;29(6):1121-7.

Aro HT, Koivunen T. Minor axial shortening of the radius affects outcome of Colles' fracture treatment. J Hand Surg Am. 1991 May;16(3):392-398.

Barton T, Chambers C, Bannister G. A comparison between subjective outcome score and moderate radial shortening following a fractured distal radius in patients of mean age 69 years. J Hand Surg Eur. 2007 Apr;32(2):165-9.

Batra S, Gupta A. The effect of fracture-related factors on the functional outcome at 1 year in distal radius fractures. Injury. 2002 Jul;33(6):499-502.

Bentohami A, Bijlsma TS, Goslings JC, de Reuver P, Kaufmann L, Schep NW. Radiological criteria for acceptable reduction of extra-articular distal radial fractures are not predictive for patient-reported functional outcome. J Hand Surg Eur Vol. 2013 Jun;38(5):524-9.

Beumer A, Adlercreutz C, Lindau T. Early prognostic factors in distal radius fractures in a younger than osteoporotic age group: a multivariate analysis of trauma radiographs. BMC Musculoskelet Disord. 2013 May 22;14:170.

Braziulis K, Rimdeika R, Kregzdyte R, Tarasevicius S. Associations between the fracture type and functional outcomes after distal radial fractures treated with a volar locking plate. Medicina (Kaunas). 2013;49(9):399-402.

Brogren E, Hofer M, Petranek M, Wagner P, Dahlin B, Atroshi I. Relationship between distal radius fracture malunion and arm-related disability: A prospective population based cohort study with 1-year follow-up. BMC Musculoskelet Disord. 2011 Jan 13; 12:9.

Choi WS, Lee HJ, Kim DY, Lee CH, Lee BG, Kim JH, Lee KH. Does osteoporosis have a negative effect on the functional outcome of an osteoporotic distal radial fracture treated with a volar locking plate? Bone Joint J. 2015 Feb;97-B(2):229-234.

Chung KC, Kotsis SV, Kim HM. Predictors of Functional Outcomes After Surgical Treatment of Distal Radius Fractures. J Hand Surg Am. 2007 Jan;32(1):76-83.

Dario P, Matteo G, Carolina C, Marco G, Cristina D, Daniele F, Andrea F. Is it really necessary to restore radial anatomic parameters after distal radius fractures?
Injury. 2014 Dec; 45 Suppl 6:S21-6.

Dixon S, Allen P, Bannister G. Which Colles' fractures should be manipulated? Injury. 2005 Jan;36(1):81-3.

Fernandez JJ, Gruen GS, Herndon JH. Outcome of distal radius fractures using the short form 36 health survey. Clin Orthop Relat Res. 1997 Aug;(341):36-41.

Finsen V, Rod O, Rød K, Rajabi B, Alm-Paulsen PS, Russwurm H. The relationship between displacement and clinical outcome after distal radius (Colles') fracture.
Journal Hand Surg Eur Vol. 2013 Feb;38(2):116-26.

Foldhazy Z, Tornkvist H, Elmstedt E, Andersson G, Hagsten B, Ahrengart L. Long-term outcome of nonsurgically treated distal radius fractures.
J Hand Surg Am. 2007 Nov;32(9):1374-1384.

Forward DP, Davis TRC, Sithole JS. Do young patients with malunited fractures of the distal radius inevitably develop symptomatic post-traumatic osteoarthritis?
J Bone Joint Surg Br. 2008 May;(5):629-37.

Fujii K, Henmi T, Kanematsu Y, Mishiro T, Sakai T, Terai T. Fractures of the distal end of radius in elderly patients: a comparative study of anatomical and functional results. J Orthop Surg (Hong Kong). 2002 Jun;10(1):9-15.

Gavaskar AS, Muthukumar S, Chowdary N. Fragment-specific fixation for complex intra-articular fractures of the distal radius: results of a prospective single-centre trial. J Hand Surg Eur Vol. 2012 Oct;37(8);765-71.

Gliatis JD, Plessas SJ, Davis TR. Outcome of distal radius fracture in young adults.
J Hand Surg Br. 2000 Dec;25(6):535-43.

Grewal R, Macdermid J, Pope J, Chesworth B. Baseline predictors of pain and disability one year following extra-articular distal radius fractures. Hand (N Y). 2007 Sep;2(3):104–11.

Hollevoet N, Verdonk R. The functional importance of malunion in distal radius fractures. Acta Orthop Belg. 2003 June;69(3):239-45.

Jaremko JL, Lambert RG, Rowe BH, Johnson JA, Majumdar SR. Do radiographic indices of distal radius fracture reduction predict outcomes in older adults receiving conservative treatment Clin Radiol. 2007 Jan;62(1):65-72.

Jenkins NH, Mintowt-Czyz WJ. Mal-union and dysfunction in Colles' fracture J Hand Surg Br. 1988 Aug;13(3):291-3.

Karnezis IA, Panagiotopoulos E, Tyllianakis M, Megas P, Lambiris E. Correlation between radiological parameters and patient-rated wrist dysfunction following fractures of the distal radius. Injury. 2005 Dec;36(12):1435-9.

Kodama N, Takemura Y, Ueba H, Imai S, Matsusue Y. Acceptable parameters for alignment of distal radius fracture with conservative treatment in elderly patients
J Orthop Sci. 2014 Mar;19(2):292-7.

Kopylov P, Johnell O, Redlund-Johnell I, Bengner U. Fractures of the distal end of the radius in young adults: a 30-year follow-up J Hand Surg Br. 1993 Feb;18(1):45-9.

