Guidelines German Orthopaedics and Trauma Surgery Society (DGOU)

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Distal radius fracture of the adult

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Guideline Commission

of the German Society for Orthopaedics and Trauma Surgery (DGOU)

with the
German Society for Trauma Surgery e.V. (DGU)
Austrian Society for Trauma Surgery (ÖGU)
Swiss Society for Surgery (SGC)

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Preamble 2021

The German Society for Trauma Surgery (DGU) and the German Society for Orthopaedics and Orthopaedic Surgery (DGOOC) have merged the guideline commissions of the two specialist societies into the Guideline Commission of the German Society for Orthopaedics and Trauma Surgery (DGOU). Guidelines from the field of trauma surgery and orthopaedics are now published by the AWMF under the reference number 187. The Guidelines Office of the DGOU is responsible for all guideline issues, contact: leitlinien@dgou.de.

The DGOU Guideline Commission has adopted a uniform structure and outline for all guidelines. This structure simplifies the answering of questions in all guidelines.

This S2e guideline was edited and approved by the DGU Guideline Commission. An attempt was made to draft the texts in keyword form as far as possible in order to simplify the reading of the guideline and to present it in a time-efficient manner. The evidence levels are printed behind the citation numbers. Recommendations of the Commission are graphically highlighted and do not refer to the evidence alone, but also take into account general specialist knowledge and experience. The exact approach and the grading of the evidence can be seen from the guideline report. In addition, reference is made to the preamble of the 2015 guideline version.

The DGOU Guideline Commission is grateful for any comments and remarks on this guideline *Distal Radius Fracture*.

DGOU Guidelines Commission Berlin March 2021

Preamble of the Guideline 2015
Trauma surgical guidelines for diagnostics and therapy

The German Society for Trauma Surgery e.V. (DGU) has been issuing guidelines for accident surgery diagnostics and therapy as a scientific professional society since 1996. These guidelines are formulated by the Guidelines Commission in cooperation with the Austrian Society for Trauma Surgery (ÖGU) and the Swiss Society for Surgery (SGC) and consulted with the Executive Board of the DGU. The guidelines are also consulted with the Guideline Commission of the German Society for Orthopaedics and Orthopaedic Surgery (DGOOC) and, if necessary, other specialist societies.

The guidelines are also published on the homepage of the Arbeitsgemeinschaft Medizinisch Wissenschaftlicher Fachgesellschaften AWMF (awmf.org). The list of all current DGU guidelines can be found on the DGU homepage (dgu-online.de) with a respective link to the relevant AWMF page.

Guidelines can only ever be a snapshot because of the rapid growth of medical knowledge and its relatively short half-life. Therefore, the AWMF has agreed that guidelines should be revised every 5 years. After that, the validity of these guidelines expires at the AWMF. The Guideline Commission of the DGU is constantly working on revising its guidelines, but cannot always meet the 5-year deadline. Therefore, for each specific application of a guideline, it should be checked whether the statement in question still corresponds to the current state of knowledge. This also applies before the expiry of the 5-year period. However, the experience of the Guideline Commission with amendments has shown that changes after 5 years mostly relate to the indications and the surgical procedures. In contrast, the vast majority of the content of the guidelines remains valid for a long time.

The members of the guideline committee, the lead authors and the working groups work on a voluntary basis. The respective statements on compliance can be found for each guideline on the AWMF website. The methodology of guideline development, evidence generation and the consensus-building process are described in detail in a separate document that is attached to each guideline. The current status of guideline development can be found on the homepage of the DGOU (dgou.de) or can be obtained from the head of the Guideline Commission and the office of the DGIU (office@dgou.de).

Guidelines are intended to provide information and contribute to quality assurance for students, doctors in training, specialists, experts, examiners, members of the medical professions, patients and interested laypersons. Their application requires medical expertise. It must be taken into account that guidelines are not fully applicable in every treatment situation.

The freedom of the medical profession cannot and must not be restricted by guidelines. Guidelines are therefore recommendations for medical action in characteristic situations. In individual cases, a diagnosis or therapy that deviates from the guidelines may well be indicated. Guidelines primarily take into account medical-scientific and not economic aspects.

Where possible, the trauma surgery guidelines are drafted in key words and are not intended to be a substitute for textbooks or surgical teachings. Therefore, the guidelines are kept as brief as possible. Accompanying measures such as general preoperative

diagnostics or the indication and nature of any thrombosis or antibiotic prophylaxis are not described in detail; they are the subject of separate guidelines. The treatment methods are usually listed only as a brief designation and not with a description of the specific technique. These can be found in surgical textbooks and current scientific publications.

All accident surgery guidelines are structured according to a uniform structure so that, for example, diagnostics and its sub-items can always be found under point 4 of all guidelines. The structure of individual guidelines can be sensibly adapted in the sub-items.

The guidelines are drafted in such a way that they allow for future innovations and also cover procedures that are rare but useful in individual cases. The development of medical knowledge and medical technology is progressing so rapidly, especially in the field of trauma surgery, that the guidelines always reflect only the current status. New diagnostic and therapeutic methods not mentioned in these guidelines may prove useful in the future and be applied accordingly.

The typical difficulties, risks and possible complications listed in the guidelines do not, by their very nature, represent a complete list of all possible eventualities in individual cases. Their mention indicates that they can also occur despite all the care taken by the acting physician and must be distinguished from a treatment error in the event of a dispute. It must always be expected that even with strict application of the guidelines, the desired treatment result cannot be achieved.

Guidelines are based on scientifically proven study results and the diagnostic and therapeutic consensus of those who formulate guidelines. Medical doctrine can never be homogeneous. This is also documented by the fact that different scientific societies publish guidelines on overlapping topics with occasionally different statements.

Guidelines of level S2e and S3 are based, among other things, on a systematic literature search and assessment with the aim of being able to make certain statements in an evidence-based manner. The level of evidence is determined according to the SIGN criteria.

In the case of questionable treatment errors, it is the task of the court expert to describe the medical standard applicable at the relevant time and to inform the court. The function of the peer and experienced expert cannot be replaced by guidelines. Their application requires medical expertise.

Univ.-Prof. Dr. med. Klaus Michael Stürmer
Göttingen, 9 October 2019
Head of the Guideline Commission
German Society for Trauma Surgery e.V.

Evidence classes (EC) modified according to AHCPR 1992, SIGN 1996

Ia Evidence based on meta-analyses of randomised controlled trials

Ib Evidence based on at least one randomised controlled trial

IIa Evidence based on at least one well-designed, controlled study without randomisation

IIb Evidence based on at least one well-designed, non-randomised and non-controlled clinical trial, e.g. cohort study.

III Evidence based on well-designed, non-experimental, descriptive studies, such as comparative studies, correlation studies and case-control study

IV Evidence based on expert committee reports or expert opinions and/or clinical experience of recognised authorities

The evidence classes are indicated in **bold** after the reference.

1. General

*The General **Preamble** for Trauma Surgery Guidelines is an integral part of this guideline. The guideline may not be used, published or reproduced without consideration of this preamble.*

This guideline was prepared at the S2e level according to AWMF. After the literature reference, the level of evidence is given in Roman numerals.

The sentences marked as recommendations of the Guideline Commission reflect the opinion of the Guideline Commission; they do not necessarily refer to evidence-based literature results, but also take clinical experience and knowledge into account. A weighting of these recommendations was deliberately omitted.

This guideline refers to the injury situation in adults. Fractures of the distal radius also occur in children and adolescents. Here, due to the growth of the skeleton, special aspects must be taken into account which are not listed below.

1.1. Aetiology and epidemiology

1.1.1. Incidence

- Incidence in Sweden 0.32% (32 per 10,000 person-years) [169] **IIb**
- Incidence in patients >35years: 0.37% women (women over 35 years 368/100,000), 0.09% men (90/100,000 in men), [183] **IIa**, men 0.16% , age grouped 0.0104% 65-69years, 0.136% 70-74years, 0.237% >80years [282] **IIb**
- In men 65-69 years old at 0.01, >80 years at 0.024 [282] **IIa**
- Older men have less severe fractures than women [116] **III**
- Men with distal radius fracture after low-energy trauma have significantly low BMD [113] **IIb**
- In polytrauma patients 3.5% [77] **IIb**, in these and high-energy monotraumas > type C injuries [77] **IIb**
- Diabetes mellitus does not seem to influence the incidence of distal radius fractures [264] **Ib**, BMD is not reduced in diabetics [48] **IIb**
- History of falls are independent predictors of radius fractures, BMD screening recommended [52] **IIb**
- Complex fracture patterns (AO/OTA type C) are not dependent on known risk factors for fractures: BMI, osteoporosis, number of previous fractures, smoking, alcohol consumption, but on age and gender (male) [47] **IIb**
- Complex fractures are increasing due to better medical care, longer life expectancy and social changes [44] **IIa**

1.1.2. Accident mechanism

- Fracture localisation and fracture type essentially dependent on
  - from the position of the wrist during the fall
  - the age of the patient
  - see also classification
- Fall on the extended or flexed hand
- Sports accidents

1.1.2.1. Patients: < 40 years mostly high energy trauma:

- Falls and traffic accidents [108] **Ia**
- Gender distribution: approximately equal [157] (Epidemiological study Sweden),
- with a slight overweight of male patients (1.4x more between 15-40 years of age) [244] **IIa**
- >50% dislocated, 2/3 involve the radio-ulnar or radio-carpal joint [157].