Kumar S, Penematsa S, Sadri M, Deshmukh SC. Can radiological results be surrogate markers of functional outcome in distal radial extra-articular fractures? Int Orthop. 2008 Aug;32(4):505-9.

Leung F, Ozkan M, Chow SP. Conservative treatment of intra-articular fractures of the distal radius--factors affecting functional outcome. Hand Surg. 2000 Dec;5(2):145-53.

MacDermid JC, Donner A, Richards RS, Roth JH. Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture.
J Clin Epidemiol. 2002 Sep;55(9):849-54.

Porter M, Stockley I. Fractures of the distal radius. Intermediate and end results in relation to radiologic parameters. Clin Orthop Relat Res. 1987 Jul;(220):241-52.

Sammer DM, Shah HM, Shauver MJ, Chung KC. The effect of ulnar styloid fractures on patient-rated outcomes after volar locking plating of distal radius fractures.
J Hand Surg Am. 2009 Nov;34(9):1595-602.

Smilovic J, Bilic R. Conservative treatment of extra-articular Colles' type fractures of the distal radius: prospective study. Croat Med J. 2003 Dec;44(6):740-5.

Solgaard S. Function after distal radius fracture. Acta Orthop Scand. 1988 Feb;59(1):39-42.

Stewart HD, Innes AR, Burke FD. Factors affecting the outcome of Colles' fracture: an anatomical and functional study. Injury. 1985 Mar;16(5):289-95..

Synn AJ, Makhni EC, Makhni MC, Rozental TD, Day CS. Distal radius fractures in older patients: Is anatomic reduction necessary? Clin Orthop Relat Res. 2009 Jun;467(6):1612-20.

Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. J Hand Surg Am. 1994 Mar;19(2):325-40.

Tsukazaki T, Takagi K, Iwasaki K. Poor correlation between functional results and radiographic findings in Colles' fracture. J Hand Surg Br. 1993 Oct;18(5):588-91.

Villar RN, Marsh D, Rushton N, Greatorex RA. Three years after Colles' fracture. A prospective review. J Bone Joint Surg Br. 1987 Aug;69(4):635-8.

Warwick D, Field J, Prothero D, Gibson A, Bannister GC. Function ten years after Colles' fracture. Clin Orthop Relat Res. 1993 Oct;(295):270-4.

Wilcke MK, Abbaszadegan H, Adolphson PY. Patient-perceived outcome after displaced distal radius fractures: a comparison between radiological parameters,objective physical variables, and the DASH score. J Hand Ther. 2007 Oct-Dec;20(4):290-8; quiz 299,

RAND COPORATION: https://www.rand.org/topics/delphi-method.html

12.2 Fracture Clinic

12.2.1 Re-displacement and initial displacement

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Jung et al (2015) *Case series*	Initial displacement	Adults (n=132)	Radiographic displacement	Initial displacement, particularly radial shortening, correlated to final displacement.
Roth et al (2013) *Case series*	Initial displacement	Adults (n=82) All undisplaced initially.	Final radiographic displacement	None displaced radiographically on follow up.
Tahririan et al (2013) *Case series*	Initial displacement	Adults (n=157)	Final radiographic displacement	Initial radial shortening and radial inclination correlated with subsequent radiographic displacement.

				Initial dorsal angulation did not correlate with subsequent radiographic displacement.
Blackeney et al (2009) *Case series*	Initial displacement	Adults (n=176) Needing MUA but not deemed to need surgery	Final radiographic displacement	Initial displacement correlated to subsequent radiographic displacement.
Makhni et al (2008) *Case series*	Initial displacement	Adults (n=124)	Final radiographic displacement	Initial displacement requiring MUA correlated to subsequent radiographic displacement.
MacKenney et al (2006) *Case series*	Initial displacement	Adults (n=4024)	Final radiographic displacement	Initial dorsal angulation correlated with final radiographic displacement.
Altissimi et al (1994) *Case series*	Initial displacement (Older Classification used)	Adults (n=645)	Final radiographic displacement	Initial radial shortening strongly correlated with final radial shortening.
Hove et al (1994) *Case series*	Initial displacement (Older Classification used)	Adults (n=645)	Final radiographic displacement	Final dorsal angulation correlated with initial displacement using the Older classification
Lafontaine et al (1989) *Case series*	Initial displacement	Adults (n=112)	Final radiographic displacement	Initial dorsal angulation correlated with final radiographic displacement.
Abbaszadegan et al (1989) *Case series*	Initial displacement	Adults (n=267)	Final radiographic displacement	Initial radiographic displacement did correlate with final radiographic displacement, particularly initial radial shortening.

Solgaard (1984) *Case series*	Initial displacement	Adults (n=269)	Final radiographic displacement	Smiths fractures not included. Initial radiographic displacement did correlate with final radiographic displacement.