1.1.2.2. Patients: > 40 years of low energy trauma:

- Minor trauma, e.g. fall from a standing position [227] **III** [108] **Ia**

- Gender distribution: Significantly more women than men (risk 6.2x higher) [183] **IIa**, in Finland 4.6x higher [119] **IIb**
- Fall on the extended or flexed hand
- Causes of accidents in old age: falls in the home environment
- Fall in case of cardiac arrhythmia or cerebral ischaemia
- Elderly patients more insecure, frail, less agile and less able to arrest falls [209] (R)
- In dislocated distal radius fractures (Colles type) of the elderly patient, volume density of the cortical bone and the average cortical bone thickness are lower than in non-dislocated fractures [283] **IIb.**
- Higher fragility of the bones resulting from
  - Conservation
  - Osteoporosis

1.1.2.3. Predictors of a radius fracture

- Reduced bone density of the distal radius [265] **IIa**, [78] **IIb**, [118] **III**
- Also in men with low-energy trauma, frequently lowered BMD as explanation of fracture [113] **III**
- Increased history of falls [137] **IIa**, [265] **IIa** [52] **IIb**
- Fracture after the age of 50 [265] **IIa** in men [282] **IIa**
- Decreased mental capacity especially >75 years [265] **IIa**
- High serum phosphate [282] **IIb**
- Corticosteroid use, selective serotonin receptor inhibitors (SRIs) 2.6 to 3.6-fold risk of distal radius fractures with SRI use in men [282] **IIa**
- High BMD is a protective factor in men [282] **IIb**

1.2. Prevention

- General accident prevention
- Osteoporosis prophylaxis with medication [46]
- Secondary fracture prophylaxis neglected [178] **IV**
- Physical and mental training, mobility [15] **Ib**, [105] **IIb** [218] **III**
- Protective clothing for appropriate sports (e.g. inline skating)
- Footwear and walking aids adapted to the weather
- Age-appropriate home furnishings
- Treatment of diseases that cause falls
- Fall prevention training is effective [256] **IIb**
- Risk factors for falls are muscle weakness, sarcopenia, impaired balance, impaired vision and should be prevented by prevention programmes [218] [217] **III**, the effect on evidence is not clear

1.3. Localisation

- Distal radius, extra-articular metaphyseal
- Distal radius, intra-articular

1.4. Typical concomitant injuries

- Dislocations and ligament ruptures of the distal radio-ulnar joint and the carpus
- Ulnar ligament complex: Discus triangularis including ligament and tendon apparatus
- Radiocarpal injury
- Carpal injuries
- Fractures and dislocations of the carpus and wrist, especially scaphoid fractures
- SL ligament ruptures
- Processus styloideus ulnae fractures
- Extensor tendon injuries, especially of the thumb
- Nerve injuries
- Fractures of the radial head

1.5. Classification

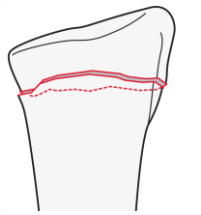
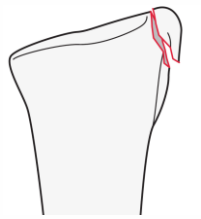
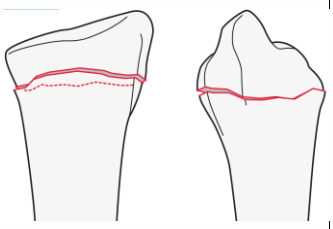
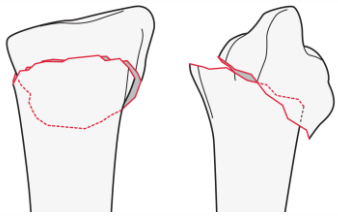
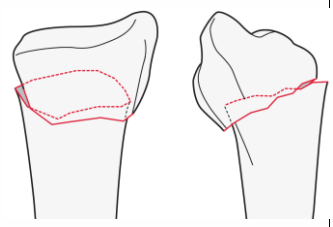
Distal radius fractures are fractures located up to 3 cm proximal to the radiocarpal joint.

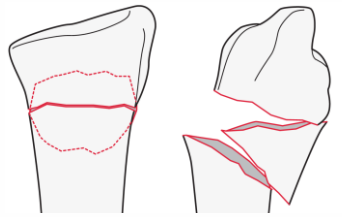
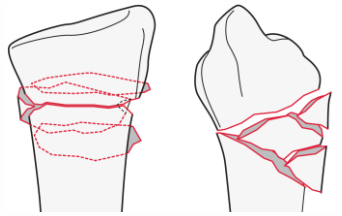
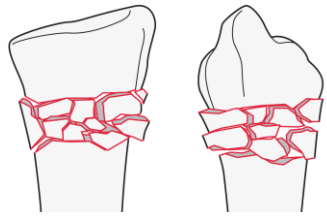
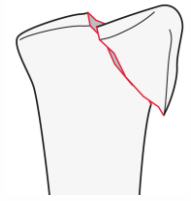
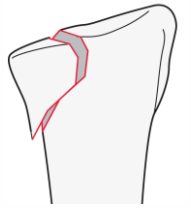
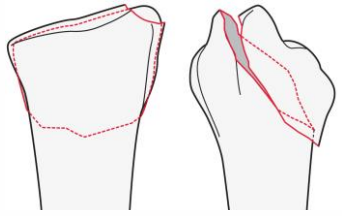
A distinction is made between extra-articular and intra-articular radius fractures, the Ratio is 3:1 [265] **IIb**

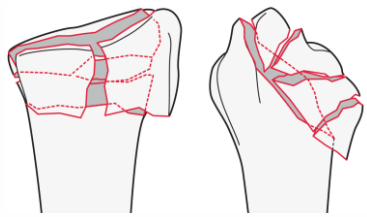
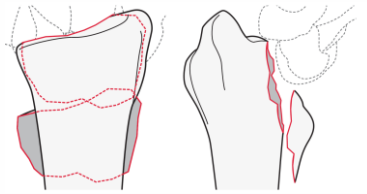
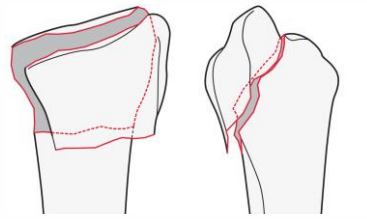
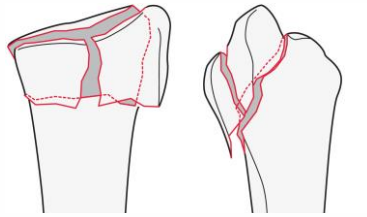
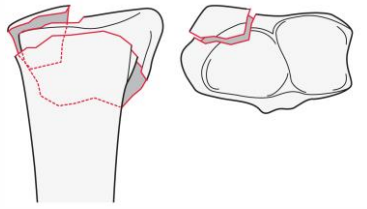
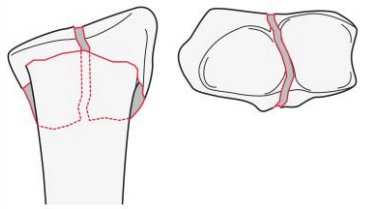
1.5.1. Historical typing

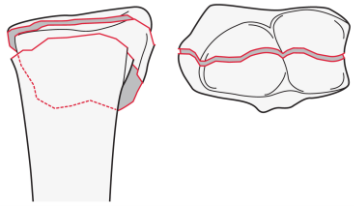
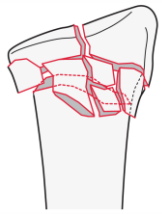
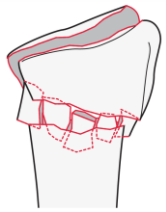
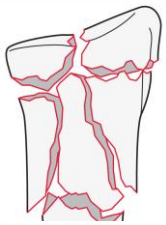
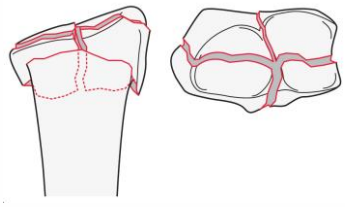
- Colles fracture (1814): extension fracture, dislocation to the dorsal [28] **IV** also Pouteau fracture (1783)
- Smith fracture: flexion fracture, dislocation to palmar also Goyrand-
- Smith fracture [192] **IV**
- Barton fracture: intra-articular, dorsal two-fragment fracture [18] **IV**
- Reversed Barton fracture (Smith II): intra-articular, palmar edge fragment
- Chauffeur fracture: radial wedge fracture

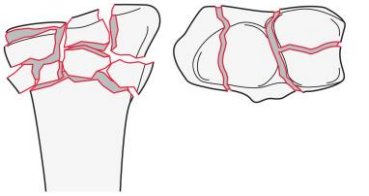
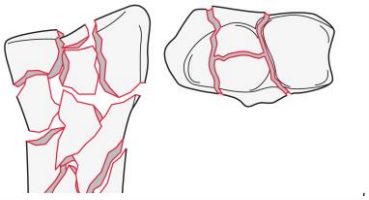
1.5.2. AO/OTA [167]: slightly modified use of the illustrations:

AO/OTA Classification [167]	*Group*	*Subgroup*	*Code*
 Radius, distal end segment			2R3
Type: Radius, distal end segment, **extra-articular fracture**			2R3A
	Radius, distal end segment **extra-articular fracture**		2R3A
	Radius, distal end segment extraarticular **Avulsion fracture Proc. styloideus radii**		2R3A1
	Radius, distal end segment extra-articular **simple fracture**		2R3A2
		**Transvers, no dislocation/inclination (may be abbreviated)**	2R3A2.1
		**simple fracture dorsal dislocation/inclination (Colles)**	2R3A2.2
	Radius, distal end segment, extra-articular, **wedge or multifragmentary fracture**	**simple fracture Volar dislocation/inclination (Smith)**	2R3A2.3 2R3A3

AO/OTA Classification [167]	*Group*	*Subgroup*	*Code*
		**intact wedge fracture**	2R3A3.1
		**fragmented wedge fracture**	2R3A3.2
		**multifragmentary fracture**	2R3A3.3
Type: Radius, distal end segment, **partial articular fracture**			2R3B
	Radius, distal end segment Partially articular, **sagittal fracture**		2R3B1
		**Scaphoid fossa involved**	2R3B1.1
	Radius, distal end segment, partial articular, **dorsal edge (Bartons') fracture**	**Fossa lunata involved**	2R3B1.3 2R3B2
		**simple fracture**	2R3B2.1

AO/OTA Classification [167]	*Group*	*Subgroup*	*Code*
		**fragmented fracture**	2R3B2.2
		**with dorsal dislocation**	2R3B2.3
	Radius, distal end segment, partial articular, **volar edge (reverse Bartons', Goyrand-Smith s'II) fracture**		2R3B3
		**simple fracture**	2R3B3.1
		**fragmented fracture**	2R3B3.3
Type: Radius, distal end segment, **complete articular fracture**			2R3C
	Radius, distal end segment, complete, **simple articular and metaphyseal fracture**		2R3C1
		**Dorsomedial articular fracture**	2R3C1.1* *Qualifications: t DRUG stable u DRUG unstable
		**sagittal articular fracture**	2R3C1.2* *Qualifications: t DRUG stable u DRUG unstable