12.2.2 Re-displacement and age of patient

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Jung et al (2015) *Case series*	Age	Adults (n=132)	Radiographic displacement	Age correlated with late, but not early, radiographic displacement.
Tahririan et al (2013) *Case series*	Age	Adults (n=157)	Radiographic displacement	Age correlated with later radiographic displacement.
Makhni et al (2008) *Case series*	Age	Adults (n=124)	Radiographic displacement	3 sub-groups of age considered. Age correlated with later radiographic displacement.
MacKenney et al (2006) *Case series*	Age	Adults (n=4024)	Radiographic displacement	Age correlated with later radiographic displacement.
Nesbitt et al (2004) *Case series*	Age	Adults (n=50)	Radiographic displacement	Age correlated with later radiographic displacement.
Leone et al (2004) *Case series*	Age	Adults (n=71)	Radiographic displacement	Extra-articular #s only. Age correlated to late (> 1week), but not

				early, radiographic displacement.
Hove et al (1994) *Case series*	Age	Adults (n=645)	Radiographic displacement	Smiths fractures not included. Age did correlate with radiographic displacement
Abbaszadegan et al (1989) *Case series*	Age	Adults (n=267)	Radiographic displacement	Smiths fractures not included. Age did correlate with radiographic displacement
Lafontaine et al (1989) *Case series*	Age >60	Adults (n=112)	Radiographic displacement	Age did correlate with radiographic displacement
Solgaard (1984) *Case series*	Age	Adults (n=269)	Radiographic displacement	Smiths fractures not included. Age did correlate with radiographic displacement.

12.2.3 Re-displacement and comminution

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Jung et al (2015) *Case series*	Dorsal comminution	Adults (n=132)	Radiographic displacement	Dorsal comminution was not correlated with early or late radiographic displacement.
Wadsten et al (2014) *Case series*	Comminution (Buttazzoni classification)	Adults (n=398)	Final radiographic displacement	Volar and dorsal comminution both correlated with subsequent radiographic displacement.

				Volar comminution more strongly correlated than dorsal.
Makhni et al (2008) *Case series*	Dorsal comminution with free fragment	Adults (n=124)	Final radiographic displacement	Comminution did correlate with subsequent radiographic displacement.
MacKenney et al (2006) *Case series*	Comminution	Adults (n=4024)	Final radiographic displacement	Any comminution was correlated with early and late radiographic displacement.
Leone et al (2004) *Case series*	Dorsal comminution	Adults (n=71)	Final radiographic displacement	Trend for dorsal comminution to correlate with early displacement (p=0.06). Dorsal comminution was not correlated with late displacement.
Abbaszadegan et al (1989) *Case series*	Comminution	Adults (n=267)	Final radiographic displacement	Comminution did correlate with late radiographic displacement.
Lafontaine et al (1989) *Case series*	Dorsal comminution	Adults (n=112)	Final radiographic displacement	Dorsal comminution strongly correlated with late radiographic displacement.

12.2.4 Does this fracture need a plaster cast?

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
O'Connor et al (2003) *RCT*	POP for 6 weeks vs Futura splint for 6 weeks	Adults (n=66) Not requiring manipulation	Gartland and Werley	Score better at 6 weeks, same by 12. Patients more satisfied with splint.
Jensen et al (1997) *RCT*	1 week back slab then mobilise vs 3 weeks back slab then mobilise	Adults (n=62) Minimally displaced	Gartland and Werley	No difference in score at 26 weeks. More pain if plaster removed at 1 week.
Davis et al (1987) *RCT*	1-2 weeks back slab then double tubigrip and mobilise vs 5 weeks POP	Adults (n=52) Minimally displaced	Gartland and Werley	Early functional score better with early mobilisation (up to 7 weeks). Patients more satisfied with double tubigrip.
Dias et al (1987) *RCT*	5/52 POP vs crepe and early mobilisation	Adults over 55 years (n=97) Minimally displaced	Gartland and Werley	Early mobilisation group tended to better scores but not statistically compared.

12.2.5 In what position should a fractured distal radius be immobilised?

Back

Additional reference: Gelberman RH, Szabo RM, Mortensen WW. 'Carpal tunnel pressures and wrist position in patients with Colles fractures'. J Trauma 1984; 24(8):747-9

12.2.6 Will the anxious patient recover less well?

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments

Ring et al (2006) *Case series*	EPQ-R CES-D PASS	Adults (n=27) Non-operatively treated distal radius fractures	DASH	Only depression correlated with poor DASH score. Female sex also correlated strongly with a poor DASH score. Small study population.

12.3 Surgery

12.3.1 Non-operative versus operative management

Study	**Intervention/ comparison**	**Patients**	**PROM(s)**	**Comments**
Arora et al. (2009) *Retrospective cohort*	Non-operative vs ORIF	Adults (n=114)	DASH PRWE	Elderly patients (≥70yrs) No difference in DASH and PRWE at mean final follow-up of 4.5yrs
Aktekin et al. (2010) *Retrospective cohort*	Non-operative vs external fixation	Adults (n=46)	DASH	Elderly patients (≥65yrs) No difference in DASH at mean final follow-up of 2.1yrs
Egol et al. (2010) *Retrospective cohort*	Non-operative vs surgery	Adults (n=90)	DASH	Elderly patients (≥65yrs) No difference in DASH at 3, 6 and 12 months post injury

Arora et al. (2011) *PRCT*	Non-operative vs ORIF	Adults (n=73)	DASH PRWE	Elderly patients (≥65yrs) ORIF group had superior DASH and PRWE scores at 6 weeks and 3 months but no difference seen at 6 and 12 months
Bartl et al. (2014) *PRCT*	Non-operative vs ORIF	Adults (n=185)	DASH EQ-5D	Elderly patients (≥65yrs) No difference in DASH at 3, 6 and 12 months follow-up

Back

12.3.2 MANIPULATION UNDER ANAESTHESIA WITH K-WIRES VERSUS OPEN REDUCTION AND INTERNAL FIXATION

Back

Study	**Intervention/ comparison**	**Patients**	**PROM(s)**	**Comments**
Hull et al. (2011) *Retrospective cohort*	MUA+K-wire vs ORIF	Adults (n=71)	PWRE DASH	No difference at 1 and 2 years post surgery for both PWRE and the DASH