AO/OTA Classification [167]	*Group*	*Subgroup*	*Code*
		**Frontal/coronary articular fracture**	2R3C1.3* *Qualifications: t DRUG stable u DRUG unstable
	Radius, distal end segment, complete, simple articular, **metaphyseal multifragmentary fracture**		2R3C2
		**sagittal articular fracture**	2R3C2.1* *Qualifications: t DRUG stable u DRUG unstable
		**frontal/coronary fracture**	2R3C2.2* *Qualifications: t DRUG stable u DRUG unstable
		**Extension into the diaphysis**	2R3C2.3* *Qualifications: t DRUG stable u DRUG unstable
	Radius, distal end segment, complete, **articular multifragmentary fracture, simple or metaphyseal multifragmentary fracture**		2R3C3
		simple metaphyseal fracture	2R3C3.1* *Qualifications: t DRUG stable u DRUG unstable

AO/OTA Classification [167]	*Group*	*Subgroup*	*Code*
		Metaphyseal multifragmentary fracture	2R3C3.2* *Qualifications: t DRUG stable u DRUG unstable
		with extension into the diaphysis	2R3C3.3* *Qualifications: t DRUG stable u DRUG unstable

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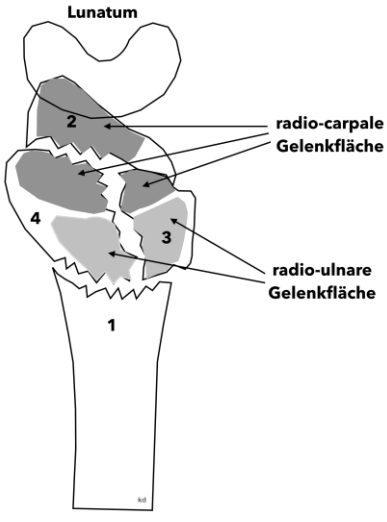
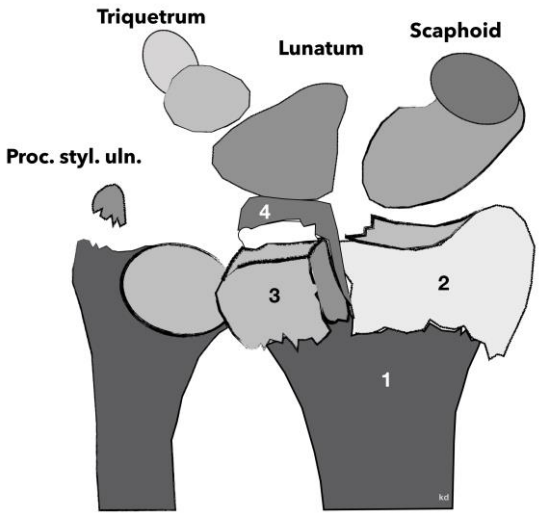
1.5.3. **Frykman (1967)** [82] **IV**

- Type I/II: extra-articular/with avulsion of the ulnar styloid proc.
- Type III/ IV: Involvement of the radio-carpal joint surface/with avulsion of the ulnar styloid proc.
- Type V/VI: Involvement of the radio-ulnar articular surface/with avulsion of the ulnar styloid proc.
- Type VII/V III: Involvement of both joint surfaces/with avulsion of the ulnar styloid proc.

1.5.4. **Melone (1984)** [170, 171] **IV** Classification for intra-articular 4-fragment fractures, emphasis on key ulnar fragments *(1st radial shaft, 2nd radial fragment, 3rd dorso-ulnar fragment, 4th palmar-ulnar fragment):*

- Type 1: stable, little dislocated, little immersed





- Type 2: unstable, ulnar key fragments in the compound
  - Type 2a: unstable, anterior (palmar) moderate to severe dislocation, die-punch fragment
  - Type 2b: unstable, dorsal non-reducible dislocation, double die-punch fracture
- Type 3: unstable, ulnar key fragments dislocated in the composite, additional palmar shaft fragment, die-punch or lunate-load fracture, additional radius fragment dislocated in flexor compartment

- Type 4: unstable, wide dislocation ±rotation of dorsal and palmar ulnar (=medial) key fragment

1.5.5. **Mayo classification (intra-articular radius fractures) [**174] **IV**

- Type 1extraarticular radiocarpal fracture, intraarticular radio-ulnar
- Type 2intraarticular scaphoid fossa
- Type 3intraarticular lunate ±scaphoid fossa
- Type 4intraarticular scaphoid fossa, lunata + scaphoidea

1.5.6. **Pechlaner classification [**191] **IV**

- Type I-1 dorsal metaphyseal fracture
- Type I-2dorsal metaphyseal - articular fracture
- Type I-3dorsal luxation fracture
- Type II-1 central metaphyseal fracture
- Tap II-2central metaphyseal - articular fractures
  - Type II-2Central impression fracture
  - Type II-2B fracture of the proc. styloideus radii
  - Type II-2Culnar rim fracture
  - Type II-2Central multifragment fracture
  - Type II-3 central luxation fracture
- Type III-1palmar metaphyseal fracture
- Type III-2 palmar metaphyseal - articular fracture
- Type III-3palmar luxation fracture

Supplementary parameters

- AFracture undisplaced
- B fracture closed reducible and stable
- CFracture closed reducible and/or unstable
- Dmetaphyseal compression zone < 5mm
- Emetaphyseal compression zone > 5mm
- Fintraarticular dislocation of the fragments <5mm Intraarticular dislocation of the fragments >5mm
- G Instability of the distal radioulnar joint
- Iconcomitant carpal instability

When classifications are tested for reliability and reproducibility on conventional radiographs, it is found that intra- and interobserver reliability is highest for the AO/OTA classification [167] [267] **IIb**

Recommendation of the Guidelines Commission

Stability: indicator for therapy and choice of treatment procedure

1.5.6.1. Instability criteria:

- Break-off of a flexor joint lip
- Dorsal and/or palmar dislocated edge fragments [163] **Ib**

- Rubble zones with relevant shortening of the radius
- Near-base fracture of the ulnar styloid and/or dislocated comminuted fracture
- Radio-ulnar dissociation
- Tendency to redislocation after reduction [163] **Ib**
- Dorsal tilt of the peripheral fragment (dorsal angulation) > 20° in the lateral beam path [152] **IIb,** 10° [5] **III**
- Palmar marking of the peripheral fragment >20° [152] **IIb**
- Relative ulna lengthening >4mm [163] **Ib** [152] **IIb**
- Radial inclination in ap ray (radius joint angle normal approx. 25°) <10° [152] **IIb**
- dorsal and palmar frontal angle have a difference of 7°.
- Radius shortening [163] **Ib** [152] **IIb**
- fractures that can only be held in extreme position, are to be classified as unstable [68] **IV**
- Age is a strong predictive factor for redislocation and failure to heal [163] **Ib**

2. Preclinical management

2.1.Analysis of the course of the accident

- Clarification of the cause of the fall
- Wrist position during fall
- Direct / indirect trauma
- Extent of the violence
- Wearing orthoses / wrist protection e.g. when inline skating

2.2.Emergency measures and transport

- Splint immobilisation of the injured limb
- Adequate analgesia (pain attenuation, pain control)
- Reduction under axial traction in case of extreme malposition with
  - Soft tissue damage
  - Neurological deficits
  - Circulatory disorders

2.3.Documentation

- Circulation
- Sensitivity
- Motor skills
- Measures implemented
- Accident within the scope of the statutory accident insurance

3. Medical history

3.1. Analysis of the mechanism of injury

- Position of the wrist in
  - Extension
  - Flexion
  - Pronation
  - Supination

- Check mechanism
- Adequate trauma
- s. a.1.1

3.2.Statutory accident insurance

- In Germany, an accident report must be made by the employer for all accidents at work, accidents on the way to and from work, accidents in connection with studies, school and kindergarten, and all other legally insured activities - including all their consequences - if the accident results in incapacity for work of more than three calendar days or death.
- In Austria, this notification must be made in any case.
- In Switzerland, employees report accidents to their employer immediately. The employer reports the accident to the responsible Suva agency.
- In Germany, patients must be presented to a doctor who is authorised to perform the accident insurance procedure. This doctor decides on the initiation of an accident insurance curative procedure.
- Further treatment in Germany must take place at the earliest possible time in a facility approved by the DGUV, graded according to DAV, VAV and SAV.
- In the case of all subsequent consequences of accidents and secondary illnesses, the bg-liche healing procedure must be resumed.
- According to the DGUV injury type list (as of 1.7.2018), the following injuries to the **distal radius must** be treated in clinics approved for VAV or SAV:
  - 6.4 (V) Fractures of the forearm combined and single, with given or to be clarified need for surgery in case of multi-part fracture according to type C of the AO classification
  - 6.4 (S) Soft tissue damage
  - 7.7 (7) distal radial fractures with severe displacement by shaft width or joint involvement corresponding to type C3 of the AO classification
  - 8.3 (V) Concomitant fractures of individual carpal bones in the case of a given or to be clarified need for surgery
  - 8.4 (S) Concomitant injuries to the trunk nerves and functionally significant nerves
  - 8.5 (S) Vascular injuries of the fingers, hand or forearm with acute or threatening nutritional disorders, also with clarification of the need for surgery
  - 8.7 (S) All injuries to the hand (including the forearm) with deep, extensive and progressive inflammation
  - 10.1-5 (S) Multiple injury
  - 11.1-5 (S) Complications

3.3. Pre-existing conditions and injuries

3.3.1. Local

- Previous injuries and/or previous operations e.g.
  - Fracture of the radius
  - Dislocation of the carpus
  - Carpal instability
  - Scaphoid fracture
  - Forearm fracture
  - Tendon and nerve injuries
  - Soft tissue injuries

  - Malformations, congenital deformities of the forearm and hand (e.g. Madelung deformity)
- Tumour, e.g. enchondroma, metastasis
- Shunt arm for dialysis
- Infection
- Pre-existing compression syndrome (in Guyon's lodge, in carpal tunnel)
- Pre-existing Complex Regional Pain Syndrome (CRPS)
- Pre-existing diseases of the tendons/tendon sheaths
- Diseases of the rheumatic spectrum - Neurological diseases
- Paralysis
- Osteoarthritis of the wrist or carpus - Aseptic necrosis of a carpal bone - Skin diseases

3.3.2. General

- Polyarthrosis
- Arthritides (e.g. rheumatoid arthritis)
- Tumour disease
- Bone metabolism diseases
  - Osteoporosis
  - chronic kidney disease
- Metabolic disorders
  - Diabetes mellitus does not seem to have an influence on the incidence of distal radius fractures [264] **Ib**
- Lymphatic drainage disorders
- Vascular diseases
  - M. Raynaud
- Neurogenic diseases
  - Paralysis
- Addiction
- Infections
  - Hepatitis
  - H IV
  - Multi-resistant germs (MRSA, MRSE)
- Taking medication, especially anticoagulant medication (e.g. ASA, clopidogrel, coumarins).
- Allergies e.g. against
  - Metals (e.g. nickel)
  - Antibiotics

3.3.3. Social

- Professional activity
- Chronic wrist-straining activities
- sporting stresses
- Walking disability (use of a walking aid)
- Pre-existing retirement

3.4.Important accompanying circumstances

- Additional injury ipsilateral

- handedness (right-handed, left-handed)
- Special activities that put strain on the wrist
- (profession, sport, music)
- Time and interval between accident and first
- Use of a doctor
- Medication:
  - Anticoagulant substances - Oral antidiabetics, insulin
  - Long-term cortisone medication
  - Cytostatics
  - Anti-epileptic drugs or other drugs that significantly affect bone metabolism.
- Drug abuse
- Nicotine abuse
- Malabsorption syndrome
- Legally insured accident

3.5. Symptoms

- Pain especially with supination and forearm rotation
- Loss of strength
- Visible malposition
- Dysfunction and loss of function
- Swelling
- Emotional disturbances

4. Diagnostics

4.1. Necessary examinations

4.1.1. Clinical examination

4.1.1.1. Inspection

pay special attention:

- Soft tissue damage
- Bounce marks
- Prospecting
- Haematoma
- Wounds in the fracture area (open fracture)
- Malposition
- Previous damage, scars

4.1.1.2. Palpation

- Pressure pain over the distal radius
- Pressure pain over the distal radio-ulnar joint
- Pressure pain over the distal ulna
- Pressure pain in the tabatière
- Vascular status, circulatory disorder

4.1.1.3. Function test

- Forearm rotation
- Active / passive function of the wrist
- Active / passive function of the finger joints

- Active / passive mobility thumb joints
- Neurological status
- Compartment syndrome

4.1.1.4. Examination for additional concomitant injuries

- Forearm, elbow, upper arm, shoulder, ipsilateral
- Chain injuries
- Injury to the upper and lower arm plexus
- Injury to the lower extremity, pelvis, spine
- Search for typical concomitant injuries of the hand skeleton and the ligaments of the metacarpus and fingers

At the end of the examination, a fracture gap anaesthesia can be administered for pain management after haematoma aspiration.

Recommendation of the Guidelines Commission

4.1.2. X-ray examination

- Images of the wrist in 2 planes with shoulder abduction of 90°, elbow bent in middle position [235] **IV**
- It is recommended to raise the wrist 10 degrees in the a.p. shot and 20- 25 degrees in the lateral shot.

4.1.3. Laboratory tests

- Preoperative laboratory tests taking into account age and concomitant diseases

4.2. Optional diagnostics

4.2.1. Imaging

4.2.1.1. X-ray

- Wrist with forearm on hand board ap and sideways
- Fluoroscopy / dynamic examination after analgesia

4.2.1.2. Computed tomography (CT)

- For the exclusion of carpal concomitant injuries [96] **III,**
- for the assessment of joint surface congruence [43] **IIb**, [34] **IV**

4.2.1.3. Magnetic resonance imaging (MRI)

- only useful with hand coil
- for detection/exclusion of scaphoid fractures (gold standard) [254] **III** [134] **IIa**, Prospective comparative studies have demonstrated high sensitivity of MRI [134] **IIa**
- for the detection of ligamentous lesions [184] **IIa, [**203] **IV**
- for the detection of cartilage lesions [34] **IV**

4.2.1.4. Sonography

- Sonography [35] **Ib** (> for reduction control) [150] **III**

4.2.1.5. Arthroscopy

- Arthroscopy as part of surgical care [224] **III [**79] **III** [175] III [155] **III [**2] **IV**

4.3.Exceptionally

- not applicable

4.4. Not required

- Purely diagnostic arthroscopy without reconstructive intent in the same session
- Scintigraphy

4.5. Diagnostic difficulties

- Radiological evidence of an undislocated fracture
- Interpretation of the fracture type
- Recognition of additional injuries s. 1.4
- Development of carpal tunnel symptoms
- Development of compartment syndrome

4.6. Differential diagnosis

- Bruise
- Distortion
- Forearm fracture
- Wrist arthritis
- Instability or dislocation in the carpal region
- Dissociation in the distal radioulnar joint
- Injuries of the ulnar complex
- Congenital norm variants and malformations
- Instead of fracture
- Pathological fracture
- Scaphoid fracture
- Tendovaginitis

5. Clinical primary care

5.1. Clinical management

- Analgesia
- Primary immobilisation by splinting
- rapid immediate treatment and immediate diagnostics for emergency indications:
  - Vascular injuries of large vessels
  - Open fractures
  - Soft tissue injuries
  - Luxations
    - in the wrist
    - Wrist
    - Perilunate luxations
  - Compression syndromes
  - Nerve involvement

5.2. General measures

- Continuation of adequate pain treatment and immobilisation

5.3. Special measures

- Preparation for reduction or surgery

5.4. Clinical first aid in polytrauma

- Reduction ±Image intensifier control
- Immobilisation in the
  - Cast
  - Cast rail
  - External fixator
- In open fractures: early administration of antibiotics more important than debridement [138] **Ia,** but debridement promptly [127] **III** and surgical stabilisation usually with external fixator

6. Indication for definitive therapy

A consensus on the indications for conservative or surgical therapy could not be reached so far due to the insufficient study quality.

The choice of treatment procedure is influenced by

- Fracture type
- Concomitant diseases
- biological age
- General condition of the patient (physical and mental)
- Functional demands of the patient and their needs

Goals of treatment [209] (R):

- Freedom from pain
- Mobility and strength
- Restoration of hand and wrist function
- Forearm mobility
- Avoidance of complications
- Reintegration into the social environment

6.1. Non-surgical therapy

6.1.1. Established indications

- Stable extra-articular fractures [166] **IV** [68] **IV**
- Non-displaced or low-displaced intra-articular fractures [166] **IV** [68] **IV**
- local or general contraindication to the operation
- In patients older than 70 years, no functional difference between operative and non-operative with regard to subjective and functional outcome, therefore rather conservative procedure [12] **IIb**
- Radiological outcome and functional outcome often do not correlate in non-surgical care [12] **IIb**
- in over 80s [258] **III**

6.1.2. Relative indications

- Primary reducible and retinable fractures with instability criteria [68] **IV**

- Displaced extra- and intra-articular fractures with an acceptable reduction (radial inclination ≥15°, volar and dorsal angulation <15°, intra-articular step <2mm) at all ages [176] **III**
- Refusal of a proposed therapy [68] **IV**
- Contraindication to surgery [68] **IV**

6.2. Surgical therapy

Indication for osteosynthesis

6.2.1. Clear indications

- Unstable fractures
- Dislocated intra-articular fractures
- Fractures with closed 2° and 3° soft tissue damage
- 2° and 3° open fractures
- Traumatic median nerve compression
- Concomitant vascular and/or nerve injuries
- Unsuccessful conservative reduction and retention attempts
- Displaced Smith fractures
- Acute circulatory disorders after reduction
- Complex concomitant injuries of the wrist and carpus

Instability criteria speak for surgical treatment:

- Break-off of a flexor joint lip
- Dorsal and/or palmar dislocated edge fragments [163] **Ib**
- Rubble zones with relevant shortening of the radius
- Near-base fracture of the ulnar styloid and/or dislocated comminuted fracture
- Radio-ulnar dissociation
- Tendency to redislocation after reduction [163] **Ib**
- Dorsal tilt of the peripheral fragment (dorsal angulation) > 20° in the lateral beam path [152] **IIb,** 10° [5] **III**
- Palmar marking of the peripheral fragment >20° [152] **IIb**
- Relative ulna lengthening >4mm [163] **Ib** [152] **IIb**
- Radial inclination in ap ray (radius joint angle normal approx. 25°) <10° [152] **IIb**
- dorsal and palmar frontal angle have a difference of 7°.
- Radius shortening [163] **Ib** [152] **IIb**
- fractures that can only be held in extreme position, are to be classified as unstable [68] **IV**
- Age is a strong predictive factor for redislocation and failure to heal [163] **Ib**

6.2.2. Relative indications

- For local additional injuries requiring surgery
- For serial injuries of the upper limb
- Bilateral fractures
- Synchronous injury to the lower limb to allow mobilisation
- For multiple injuries
- Explicit patient request
- Special professional or functional requirements on the part of the patient (e.g. watchmaker, musician, special trauma surgeon).

An algorithm is not used because the evidence does not favour clear pathways.