Chaudhry et al. (2015) *Meta-analysis*	MUA+K-wire vs ORIF	Adults (n=875)	DASH	ORIF found to have superior DASH scores at 3 and 12 months but not clinically significant

Study	Intervention/ comparison	Patients	PROM(s)	Comments
Cui et al. (2011) *Meta-analysis*	External fixation vs ORIF	Adults (n=738)	DASH ROM Grip Strength	Pooled results suggest ORIF superior DASH score at 3 months and 1 year
Landgren et al. (2011) *Retrospective cohort*	External fixation vs ORIF	Adults (n=50)	QuickDASH	Long-term follow-up of previous PRCT. At a mean follow-up of 5 years, no difference in QuickDASH between groups.
Richard et al. (2011) *Retrospective cohort*	External fixation vs ORIF	Adults (n=115)	DASH ROM Grip Strength	Superior DASH score following ORIF at 1 year
Jeudy et al. (2012) *PRCT*	External fixation vs ORIF	Adults (n=75)	PRWE	No difference in PRWE at 3 and 6 months post surgery
Wei et al. (2012) *Meta-analysis*	External fixation vs ORIF	Adults (n=1011)	DASH	Pooled results suggest ORIF superior DASH score
Esposito et al. (2013) *Meta-analysis*	External fixation vs ORIF	Adults (n=707)	DASH	Pooled results suggest ORIF gives superior DASH score

Williksen et al. (2013) *PRCT*	External fixation vs ORIF	Adults (n=111)	QuickDASH	No difference in QuickDASH score at 1-year post surgery
Xie et al. (2013) *Meta-analysis*	External fixation vs ORIF	Adults (n=772)	DASH	Pooled results suggest ORIF gives superior DASH score at 12 months. Independent analysis of studies suggests superior DASH score at 3 and 6 months for ORIF, but not at 12 months.

12.3.3 External fixation versus Open reduction and Internal Fixation

Back

12.3.4 Concomitant distal ulnar styloid fracture management

Back

Study	**Intervention/ comparison**	**Patients**	**PROM(s)**	**Comments**
Souer et al. (2009) *Retrospective cohort*	No fixation versus no fracture	Adults (n=76)	DASH	No difference in DASH score at 1 and 2 years post injury
Kim et al. (2010) *Prognostic retrospective cohort*	No fixation versus no fracture	Adults (n=138)	DASH	No difference in DASH at mean final follow-up of 1.5yrs

12.4 Rehabilitation

12.4.1 Rehabilitation whilst in cast

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Handoll et al. (2015) Cochrane systematic review *Systematic Review*	Early therapeutic intervention vs occupational therapy vs cyclic pneumatic soft tissue compression vs digit mobilisation programme vs pulsed electromagnetic field therapy vs cross-education programme vs no intervention	Six studies (Challis et al 2007; Cooper et al 2001; Gronlund et al 1990; Kuo et al 2013; Lazovic et al 2012; Magnus et al 2013)	DASH Modified Gartland & Werley Grip strength Pinch grip ROM Dexterity Finger movement Complications and cast problems Referral to hand therapy Use of appliances and home help Oedema Participant satisfaction MAM-36 Fracture displacement PRWE	Unable to combine data to perform meta-analysis; participants tending to be without serious fracture or treatment-related complications or pre-existing comorbidities or functional deficits; all studies of low methodological quality; very low quality evidence

12.4.2 Rehabilitation following definitive treatment of distal radius fracture

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Handoll et al (2015)	Physiotherapy & home exercise programme vs Physiotherapy vs occupational therapy vs occupational therapy & continuous	(Bache 2001; Basso 1998; Cheing 2005; Christensen	PRWE QuickDASH Grip strength ROM Thumb motion Web span	Unable to combine data to perform meta-analysis; participants tending to be without serious fracture or

	passive motion vs pulsed electromagnetic field therapy vs ice with / without pulsed electromagnetic field vs passive mobilisation vs intermittent pneumatic compression vs ultrasound vs whirlpool vs dynamic wrist extension splint	2001; Jongs 2012; Kay 2008; Maciel 2008; Rozencrawaig 1996; Svensson 1993; Taylor 1994; Toomey 1996; Wakefield 2000	Complications / adverse events Participant satisfaction Compliance Request / referral for physiotherapy / occupational therapy Levine score ADL Modified Gartland & Werley Pain SF-36 Number of sessions Duration of therapy Time to achieve independence Cost	treatment-related complications or pre-existing comorbidities or functional deficits; all studies of low methodological quality; very low quality evidence

12.4.3 Type of Intervention

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments
Bache et al. (2000) *PRCT*	Advice and exercise vs Advice, exercise and physiotherapy	Adults (n=98)	ROM Function (Levine scale) Grip strength Pain (VAS)	A trend towards improvements with physiotherapy group but no significant findings
Brehmer et al. (2014) *PRCT*	Standard exercise vs Early resistance and passive exercise	Adults (n=78)	DASH Active ROM Grip strength Pinch strength X-ray	Immediate ROM and strengthening at two weeks gives earlier return to clinically relevant function