6.3. Inpatient or outpatient

- Predominantly outpatient with conservative treatment
- Often inpatient for surgical treatment depending on
    - From injury type
    - the nature of the operations
    - the individual situation of the patient
    - the respective applicable legal basis

7. Therapy non-surgical

7.1. Logistics

- Materials for hernia splitting and/or regional anaesthesia
- Personnel and material requirements:
- Supporting bandages and the necessary aids and
- Facilities
- Personnel and material competence for the treatment and
- Reposition
- X-ray, image intensifier with documentation option or
- X-ray equipment

7.2. Accompanying measures

- documented education about:
    - Alternative procedure
    - About the further treatment
    - Duration of the treatment
    - "Plaster control", see guideline 012-009 [145].
    - Agreements of control ideas with the doctor
    - Movement therapy in a support bandage
- Instructions for independent practice
- Possible complications
- Correction loss

- Malfunctions
- Complex Regional Pain Syndrome (CRPS)
- Behavioural measures
- Local, regional or general anaesthesia for reduction
- Analgesics as needed

7.3. Most common procedures

There is insufficient evidence to favour a closed technique procedure in the treatment of dislocated distal radius fractures [109], [110] **Ia.**

7.3.1 Non-displaced fractures

- Support bandage
  - Expertise should be available for reduction and application of the support bandages [201] **III**
  - in stable fractures no advantage of upper arm cast vs. forearm cast [190] **Ib**
- Mineral gypsum [61] **IV**, [62] **IV**, [64] **IV**
- to be preferred after reduction [65] **IV,** as better modelling properties [27] **III**
- biodegradable Wood Cast, similar results to fibreglass dressings [102] **Ib**
- Plastic
  - semi-rigid materials [63] **IV**, viscoelastic properties allow accommodation to volume changes [50] **III**, not as primary measure after reduction [58] **IV**
  - rigid materials [60] **IV** [59] **IV**
- Primary definitive with semi-rigid support bandage material, e.g. made of fibreglass [57] **IV**
- Combi-cast technique (hardcast (e.g. made of fibreglass) integrated into semi-rigid material [66] **IV**, for distal radius fractures "focused rigidity casting" is more favourable in terms of functional scores and satisfaction [42] **III**
- Individualised 3D-printed orthoses [287] **III**

7.3.2 Dislocated fractures

- Reposition
- Reduction should always be done under analgesia:
  - Medicinal
  - Fracture gap anaesthesia [61] **IV**, this is very safe and effective in elderly patients [250] **III**
  - Regional anaesthesia
  - Short anaesthesia

*There is currently no hard evidence from randomised trials on which **anaesthetic procedure** should be preferred for reduction of the distal radius fracture in adults [111] **Ia**.*

- Manual traction and reduction (hypomochlion, or countertraction)
- Continuous traction (girl catcher with weight over fingers 1, 2 and manual reduction [65] **IV**
- Retinating forearm support bandage avoiding strong flexion [209] **IV** (no Schede position)

- Whether the position in the cast should be in the functional position or volar flexion and ulnar deviation has not been decided [200] **Ib**
- The result of the reduction is checked under X-ray.

7.4. Alternative methods

- Functional Brace Treatment

7.5. Rare procedures

- Immobilisation without reduction
- Upper arm support bandage, e.g. for immobilisation of the distal radio-ulnar joint or in case of concomitant injuries after drill wire lancing in case of instability in the distal radio-ulnar joint.

7.6. Time

- As soon as possible after the accident

7.7. Further treatment

7.7.1.Behavioural instructions for the patient

- Avoid anything that increases swelling [209] **IV** (R).
- No shoulder immobilisation through arm sling
- Early independent movement exercises (of the adjacent joints) has a preventive influence on the development of CRPS [24] **IIb**
- Use of the hand in all light daily activities [209] (R) [49] **IV**
- Physiotherapy during immobilisation has no clear positive influence on the later extent of mobility (ROM) [106] **Ia**
- There is no evidence whether physiotherapy ±occupational therapy gives better outcome than instructed self-training [106] **Ia**
- Thumb and long finger movement exercises
- Do not let the arm hang down
- Bedding on pillows at night
- If pain or sensory disturbances persist or increase, see a doctor/specialist immediately (e.g. bandage too tight, compression syndrome?).

7.7.2. Medical measures

- For control of support bandage, blood circulation and nerve function see guideline 012-009 [145].
- Pay attention to the extension in the thumb (EPL)
- X-ray check after reduction and support bandage application again within the first week
- Individual progress controls

- Pain medication, administration of non-steroidal anti-inflammatory drugs (ibuprofen) has no influence on fracture healing (radiological), range of motion [8] **IIb**
- Immobilisation >4-5 weeks [40] **Ib**
- In case of unacceptable redislocation: change of treatment procedure
- No secondary post-reposition, as the rate of Complex Regional Pain Syndrome (CRPS) is increased [213] **IIa**

7.8. Risks and complications

7.8.1. General

- Allergic reaction to components of the fixing
Association
- Drug side effect, e.g. analgesics

7.8.2. Local

- redistribution
- acute
- creeping
- Nerve compression
- acute
- chronic
- Acute post-traumatic carpal tunnel syndrome
- Pre-existing carpal tunnel syndrome
- Pressure points due to support bandage
- Movement restriction

Restriction of movement especially of rotation, flexion and extension are difficult to predict [209] (R)

Recommendation of the Guidelines Commission

- Power reduction
- Functional disability
- Inactivity dystrophy
- Primary or secondary rupture of the long extensor tendon of the thumb after osteosynthesis [140] **III [**23] **III [**215] **III** [26] **IV, [**252] III**,** [74] III, incidence at 5% [215] **III**
- Arthrosis, incongruence in the articular surface determinant for post-traumatic arthrosis after non-osteoporotic fracture [147] **IIa**
- Aggravation of pre-existing osteoarthritis
- Shoulder pain due to poor posture of the arm
- Accompanying injuries of the ligamentous apparatus of the wrist and carpus with subsequent painful restriction of movement and instability (TFCC ruptures, DRUG instabilities)
- Complex regional pain syndrome (CRPS), rate
- Delayed healing and pseudarthrosis [159] **III** [208] **IV [**197] **IV**
- Refraction in case of renewed violence within the first 3 months

7.8.3. Risk factors for loss of reduction [238] **Ib,** [181] **IIb, [**152] **III**

- Patient age

- Dorsal debris zone
- Dislocated fracture of the ulna
- Displaced intra-articular fracture
- Flexion fracture
- Distal forearm fracture (misinterpretation)

7.8.4. early instability criteria (<1 week):

- Immediate loss of the repositioning result
- Substantial initial deformity
- Dorsal tilt of the articular surface in the lateral ray path >20°.
- >5mm radius reduction in the ap beam path

7.8.5. secondary instability criteria:

- Loss of reduction with decrease of the palmar and dorsal frontal angle
- Higher age (>60 years)
- radius reduction
- Palm marking

Distal radius fractures in the patient with osteoporosis are challenging. These fractures are often unstable and lose position after reduction and brace immobilisation. They are also difficult to stabilise surgically [209](R). Here, the angle-stable implants show significantly less loss of reduction than the non-angle-stable implants [178] ***III*** *[187]* ***III*** *[144]* ***III****, [185]* ***III****. In osteoporotic bone, support-bandage immobilisation alone is often insufficient to maintain the reduced position [229]* ***IIb*** *[209] (R), see also 8*

Recommendation of the Guidelines Commission

8. Surgical therapy

The choice of surgical procedure depends on the patient's general condition, bone quality, closed or open soft tissue lesions, concomitant injuries, patient motivation/compliance and expected functional load [108] ***Ia***. Although there is insufficient evidence, the trend in industrialised countries is towards surgical treatment of distal radius fracture, mostly angular stable volar plate osteosynthesis [119] **IIb**

8.1. Logistics

- Instruments and implants for the intended osteosynthesis - Instruments for intraoperative complications
- Possibility for additional fixative support bandages
- Possibility of radiological image documentation and fluoroscopy

- Optional
- Instruments for spongiosaplasty
- Bone cement
- Cooking substitutes
- in case of known allergy: titanium implants
- stable-angle implants in osteoporosis [144] **III**, [209] **IV,** [268] **IIb** [164] **IIb**

8.2. Perioperative measures

8.2.1.General measures

Timely, documented education about:

- Operation
- Alternative procedure
- Risks and prognosis of the treatment
- Long-term consequences
- Laboratory as required, especially for relevant general
- Diseases and significant concomitant injuries
- ECG and X-ray of the thorax according to age and medical history
- Thrombosis prophylaxis ind individual according to risk and as needed (see guideline Thrombosis prophylaxis of the AWMF[73]
- Perioperative antibiotic prophylaxis , see LL Antibiotics

8.2.2.Local measures

- Intraoperative stability examination after stabilisation of the fracture to exclude ligamentous injuries (carpus, distal radio-ulnar joint) and to check the fracture stability achieved (to determine possible postoperative immobilisation vs. functional follow-up).
- Do not force wound closure if swelling is severe.

8.2.3.Anaesthesia procedures

- Regional anaesthesias
  - Intravenous regional anaesthesia (IVRA)
  - Brachial plexus anaesthesia
    - the use of continuous nerve block via pump vs. single-shot block in the context of general anaesthesia/sedation does not bring any advantages in pop pain scores [86] **Ib**
    - For drill wire osteosynthesis local anaesthesia in combination with fracture gap anaesthesia
  - With regional anaesthesia procedures compared to general anaesthesia, the postoperative need for opiates is significantly reduced [222] **Ib**
- General anaesthesia

There is currently no hard evidence from randomised trials on which anaesthesia procedure should be preferred in the management of adult distal radius fractures.

8.3. Most common procedures

There is a wide variance in osteosynthesis procedures [230]**IIb**

8.3.1. Osteosynthesis procedures

8.3.1.1. internal procedures

8.3.1.1.1. Conventional plate osteosyntheses

- The distal limit of the volar plate position - no protrusion above watershed line - should be observed according to the Soong classification [248] **IIb** (good reliability) [45] **III [**161] **III** [126] **III**
- The pronator quadratus sparing technique to minimise soft tissue trauma and blood supply to the bone is recommended [38] **III** [126] **III**
- Reconstruction of the pronator muscle does not result in significant differences in pronation force, pain score and mobility [293] **Ib.**
- Palmare plate osteosynthesis [84] **III**, [245] **Ib [67] IIb**
- Almost all dorsally submerged fractures can be anatomically reduced from palmar [37] **IIb**, faster healing due to intact dorsal soft tissues, less frequent spongiosaplasty and fewer tendon problems
- Dorsal plate osteosynthesis, dorsal distraction plate in comminuted fractures leads to good results [194] **IIa**
- In the lift-off technique (reduction on/with the plate), the plate is first fixed distally in the joint block with screws and then fixed with the plate to the metaphysis and shaft, applicable for conventional and angular stable plate osteosynthesis (reduction screw) [237] **IV** [210] **III**

8.3.1.1.2. Angular stable osteosyntheses

- angular stable volar plate osteosynthesis for C-fractures frequent (54%) [123] **III**
- Angular stable implants (especially indicated in osteoporosis), [83] **Ia**, [269] **Ia** [273] **III**
- volar angular stable plate osteosynthesis for unstable fractures in the elderly are effective [273] **III**
- Increase in stability depending on number of bolts and arrangement) [164] **II a** [144] **III**, [186] **IIa, [**206] **III, [**209] **III, [**226] **IIb**
- Bicortical screws in the distal part of the plate should be avoided [85] **III**
- Financial expenditure increased compared to other methods [179] **IIb**, [93] **IIa**
- Multidirectional stable-angle implants [247] **IV** [257] **III**
- angular stable volar plate osteosynthesis via MIO access results in higher patient satisfaction, no functional, clinically significant differences [151] **Ia,**
- MIO via flexor carpi radialis approach have few complications, allows anatomical joint repositioning [124] **III**, MIO with tunneling of pronator muscle [239] **IV** results in less pop pain, recovery of grip strength [39] **III,**

8.3.1.1.3.Screw osteosynthesis

- for AO/OTA B1 (chauffeur) fractures, also percutaneous
- as an additional measure

8.3.1.1.4.Intramedullary nailless osteosynthesis

- for non-complex intra-articular fractures [99] **Ib**
- Identical results as plate osteosyntheses (mostly stable angle) [182] **Ib**, [271] **Ia**
- for intra-articular fractures identical results to volar angular stable plate osteosynthesis with regard to movement, grip strength, degree of pain after 8 weeks, after 2 years better mobility after plate osteosynthesis [98] **Ib**

8.3.1.2.Percutaneous/semi-open procedures

- ***Boring wires*** (Kirschner wires)
- Drill wire osteosynthesis + immobilisation in (plaster) [241] **IIb,** [223] **IV**, for AO/OTA A2, A3, B1 and B2 [25] **IIb,** for AO/OTA A2, A3, C1 [236] **IIb,** [93] **Ib**
- Intrafocal osteosynthesis/drill wire support according to Kapandji + immobilisation in support bandage (plaster) [101] **III**, [225] **Ib, [**249] **Ib**
- Fewer infections with drill wires sunk under the skin [205] **III**

8.3.1.3.external procedures

- ***External fixator*** *as:*
- standard measure for AO type C fractures hardly any differences compared to angle-stable plate osteosynthesis [269] **Ib**
- Emergency measure [207] **III**
- for multiple injuries and polytrauma
- Ilizarov [69] **IIb**
- External fixator with joint excess [100] **Ib,** [107] **Ia, [**54] **IIb, [**207] **III**
- External fixator without joint excess [100] **Ib,** [81] **IIb**
- External fixator with joint overlap vs. external fixator without joint overlap no differences in wrist function, fewer pin infections and nerve irritations with joint overlap [100] **Ib**
- Intraoperative silent assistance

8.3.2.Material/method combinations

- Internal and external procedures, for C3 fractures [290] **III,** [158] **III, [**220] **IIb, [**211] **III**
- Plate osteosynthesis plus drill wires [92] **III**
- Palmary and dorsal plate osteosynthesis [158] **III**

When using dorsal plates with a dimension of 3.5 or 2.7 mm, a high rate of tendon irritation postoperatively is to be expected. When using form-adapted plates of smaller dimensions with limited access, especially ulnodorsally, these hardly occur. The indication for the use of limited dorsal access with shaped plates 2.4 mm results from the injury pattern if a dislocated ulnodorsal edge fragment cannot be reduced and fixed from the palmar side.

Recommendation of the Guidelines Commission

8.3.3. Optional additional measures

- Conservative - non-surgical - treatment of distal ulnar fractures possible in elderly patients [228] **III**
- **Arthroscopically** controlled reduction improves the results with regard to supination, flexion and extension [4] **III, [**224] **III, [**79] **III, [**175] III**, [**155] III**, [**2] **IV**
- especially in younger patients, additional cartilage and ligamentous injuries [155] **IV,** [156] **III** [11] **IIb**, [80] **IV**
- Evidence of violations of the TFCC complex can be detected [142] **III**, [41] **III, [**221] **III**
-

In case of severe swelling and/or traumatic carpal tunnel syndrome: carpal roof splitting, leave skin and forearm fascia open. Secondary wound closure or secondary skin grafting

Recommendation of the Guidelines Commission

- Carpal tunnel splitting [7] **Ib,** [70] **III, [**242] **III**
- Spongiosaplasty, more recent literature is sparse [16] **IV**, [143] **IV**, [146] **IV**
- for an additional spongiosaplasty there are different statements, no clear evidence: reference is made to older literature:
  - Supportive: in combination with the external fixator Advantages [30] **III**, [112] **Ia**
  - no effect - no sufficient evidence [112] **Ia**
- Bone substitutes
  - Bone replacement additive to plate osteosynthesis shows no reliable evidence [168] **Ia,** [87] **IIa**
  - (injectable) calcium phosphate cement [117] **III**, [32] **Ib, [**280] **Ib**
  - Experimental evidence shows: administration alone is insufficient, additive osteosynthesis is required [120] **IIb,** [112] **Ia**
  - Hydroxyapatite [275] **IIb**.
  - (Bio)glass [139] **III**
  - Bone cement in elderly patients [125] **III,** [180] **III**

- Fixation of the ulnar styloid process -no evidence of a positive effect of fixation [9] **IIa**, [89] **III,** [277] **Ib, [**94] **III**
- Fixation of the triangular fibrocartilaginous complex (TFCC) open or arthroscopically [221] **III**
- Transfixation of the distal radio-ulnar joint for dislocation
- Reduction and transfixing drill wires for scapholunate dissociation
- Screw osteosynthesis in concomitant scaphoid fracture (see guideline Scaphoid fracture)[51].

8.4.Alternative travel

- Arthroscopy as an additional measure or as arthroscopically supported osteosynthesis [3] **III,** [142] **III,** [219] **IIa**
- Composite osteosyntheses
  - In the case of pronounced osteoporosis [125] **III**
  - For pathological fractures (metastases, primary bone tumours)

8.5. Rare procedures

- Osteosynthesis + Cage Filling [202] **III**
- Cancellous spongiosaplasty and support bandage immobilisation alone

- solitary defect filling with bone substitutes is not recommended (the sole use without osteosynthesis cannot withstand the physiological demands [120] **IIb**, [130] **Ib.**

*There has long been insufficient hard evidence favouring one surgical procedure [109] **Ia**, [189] **Ia**. Even in highly developed industrialised countries, the variation of therapeutic procedures is high [230] **IIb**. An evidence-based statement for or against conservative or surgical therapy cannot be given [17] **Ib**. Anatomical exact fracture reduction and internal fixation do not seem to have a better outcome than imperfectly reduced fractures in long-term follow-up. In dislocated fractures, osteosynthesis can restore independence more quickly and prevents poor functional outcome as after secondary dislocation with conservative treatment [160] **IV** (R)*

Overview of therapeutic procedures for distal radius fracture (see detailed evidence table in the guideline report)

Explanation:
DASH = Disabilities of the Arm, Shoulder, and Hand
PRWE = Patient-Related Wrist Evaluation
ROM = Range of Motion
I = Therapy procedure I
II = Therapy procedure II

Procedure I vs.	Procedure II	Evidence	Result	Literature
Drilling wire	angular stable volar plate osteosynthesis	IV	Short-term results/function >II Long-term results identical	[223]
Drilling wire	angular stable volar plate osteosynthesis	III	II better radiographic anatomy (radial inclination, volar inclination, radius length), ø evidence for better function than I	[25]
Drill wire percutaneous	angular stable plate osteosynthesis	Ia	II Advantages for unstable fractures	[193]
Drill wire percutaneous	angular stable plate osteosynthesis	Ia	II slightly better function, ø differences radiologically (radial inclination, radial height, volar inclination)	[36]
Drill wire percutaneous	angular stable plate osteosynthesis	Ia	No significant differences II less pop complications, >grip strength, >motion measure, < infections	[292]
External fixator	angular stable volar plate osteosynthesis	Ia	II low better early function, better grip strength n. 3 min, no difference thereafter	[199]
External fixator	angular stable volar plate osteosynthesis	Ia	II better early function, DASH after 3 and 6 months, grip strength, flexion, extension after 3 months. II low less pop. Complications at time. 12 mon. pop	[83]

Procedure I vs.	Procedure II	Evidence	Result	Literature
External fixator	angular stable volar plate osteosynthesis	Ib	Pat. < 50J: after 12 min. I significantly better ROM, grip strength	[243]
External fixator	angular stable volar plate osteosynthesis	Ia	AO type C fracture II Reduction is held ø significant difference in outcome, palmar inclination, ulnar variance, II radial inclination slightly better,	[269]
External fixator	Internal osteosynthesis (predominantly (60%) angular stable volar plate osteosynthesis)	Ia	II Better functional outcome, supination, restoration of volar tilt and radial inclination, faster recovery.	[284]
External fixator	angular stable volar plate osteosynthesis	IIb	ø Difference DASH (Disabilities of the Arm, Shoulder, and Hand), PRWE (Patient-Related Wrist Evaluation), ROM, Grip Strength, Rad. Osteoarthritis sign	[229]
External fixator	Internal osteosynthesis (mainly stable-angle volar plate osteosynthesis)	Ia	ø Difference in long-term analysis	[97]
External fixator	angular stable volar plate osteosynthesis	III	II Outcome better, more expensive, possibly metal removal	[291]
External fixator	Plate osteosynthesis	Ia	II better DASH, better recovery radius length, < infections	[75]
External fixator	angular stable volar plate osteosynthesis	Ib	Unstable distal radius fractures after 3 years no difference in DASH, PRWE, grip strength, ROM	[229]
intramedullary nail	volar plate osteosynthesis	Ib	I idem with II grip strength, clinical outcome, no change pop complications	[182]
intramedullary nail	angular stable plate osteosynthesis	Ia	Identical clinical, functional, radiological results; carpal tunnel syndrome < after I	[271]
intramedullary nail	angular stable volar plate osteosynthesis	III	I better restoration of the volar slope II better supination, radio-ulnar variance	[29]
non-operative, closed + plaster immobilisation	angular stable plate osteosynthesis	Ib	No significant superiority for one procedure	[17]
non-operative, closed + plaster immobilisation	Plate osteosynthesis	Ia	øklin. Difference after 1 year	[168]