Jongs et al. (2012) *PRCT*	Routine care plus dynamic wrist extension splint vs Routine care (exercises and advice)	Adults (n=40)	Passive wrist extension PRWHE	Conducted on patients already presenting with flexion contracture
Handoll (2015) Cochrane systematic review)	Routine physiotherapy vs home programme vs pulsed electromagnetic field therapy & ice vs ice vs modified manual oedema mobilisation vs manual oedema mobilisation	3 studies (Watt et al 2000; Cheing et al 2005; Knygsand-Roenhoej et al 2011)	Grip strength ROM Number of physiotherapy / occupational therapy sessions Adverse events Oedema ADL Canadian Occupational Performance Measure	Unable to combine data to perform meta-analysis; participants tending to be without serious fracture or treatment-related complications or pre-existing comorbidities or functional deficits; all studies of low methodological quality; very low quality evidence
Magnus et al. (2013) *PRCT*	Strength training (contralateral hand) vs Standard home programme	Adults (n=39)	Grip strength ROM PRWHE	Greater grip strength and ROM at 12 weeks but not at 26

12.4.4 Mode of Delivery

Back

Study	Intervention/ comparison	Patients	Outcomes	Comments

Handoll (2015) Cochrane systematic review)	Supervised physiotherapy or occupational therapy vs galvanic bath & exercise session vs home programme	5 studies (Bighea et al 2013; Brehmer et al 2014; Krischak et al 2009; Pasila et al 1974; Souer et al 2011)	Grip strength Pinch strength ROM Number of physiotherapy / occupational therapy sessions Return to work PRWE DASH Mayo wrist score Pain Complications / adverse events Change to treatment Compliance Cost Fracture alignment & healing	Unable to combine data to perform meta-analysis; participants tending to be without serious fracture or treatment-related complications or pre-existing comorbidities or functional deficits; all studies of low methodological quality; very low quality evidence
Valdes et al. (2014) *Systematic review*	Home exercise programme vs 1:1 OT / PT	7 studies (Christensen et al 2000; Kay et al 2000; Krischak et al 2009; Maciel et al 2005; Souer et al 2011; Wakefield & McQueen 2000; Watt et al 2000)	PRWE DASH Gartley & Werley score Mayo score ROM Thumb motion Grip strength Pinch strength Pain	All studies included methodological flaws; studies excluded participants with complex presentations; insufficient evidence to support one form of therapy deliver over another

12.4.5. BOASTs

BRITISH ORTHOPAEDIC ASSOCIATION & BRITISH ASSOCIATION OF PLASTIC, RECONSTRUCTIVE & AESTHETIC SURGEONS

AUDIT STANDARDS for TRAUMA

OPEN FRACTURES

December 2017

Background and Justification

Open fractures may require timely multidisciplinary management. The consequences of infection can be great both for the individual patient and the community. Trauma networks and hospitals require the appropriate pathways and infrastructure to manage these patients, to enable optimum recovery, and to minimise the risk of infection.

Inclusions: all patients with open fractures of long bones, hind foot or midfoot (excluding hand, wrist, forefoot or digit).

Standards for Practice Audit:

1. Patients with open fractures of long bones, hind foot or midfoot should be taken directly or transferred to a specialist centre that can provide Orthoplastic* care. Patients with hand, wrist, forefoot or digit injuries may be managed locally following similar principles.
2. Intravenous prophylactic antibiotics should be administered as soon as possible, ideally within 1 hour of injury.
3. There should be a readily accessible published network guideline for the use of antibiotics in open fractures.
4. The examination of the injured limb should include assessment and documentation of the vascular and neurological status. This should be repeated systematically, particularly after reduction manoeuvres or the application of splints. Management of suspected compartment syndrome should follow BOAST guidelines.
5. The limb should be re-aligned and splinted.
6. Patients presenting with arterial injuries in association with their fracture should be treated in accordance with the BOAST for arterial injuries.
7. In patients where an initial "Trauma CT" is indicated there should be protocols to maximise the useful information and minimise delay:
    - The initial sequence should include a head to toes scanogram. This should be used with clinical correlation to direct further specific limb sequences during that initial CT examination.
    - There should be a local policy on the inclusion of angiography in any extremity CT related to open fractures.
8. Prior to formal debridement the wound should be handled only to remove gross contamination and to allow photography, then dressed with a saline-soaked gauze and covered with an occlusive film. 'Mini-washouts' outside the operating theatre environment are not indicated.
9. All trauma networks must have information governance policies in place that enable staff to take, use and store photographs of open fracture wounds for clinical decision-making 24 hours a day.
10. Photographs of open fracture wounds should be taken when they are first exposed for clinical care, before debridement and at other key stages of management. These should be kept in the patient's records.
11. The formation of the management plan for fixation and coverage of open fractures and surgery for initial debridement should be undertaken concurrently by consultants in orthopaedic and plastic surgery (a combined orthoplastic approach).
12. Debridement should be performed using fasciotomy lines for wound extension where possible (see overleaf for recommended incisions for fasciotomies of the leg)
    - Immediately for highly contaminated wounds (agricultural, aquatic, sewage) or when there is an associated vascular compromise (compartment syndrome or arterial disruption producing ischaemia).
    - within 12 hours of injury for other solitary high energy open fractures
    - within 24 hours of injury for all other low energy open fractures.
13. Once debridement is complete any further procedures carried out at that same sitting should be regarded as clean surgery; i.e. there should be fresh instruments and a re-prep and drape of the limb before proceeding.
14. Definitive soft tissue closure or coverage should be achieved within 72 hours of injury if it cannot be performed at the time of debridement
15. Definitive internal stabilisation should only be carried out when it can be immediately followed with definitive soft tissue cover.
16. When a decision whether to perform limb salvage or delayed primary amputation is indicated, this should be based on a multidisciplinary assessment involving an orthopaedic surgeon, a plastic surgeon, a rehabilitation specialist, the patient and their family or carers.
17. When indicated, a delayed primary amputation should be performed within 72 hours of injury.
18. Each trauma network should submit appropriate data to the TARN, monitor its performance against national standards and audit its outcomes.
19. All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work and driving

*Orthoplastic: A hospital with a dedicated, combined service for orthopaedic and plastic surgery in which consultants from both specialties work simultaneously to treat open fractures as part of regular, scheduled, combined orthopaedic and plastic surgery operating lists. The surgical service is supported by combined review clinics and specialist nursing teams (from NICE guidelines).