Procedure I vs.	Procedure II	Evidence	Result	Literature
non-operative, closed + plaster immobilisation	percutaneous procedures	Ia	II Quality of life equal to I I < complications than II	[168]
non-operative, closed + plaster immobilisation	angular stable volar plate osteosynthesis	III	In complex AO C fractures, >60 J: no static differences after 16 months in function; II better in grip strength, radial inclination, radial height, joint steps.	[289]
non-operative, closed + plaster immobilisation	volar plate osteosynthesis	Ib	In extra-articular radius fractures, after 12 months II is functionally better.	[177]
non-operative, closed + plaster immobilisation	angular stable volar plate osteosynthesis	Ib	Dorsally unstable distal radius fractures: II DASH, PRWE better after 3 + 12 mon.	[231]
non-operative, closed + plaster immobilisation	angular stable volar plate osteosynthesis	Ib	after 12 months no difference in DASH, PRWE	[13]
non-surgical	operational	Ia	No difference in clinical outcome in moderate dislocated fractures	[168]
non-operative plaster immobilisation	volar plate osteosynthesis	Ib	in acceptably reduced intra-articular fractures: II better outcome in DASH n. 12. From.	[177]
MIPO angular stable volar plate osteosynthesis	angular stable volar plate osteosynthesis	Ia	I greater patient satisfaction ø Differences in grip strength, for clinical scores, ROM, radial inclination, volar inclination.	[151]
Nagelosteo-synthesis	MIPO	III	for extra-articular unstable fractures II Incision shorter, after 6 min I better clin. Results	[253]

8.6. Time of operation

- Emergency
- Open fractures [274] **Ib**, [138] **Ib**
  - Fractures with severe soft tissue damage
  - Impending or manifest compartment syndrome
  - Concomitant nerve lesions
  - Significant non-reducible dislocation
- Primary, if justifiable by the logistics and the patient's condition
- speedy operation is advantageous [279] **III**
- Secondary

- After decongestion
- After loss of reduction with conservative approach

8.7. Postoperative treatment

8.7.1.General postoperative measures

- Analgesia adapted to pain
- Thrombosis prophylaxis see AWMF guideline VTE prophylaxis [73].
- Elevated position
- Control of blood flow, sensitivity and motor function peripherally

8.7.2.Special surgical postoperative measures

- Splint immobilisation, depending on the type of osteosynthesis and the stability achieved
- With postoperative cast immobilisation after volar plate osteosynthesis, analgesic consumption is pop. lower than without immobilisation, functional results are not influenced by immobilisation [10]**Ib**
- Treatment with compression gloves reduces swelling, pain medication requirements, improves mobility(ROM) and allows more participation in activities of daily living [173] **Ib**
- manual lymphatic drainage [141] **Ib,** [114] **IIb**
- Apparative lymph drainage (negative pressure therapy) [266] **Ib**
- Immobilisation for 8 weeks in case of additional ligament injuries
- Avoid anything that increases swelling [209] **III**
- Elevated position, positioning on pillow at night
- No shoulder immobilisation through arm sling
- Early independent movement exercises of the adjacent joints
- Use of the hand in all light daily activities [209] **III**
- the sensorimotor deficit can be improved by extensive treatment protocols, the effectiveness of proprioceptive training could not be demonstrated [281] **IIb**
- X-ray controls immediately postoperatively in 2 planes,
- 8 weeks after surgical treatment in 4 planes, CT examination if necessary.
- Check plate position, reduction and screw length with CT [90] **III,** [85] **III** or screw length with ultrasound [251] **III**
- Antibiotic prophylaxis, optional (see guideline)
- Thrombosis prophylaxis see guideline Thrombosis prophylaxis [73] [104].
- Regular wound checks

8.7.3.Physiotherapy

Randomised trials have not yet shown a preference for rehabilitation in adult distal radius fracture [106] ***Ia.***

- Instructions for regular exercises of the finger joints, elbow and shoulder joint

- Involving the injured hand in the activities of daily life as early as possible
- Do not engage in weight-bearing activity until the bony consolidation of the injury is documented.

- The timing of the start of physiotherapy shortly after surgery compared to later onset seems to positively influence dash score, grip strength and pain, after 1 year there is still no difference [294] **Ib.**

8.8. Risks and early complications

8.8.1. Non-surgical treatment

- General
  - not applicable
- Local
  - Anomalies in the course of the cutaneous branch of the median nerve [133] **IIb**
  - Acute carpal tunnel syndrome, especially with high-level trauma [56] **IIb**, [211] **IIb**
  - Rotational, axial deviations - Delayed healing
  - Pseudarthrosis [262] **Ia,** [159] **IV,** [71] **III, [**76] **III**
- Complex regional pain syndrome (CRPS)[24] **IIb**
  - Incidence 0.64% after osteosynthesis (in South Korea) [132] **IIb**
  - Factors influencing CRPS: Female gender, high energy trauma, severe injury, comminuted fracture [213] **IIb**

8.8.2. Surgical treatment

2% of all patients after osteosynthesis of a distal radius fracture have a complication within 30 days [131] ***IIb***
Reoperations 1.1% [131] ***IIb***
General complications in ASA III and IV patients are internal complications such as urinary tract infections, cardiac problems, infarctions etc., but overall low [233] ***IIb***

- General
  - Skin closure not possible with severe swelling
  - Post-bleeding
  - Vessel, nerve lesion e.g. radial artery, median nerve [74] **III**, ramus superficialis of the radial nerve
  - Sensorimotor disorders and deficits [136] **IIb**
- Wound healing disorders/infections

In most of the publications dealing with fractures (70% of randomised controlled trials)), no definition is given for infections, so comparisons are difficult [172] **Ia**

Recommendation of the Guidelines Commission

  - Pin track infection [198] **Ia,** [285] **Ia**
  - Complications postoperatively after external fixator are frequent, but no longer play a role in the long-term result
  - Infection after percutaneous drill wire osteosynthesis [115] **IIb**
  - Keep pin sites dry, dry crust beneficial [91] **IIb**
  - Infection of soft tissues, bone, joint
- Rotation, axis deviations
- Implant dislocation
- Implant malpositions [248] **IV,**
  - Malposition of the volar plate distally beyond the watershed line [279] **III**
  - Dorsal and intra-articular screw penetration, protrusion is referred to [55] **IIb**. Intraoperative control for reduction, screw position and protrusion with special radiographs (dorsal tangential adjustment) [20] **Ib,** Skyline View: vertical fluoroscopy in wrist extension and supination) [72] **III**
  - In case of doubt, CT clarification postoperatively, as conventional X-ray diagnostics may not be sufficient [55] **IIb,** [85] **III**
  - Screws in the distal part of the plate tend not to be bicortical [85] **III** conventional **radiography** cannot adequately assess volar and dorsal radius inclination, radius shortening, ulnar variance, radius inclination and joint steps [129] **Ia**

- **Complex regional pain syndrome** (CRPS), incidence 0.64% after osteosynthesis (in South Korea) [132] **IIb**
  - Risk factors: Influence by: female sex, rheumatoid arthritis, open fracture, concomitant ulna fracture; no influence by psychiatric disease, age [132] **IIb**
  - compared to bridging external fixator, both K-wire fixation, dorsal plate, volar plate, dorsal + volar plate osteosynthesis, plaster immobilisation and non-bridging external fixator appear to be better treatment options for preventing CRPS development [272] **Ia**

- Longer term
- Secondary dislocation of the fracture
- Movement restrictions in the wrist: the volar capsule release after angular stable volar plate osteosynthesis seems to influence this positively [135] **III**
- Rupture of the flexor tendon due to plate prominence [279] **III**
- Functional disorders of the wrist and fingers
- Drill wire perforation
- Secondary dislocation of the implants
- Implant fracture
- Complex Regional Pain Syndrome (CRPS)
- Secondary extensor tendon ruptures especially of the thumb in palmar plate position [14] **Ib**, in dorsal plate position [128] **IIa**, [225] **IIa, [**215] **IIb, [**276] **III, [**252] **III**
- Carpale instability
- Delayed healing of radius
- Pseudarthrosis of proc. styl. ulnae fractures has no functional effects [277] **IIa**

9. Further treatment

9.1. Rehabilitation

9.1.1.Non-surgical therapy

- Physiotherapy to muscular and functional rehabilitation sufficient [234] **IV**

9.1.2.Surgical therapy [234] **IV**

- Physiotherapy
  - Self-acting movement exercises
  - Swelling prophylaxis
- Physical
  - manual lymphatic drainage [141] **Ib,** [114] **IIb**
  - Apparative lymph drainage (negative pressure therapy) [266] **Ib**

- Medicinal
  - Normal use of the fingers and the grip function as far as possible, even after surgery and in a plaster cast

9.2. Controls

- Clinical and radiological controls, questioning the value of radiological follow-up [260] **Ia**
- CT examination in case of questionable remaining step formation in the joint
- Resumption of diagnostics and therapy in case of complications
  - Early recognition of the typical signs of Complex Regional Pain Syndrome (CRPS)
  - Early detection of secondary extensor tendon ruptures

9.3. Implant removal (see guideline Metal removal)

A general recommendation for metal removal after stable-angle volar plate osteosynthesis cannot be given [286] **Ib**. It also seems to depend on the insurance system and reimbursement, in Western Europe around 20%, in the USA 3% [286] **Ib**

The indication must be made in each individual case, it depends on the:

- Age of the patient
- activity level
- Material and rigidity of the implant
- Local complaints
- Neurological deficits, carpal tunnel syndrome
- Secondary operations that become necessary (e.g. tenolyses)
  - Problems with implant removal of titanium implants have been described [103] **III**, [261] **IV**

9.4. Late complications

- Implant loosening
- Implant migration especially with drill wires
- Posttraumatic arthrosis, incongruence in the articular surface leads to arthrosis in non-osteoporotic fracture [147] **IIb**
- In the radiocarpal joint
- In the radioulnar joint
- Complex Regional Pain Syndrome (CRPS)
  - Tendon ruptures (long extensor tendon of the thumb) [216] **IIb**
  - Restriction of movement in wrist and fingers
  - Pseudarthrosis, rate higher in polytrauma patients [77] **IIb**
- Late infection
- Hypertrophic scarring
  - Carpal collapse in case of unrecognised SL rupture

9.5.Possible permanent consequences

- Arthrosis
- Restricted movement of wrist and fingers
- In cases of residual laxity/instability following injuries to the distal radio-ulnar joint (DRUG), there is mainly a functional limitation less a reduction in strength [156] **IIb.**
- Reduction in strength of wrist and fingers
- Chronic pain conditions
- The normal course after distal radius fracture is characterised by the majority of complaints being suspended after about 2 months. Patients with residual symptoms can expect only minimal pain and functional limitation to remain after 6 months after the fracture [162] **IIb**.
- Loss of independence in elderly patients [232] **IIa**
- Increased risk of further fractures in the elderly patient [240] **IV**

10. Clinical-scientific outcome scores

- Gartland and Werley scoring system (1951) [88].
- Lidström (1959) [154]
- Sennwald (1987)
- Solgaard (1985) [246]
- Disabilities of the Arm, Shoulder and Hand (DASH) (1996) [122]Patient focused wrist outcome (2003) [21] [22].
- Patient Outcomes of Surgery - Hand/Arm (POS-Hand/Arm) (2004) [31].
- Castaing (1964) [33]
- Recommendation for measuring clinical outcome in distal radius fractures: a core set of domains for standardized reporting in clinical practice and research [95].