Evidence Base:

NICE Complex fracture guideline
https://www.nice.org.uk/guidance/NG37/chapter/recommendations

Back

12.4.5.2 Standards for Trauma (Fracture Clinic Services)

BRITISH ORTHOPAEDIC ASSOCIATION

STANDARDS for TRAUMA (BOAST)

August 2013

BOAST 7: FRACTURE CLINIC SERVICES

These guidelines are for the standard of care patients should expect following significant, acute soft tissue or bone injury that requires specialist treatment from a Trauma and Orthopaedic Surgeon in the outpatient setting (fracture clinic). They provide standards that can be audited to evaluate the quality of an outpatient fracture service. They cannot be comprehensive as local facilities and geography will require variation in the configuration of these services. However, the British Orthopaedic Association believes that these are the care standards that all patients in the United Kingdom can expect.

1. Following acute traumatic orthopaedic injury, patients should be seen in a new fracture clinic within 72 hours of presentation with the injury. This includes referrals from emergency departments, minor injury units and general practice.
2. Fracture clinics must be consultant-led clinics. All new fracture patients must be seen in a clinic by senior orthopaedic staff or by junior staff directly supervised by these senior staff. If extended scope practitioners are seeing patients, they must have evidence of adequate training and be directly supervised by a consultant orthopaedic surgeon.
3. All new fracture clinic appointments must lead to a management plan, including any clinical interventions, which is communicated to both the general practitioner and patient in writing.
4. Plaster room facilities and the ability to perform plain radiographs must be available during all fracture clinics.
5. Should patients require further imaging, (for example ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI)); this should be performed and reviewed by the clinical team within an appropriate time scale. Surgery in many cases is time-critical and waiting time for imaging must not result in undue delay. Local referral and reporting protocols should be in place to avoid delays.
6. In fracture clinics, there should be the ability to make direct referrals to physiotherapy and occupational therapy departments.
7. Patients being seen in follow-up fracture clinics should be under the care of a named consultant with all images and medical records available to ensure continuity of care. When transfer of care is appropriate (either due to the nature of the injury or geography), then all images and medical records should be available to the subsequent clinic.
8. Fragility fracture and falls prevention (Fracture Liaison Services) should be fully integrated into fracture clinics, allowing screening of all patients and onward referral where appropriate.
9. There must be a system in place that allows patients rapid access back to the fracture clinic if they have problems related to their initial presenting injury.
10. For common injuries, patient information booklets and exercise sheets should be provided. When the treatment involves cast splintage, slings or appliances, then written care instructions should be provided.
11. Complex Regional Pain Syndrome should be identified early and there should be an agreed protocol for analgesia and therapy with the local pain clinic.
12. Patients seen in fracture clinic who require operative intervention, should have a planned admission for their treatment within a maximum time period set by the surgeon(s) that will not compromise patient safety or outcome.
13. There should be local referral guidelines for fracture clinics and any re-design that deviates from these recommendations should be prospectively evaluated to support the change of practice.

Evidence Base: This guideline is based upon professional consensus, as there are very few scientific studies in this area.

Back

BRITISH ORTHOPAEDIC ASSOCIATION
AUDIT STANDARDS for TRAUMA

December 2017

MANAGEMENT OF DISTAL RADIAL FRACTURES

Fractures of the distal radius are common and result from both high and low energy trauma. The aim of treatment is to optimise functional recovery rather than to achieve specific radiological parameters.

Inclusions: Skeletally mature patients with fractures involving the distal radius.

Standards for Practice Audit:

1. The mechanism of injury and clinical findings, including skin integrity, assessment of circulation and sensation, should be documented at presentation. Radiographic assessment should be postero- anterior and lateral views centred at the wrist.
2. If manipulation is indicated, it should be undertaken using regional anaesthesia, performed by a suitably qualified and trained practitioner (as opposed to local haematoma block).
3. Open fractures should undergo surgical debridement and stabilisation in accordance with the BOAST Open Fractures.
4. Patients should be referred to the Fracture Clinic service and assessed within 72 hours (BOAST for Fracture Clinic Services).
5. Patients with a stable fracture of the distal radius should be considered for early mobilisation from a removable support once pain allows.
6. When using a plaster cast to treat a distal radius fracture, the wrist should be in neutral flexion with 3-point moulding used to hold the fracture and not forced palmar flexion. Consider removing the cast and starting mobilisation 4 weeks after injury.
7. In patients 65 years of age or older, non-operative treatment can be considered as a primary treatment for dorsally displaced distal radius fractures unless there is significant deformity or neurological compromise.
8. In patients under 65, consider ulnar variance, intra-articular step, dorsal tilt and reflect on the patient's needs when assessing whether the patient may benefit from surgical reconstruction.
9. Volar displaced fractures are unstable and should be considered for open reduction and plate fixation.
10. When surgical fixation is indicated for dorsally displaced distal radius fractures offer K-wire fixation if displacement of the radial carpal joint can be reduced by closed manipulation. If this is not possible consider open reduction and internal fixation.
11. If surgical intervention is undertaken, this should be performed within 72 hours of injury for intra-articular fractures and within one week for extra-articular fractures. When operative management is indicated for re-displacement following manipulation, surgery should be undertaken within 72 hours of the decision to operate.
12. Repeat radiographs of the wrist between 1-2 weeks after injury (or manipulation) where it is thought that the fracture pattern is unstable AND when subsequent displacement will lead to surgical intervention.
13. A radiograph of the patient's wrist at the time of removing immobilisation is not required unless there is clinical cause for concern.
14. Patients should be assessed for falls risks and bone health, and referred to the fracture liaison services and

or falls service where appropriate.

15. All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work, education and driving. Patients should be able to self-refer to the fracture service if progress is not as anticipated and hospitals should provide this mechanism.

Evidence Base:

NICE Non-Complex Trauma Guidelines: https://www.nice.org.uk/guidance/ng38

BSSH BOA Blue Book: http://www.bssh.ac.uk/professionals/management_of_distal_radial_fractures.aspx

12.5 Fragility Fracture

References:

1. Kanis JA, Oden A, Johnell O, Jonsson B, De LC, Dawson A. The burden of osteoporotic fractures: a method for setting intervention thresholds. Osteoporos Int. 2001; 12(5):417-427.
2. Crandall CJ, Hovey KM, Cauley JA. Wrist fracture and risk of subsequent fracture: findings from the Women's Health Initiative Study. Journal of Bone and Mineral Research. 2015;30(11):2086-95
3. Distal radius fracture risk reduction with a comprehensive osteoporosis management program. Harness NG et al. J Hand Surg Am. 2012 Aug;37(8):1543-9.
4. http://www.nice.org.uk/guidance/cg146/evidence/osteoporosis-fragility-fracture-full-guideline-186818365 [accessed 3/3/2016] https://www.nice.org.uk/guidance/cg161/chapter/1-recommendations#preventing-falls-in-older-people-2 [accessed 3/3/2016]

5. Sherringtonetal.2011 Exercisetopreventfallsinolderadults:anupdatedmeta-analysisandbestpracticerecommendations.' *NewSouth Wales Public Health Bulletin*
6. https://www.rcplondon.ac.uk/projects/fracture-liaison-service-database-fls-db [accessed 3/3/2016]
7. https://www.rcplondon.ac.uk/projects/falls-and-fragility-fracture-audit-programme-fffap [accessed 3/3/2016]

12.6 Outcome Measures

Supplemental data.

Acknowledgements:

The GDG wish to acknowledge the contribution of the following medical statisticians to the outcomes chapter who provided their expertise in applying the COSMIN critical appraisal checklist to the included studies.

-Trish Hepburn, Senior Statistician Faculty of Medicine & Health Sciences, University of Nottingham

- Archan Bhattacharya, Research Fellow Statistics/Epidemiology both from the Faculty of Medicine & Health Sciences, University of Nottingham

And also - Helga Perry, at the UHCW Library and Knowledge Services.

Back

Table 12.6.1 Studies of PROMs in languages other than English

Study	PROM	Questionnaire Language	Patients	Measurement properties assessed
Wilcke et al. (2009)[13]	PRWE	Swedish	Adults (n=99)	Reliability Content Validity Structural Validity Cross-cultural Validity Criterion Validity Responsiveness
Lovgren et al. (2012)[14]	PRWE DASH	Swedish	Adults (n_1=16, n_2=16)	Internal Consistency Reliability Criterion Validity
Schonnemann et al. (2011)[15]	DASH	Danish	Adults (n=60)	Internal Consistency Reliability Content Validity Structural Validity Responsiveness
Schonnemann et al. (2013)[16]	PRWE	Danish	Adults (n=60)	Reliability Content Validity Structural Validity Cross-cultural Validity Criterion Validity Responsiveness
Hemelaers et al. (2008)[17]	PRWE	German	Adults (n=44)	Internal Consistency Reliability Structural Validity
Kim et al. (2013)[18]	PRWE	Korean	Adults (n=63)	Internal Consistency Reliability Structural Validity Cross-cultural Validity Criterion Validity Responsiveness
Mehta et al. (2012)[19]	PRWE	Hindi	Adults (n=50)	Internal Consistency Reliability Structural Validity Cross-cultural Validity Responsiveness

Back

Table 12.6.2 Measurement properties for PROMs in the English language in the setting of adults with a distal radius fracture

Study	Study size	Measurement property			
		Internal consistency	Test-retest reliability	Validity	Responsiveness
PRWE					
MacDermid et al. (2000)	N=59				SRM/ Effect size =2.27/1.86 (0-3 months) =0.74/0.50 (3-6 months) =2.95/3.91 (0-6 months)
MacDermid et al. (1998)	N=64		Acute fracture: ICC=0.90 Treated fracture: ICC=0.97		
PEM					
Forward et al. (2007)	N=200	Cronbach's □=0.94		vs DASH Spearman's r=0.73	
DASH					
MacDermid et al. (2000)	N=59				SRM/Effect Size =2.01/1.86 (0-3 months) =0.68/0.44 (3-6 months) =2.52/2.32 (0-6 months)
MHQ					
Kotsis et al. (2007)	N=96				Period 1 (3-6 months) Mean (SD) =9.2 (9) SRM= 0.8 Period 2 (6-12 months) Mean (SD) =2.2 (9.2) SRM = 0.2
Brief 12-item MHQ					
Waljee et al. (2011)	N=132				SRM=0.91