11. Forecast

11.1. Fracture type

- Prognosis is favourable for most fractures, especially stable ones, depending on the **type of fracture**.
- The recovery and retention of the volar cortex is crucial for the prognosis and assessment of instability [195] **III**
- Carpal malalignment is dependent on dorsal kipping after distal radius fracture. Reduction and improvement of the dorsal tilt improves the malalignment recognisable by displacement of the capitate (sure sign of insufficient reduction) [53] **Ib**

11.2. non-surgical treatment

- After **conservative** therapy, discomfort and post-traumatic arthrosis are seen especially with dorsal compression, shortening of the radius and untreated ligament injuries.
- The more precise the reduction of the fracture, the better the functional outcome [53] **Ib** [204] **III**
- Good function is possible even with non-anatomical position and marked deformity on X-ray in patients > 80 years with limited functional requirements [258] **III**
- Ulnar styloid process fractures - do not appear to have a significant impact on outcome in terms of functional limitations, e.g. DASH, PRWE (Patient-Related Wrist Evaluation) [9] **IIa**, [288] **Ia**

- Patients after distal radius fracture (27% operative), 73% (non-operative), 53% remain with it in the following year after poor one-year results [149] **IIa**
- Older patients adapt better to the remaining deformity of the radius and the resulting functional limitation with the exception of forearm rotation.

11.3. Surgical treatment

- After **surgical** treatment (internal osteosynthesis) of unstable distal radius fractures, the outcome is subjectively significantly better measured with DASH score compared to external fixator treatment. In terms of strength, range of motion, delayed healing and median problems, the results between plate osteosynthesis and external fixator are identical [270] **IIb**
- are independently associated with postoperative complications: Risk factors AO/OTA type C, open fracture, significant lunate fossa collapse [153] **III**, for reinterventions the factors are: lunate fossa collapse and low-volume surgeons [153] **III**
- After 3 -24 months, older injured persons after dislocated distal radius fractures have significantly better function after angle-stable plate osteosynthesis, but no better DASH score [295] **Ia**
- DASH score significantly worse with radius shortening > ±2mm and >15° dorsal angulation [278] **III**

11.4. Socio-economic factors

- **Socioeconomic** factors have an influence on functional outcome [255] **Ia**
- Patients with inadequate health education, medical comorbidities are less likely to seek medical support for osteoporosis treatment after distal radius fracture, lack of compliance even with medication [212] **III,** [214] **IIb**

11.5. Osteoporosis

- **Osteoporosis** has a negative impact on functional outcome (in women) [78] **IIb**
- Patients with weakness, age-related decline in muscle mass (sarcopenia) and low appendicular lean mass [1] **IIb,** [188] **IIb**; have poorer recovery after osteosynthesis (age > 50 years), no difference in ROM, volar slope and ulnar variance, with additional slowness poor functional recovery [214] **IIb**

11.6. Age

- in **80-year-old** patients, the outcome is excellent with or without deformity (evaluated with DASH, PRWE) [258] **III**

11.7. Polytrauma

- **Polytrauma patients** with intra-articular fractures (AO/OTA 2R3 C2-3) show worse functional outcomes and higher complication rates [121] **III**
- **Polytrauma** and high-energy monotrauma show similar fracture morphology, polytrauma patients show more delayed fracture healing or pseudarthrosis [77] **IIb**
-

Unsatisfactory results occur after both surgical and conservative treatment.
Recommendation of the Guidelines Commission

12. Prevention of consequential damage

- Reduction as close as possible to the anatomy [34] **III**, restoration and retention of the volar cortex for prognosis and assessment of instability [195] **III**
- Restoration of carpal malalignment, dorsal tilt recognisable by displacement of the capitate (sure sign of inadequate reduction) [53] **Ib,** [19] **III,** flattened angle increases pressure on the ulna and TFCC [196] **IIb, [**263] **IIb** and kinematics of the DRUG [6] **IIb.**
- Reconstruction of joint surfaces, avoidance of joint steps >2mm in intra-articular fracture to prevent arthrosis [148] **IIa**
- Reconstruction of the radius length (most important factor for a good outcome-strength, range of motion, pain) [19] **III**, [165] **III,** Radius shortening has a decisive influence on the kinematics of the DRUG and the TFCC [6] **IIb.**
- Reconstruction of the palmar articular surface inclination
- Recognition and surgical treatment of carpal instabilities (otherwise leads to a poor functional outcome) [19] **III.**
- TFCC injuries in distal radius fracture do not seem to have an evident effect on long-term outcome [175] **III**. A large proportion of TFCC tears do not heal, but many patients are symptom-free [79] **III.**
- Avoidance of joint steps, the more precise the intraoperative reduction, the fewer articular steps, radius length (shortening), the better the patient-assessed outcome [204] **III**
- moderate deviation from the dorsal or volar inclination does not influence the long-term results [204] **III**
- If surgery is indicated, the most stable surgical treatment possible with immediate functional aftercare.
- Radius corrective osteomy in case of malposition and corresponding complaints as early as possible
- Diagnosis of a disc lesion as early as possible
- For all procedures, good neuro-muscular coordination can prevent secondary injuries. This can only be achieved through good physiological rehabilitation (independent exercises and physiotherapeutic care).
- Clarification and treatment of diseases that cause falls
- Diagnosis and treatment of osteoporosis (must be improved) [259] **IIb**

13. Keywords (German, English)

13.1.Keywords german

Not applicable

13.2. Key Words English

accessory injuries, acute support, aetiology, algodystrophy,Alternative method, technique, analgesia, analgesia, anamnesis, case history, anatomical reduction, antibiotic prophyalxis, AO/OTA classification, arthritis (also pl.), arthrography, arthroscopically-assisted reduction, arthroscopy, arthrosis, articular fracture, articular step, Barton fracture, Barton`s fracture, BMD, bone cement, bone density, bone graft, bone mineral density, bone substitute, brace

support, external brace support, brace treatment, brace immobilization, capability, physical function, carpal fracture, carpal injury, carpal instability, carpal tunnel decompression, carpal tunnel release, carpal tunnel syndrome, case history, cast immobilization, splint immobilization, Castaing score, Castaing`s score, Chauffeur`s fracture, Chauffeur`s fracture, circumstances of an accident, details of an accident, mechanism of injury, classification, clinical, closed soft tissue injury, Colles` fracture, combined fixation, combined method or procedure, complex regional pain syndrome (grade 1), compulsory accident (casualty) insurance, computed tomography, concomitant disorders (diseases), concomitant injuries, concomitants, concomitant circumstances, conservative treatment, conservative procedure, nonoperative treatment, controll, exam, examination, follow-up examination, evaluation, Cooney score, Cooney`s score, criteria of instability, instability criteria, CRPS complex regional pain syndrome (grade 1), CT, CT scan, DASH score, delayed wound healing, delayed, retarded healing, demo-graphic data, diagnostics (investigation, examination, evaluation), directly trauma, directly injury, displaced radius (radial) fracture, distal radius (radial) fracture, documentation, dorsal plating, dorsal plate fixation, dorsal tilt, DRUJ, distal radioulnar joint (radioulnar), dynamic examination, dynamic locked screws, early complications, emergency procedure, examination, external fixation (fixateur externe), extra-articular, facility for complications, fixation, fixed-angle implants, fluoroscopy, follow-up evaluations, forearm cast, splint, fracture localization, fracture site, fracture gap, fracture type, type of fracture, Frykman type, functional disorder (failure), functional examination (function evaluation), Gartland and Warley score, gender, general accident prevention, general injury prevention, general carpal disorder, Goyrand-Smith`s fracture, haematoma block, high-energy accident, hydroxylapatite, implant breakage, implant removal, hardware removal, inactivity dystrophy, incidence, indirectly trauma (accident), infection, injury (accident) modus, injury modus, injury modus, intra-articular fracture, intra-focal fixation, Kirschner wire fixation, k-wire fixation, late complications, longterm complications, ligament complex, localization, longterm effect, longterm outcome, longterm results, longterm results (complications, outcome), loss of grip strength, loss of reduction, loss of strength, malfunction, malfunction, malposition, medicaments, medication, drugs, mobility, movement exercises, movement limitation, limitation of movement, MRI, magnetic resonance, MRSA, multiresistant germs, microbes, nerve compression, occurance of complications, open fractures, osteoporotic radial (radius) fractures, osteosynthesis, palmar tilt, palpation, partially intra-articular fractures, pathological fracture, Pechlaner classification, Pechlaner-classification, pharmacologic osteoporosis prophylaxis, pharmacologic therapy (substitution, replacement), physiotherapy, plain radiograph, plain radiography, plaster cast, plaster of paris, polyarthrosis, POP, postoperative treatment, care, posttraumatic arthrosis, predictors, prevention, prophylaxis, primary support, primary support, primary treatment, prognosis, protect IVe clothing (gowning), pseudarthrosis, radial shortening, re-displacement, reduction, regional aneasthesia, rehabilitation, restoration of radial length, risks, risk factors, rupture of the extensor pollicis longus tendon, screw fixation, secondary displacement, Smith fracture, soft tissue damage, soft tissue injuries, soft tissue lesions, stability control, stability evaluation, styloid fracture, fracture of processus styloideus, supplemental injuries, surgical procedure, symptoms, TFCC (complex), time of surgery, typically concomitant injuries, ultrasonography, palmar plate fixation (osteosynthesis), wrist arthroscopy, x-ray evaluation, x-ray examination

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