Back

Table 12.6.3 Methodological quality of each study per PROM and measurement property

Study	Language	Internal Consistency	Reliability	Measurement Error	Content Validity	Structural Validity	Hypotheses Testing	Cross-cultural Validity	Criterion Validity	Responsiveness
PRWE										
MacDermid et al. (1998)	**English**		Good			Poor			Poor	
MacDermid et al. (2000)	**English**									Good
PEM										
Forward et al. (2007)	**English**	Poor			Good					
DASH										
MacDermid et al. (2000)	**English**									Good
MHQ										
Kotsis at al. (2007)	**English**									Fair
Brief MHQ										
Waljee at al. (2011)	**English**									Fair

Back

Table 12.6.4 Levels of evidence for PROM instrument measurement properties in the English language in the setting of adults with a distal radius fracture

PROM instrument	Internal Consistency	Reliability	Measurement Error	Content Validity	Structural Validity	Hypotheses Testing	Cross-cultural Validity	Criterion Validity	Responsiveness
PRWE	na	++	na	na	?	na	na	?	++
PEM	?	na	na	?	na	na	na	na	na
MHQ	na	na	na	na	na	na	na	na	+
DASH	na	na	na	na	na	na	na	na	++
Brief MHQ	na	na	na	na	na	na	na	na	+

+++ = strong positive evidence, ++ = moderate positive evidence, + = limited positive evidence, +/- = conflicting evidence, ? = unknown due to poor methodological quality, na = no information available

Back

1. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. J Clin Epidemiol. 2010 Jul;63(7):737-45.

2. Goldhahn J, Beaton D, Ladd A, Macdermid J, Hoang-Kim A. Recommendation for measuring clinical outcome in distal radius fractures: a core set of domains for standardized reporting in clinical practice and research. Arch Orthop Trauma Surg. 2014 Feb;134(2):197-205.

3. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res. 2010 May;19(4):539-49.

4. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007 Jan;60(1):34-42.

5. MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. J Orthop Trauma. 1998 Nov-Dec;12(8):577-86.

6. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). Am J Ind Med. 1996 Jun;29(6):602-8.

7. Macey AC, Burke FD, Abbott K, Barton NJ, Bradbury E, Bradley A, et al. Outcomes of hand surgery. British Society for Surgery of the Hand. J Hand Surg Br. 1995 Dec;20(6):841-55.

8. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. J Hand Surg Am. 1998 Jul;23(4):575-87.

9. Waljee JF, Kim HM, Burns PB, Chung KC. Development of a brief, 12-item version of the Michigan Hand Questionnaire. Plast Reconstr Surg. 2011 Jul;128(1):208-20.

10. MacDermid JC, Richards RS, Donner A, Bellamy N, Roth JH. Responsiveness of the short form-36, disability of the arm, shoulder, and hand questionnaire, patient-rated wrist evaluation, and physical impairment measurements in evaluating recovery after a distal radius fracture. J Hand Surg Am. 2000 Mar;25(2):330-40.

11. Forward DP, Sithole JS, Davis TR. The internal consistency and validity of the Patient Evaluation Measure for outcomes assessment in distal radius fractures. J Hand Surg Eur Vol. 2007 Jun;32(3):262-7.

12. Kotsis SV, Lau FH, Chung KC. Responsiveness of the Michigan Hand Outcomes Questionnaire and physical measurements in outcome studies of distal radius fracture treatment. J Hand Surg Am. 2007 Jan;32(1):84-90.

13. Wilcke MT, Abbaszadegan H, Adolphson PY. Evaluation of a Swedish version of the patient-rated wrist evaluation outcome questionnaire: good responsiveness, validity, and reliability, in 99 patients recovering from a fracture of the distal radius. Scand J Plast Reconstr Surg Hand Surg. 2009;43(2):94-101.

14. Lovgren A, Hellstrom K. Reliability and validity of measurement and associations between disability and behavioural factors in patients with Colles' fracture. Physiother Theory Pract. 2012 Apr;28(3):188-97.

15. Schonnemann JO, Larsen K, Hansen TB, Soballe K. Reliability and validity of the Danish version of the disabilities of arm, shoulder, and hand questionnaire in patients with fractured wrists. J Plast Surg Hand Surg. 2011 Feb;45(1):35-9.

16. Schonnemann JO, Hansen TB, Soballe K. Translation and validation of the Danish version of the Patient Rated Wrist Evaluation questionnaire. J Plast Surg Hand Surg. 2013 Dec;47(6):489-92.

17. Hemelaers L, Angst F, Drerup S, Simmen BR, Wood-Dauphinee S. Reliability and validity of the German version of "the Patient-rated Wrist Evaluation (PRWE)" as an outcome measure of wrist pain and disability in patients with acute distal radius fractures. J Hand Ther. 2008 Oct-Dec;21(4):366-76.

18. Kim JK, Kang JS. Evaluation of the Korean version of the patient-rated wrist evaluation. J Hand Ther. 2013 Jul-Sep;26(3):238-43; quiz 44.

19. Mehta SP, Mhatre B, MacDermid JC, Mehta A. Cross-cultural adaptation and psychometric testing of the Hindi version of the patient-rated wrist evaluation. J Hand Ther. 2012 Jan-Mar;25(1):65-77; quiz 8.