

Cover Page



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Chapter 12

Summary in English

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All studies enclosed in this thesis focus on the influence of posttraumatic distal radioulnar joint changes on the outcome of distal radius fractures; the radiological aspects in Part II, the acute aspects in Part III and delayed aspects in Part IV. Part I presents a general overview about the clinical and non-clinical aspects of DRUJ instability. Part V presents the general discussion of this thesis, the summaries of this dissertation in English and Dutch, list of publications, acknowledgements and the curriculum vitae of the author.

PART I: CLINICAL AND NON-CLINICAL ASPECTS OF DRUJ INSTABILITY

Due to the osseous anatomy of the articulating distal radius and ulna, the DRUJ yields stabilization by intra- and extracapsular structures. Changes in stabilizing osseous or soft tissue structures may result in an unstable DRUJ. Incidence of DRUJ instability in distal radius fracture patients is reported up to 30%. Despite the negative influence on outcome of distal radius fractures, DRUJ instability remains a diagnostic dilemma. Symptomatic DRUJ instability needs treatment, starting with restoration of the osseous anatomy. If not successful non-anatomical repair of stabilizing structures, salvage procedures or DRUJ replacement can be treatment options.

PART II: RADIOLOGICAL ASPECTS

A coronal fracture of the lunate facet may influence the DRUJ. Computed tomography (CT) scans of the wrist are more sensitive to diagnose these fractures compared to radiographs solely. To date, interobserver agreement for the presence of a coronal fracture of the lunate facet, and its stability, is unknown. In Chapter 2 the null hypothesis was tested that agreement between observers for the presence of a coronal split fracture of the lunate facet, and its stability, remains the same when determined with conventional radiographs, compared to radiographs with an additional CT-scan of the wrist. This study was conducted using a web-based, worldwide collaboration of various voluntary observers. Included were radiographs and CT-scans of 16 distal radius fractures. Thirty-one observers analyzed conventional radiographs only and 29 observers analyzed the CT-scan additional to the conventional radiographs. The observers were asked to determine presence of a coronal split fracture of the lunate facet and if present, its stability. Interobserver agreement for the presence of a lunate facet fracture was fair both with use of radiographs alone and with use of radiographs and additional CT-scan ($\kappa = 0.29$ and $\kappa = 0.24$, respectively). Interobserver agreement on instability of the coronal split fracture was fair for both radiographs and radiographs with CT-scan ($\kappa = 0.29$ and $\kappa = 0.32$, respectively). With respect to the presence of a coronal

fracture line in the lunate facet, the only significant finding, with respect to observer demographics, was that shoulder and elbow specialists had better agreement with CT-scan than radiographs. With respect to instability of the lunate facet fracture, the only significant findings were that hand and wrist surgeons had a significant greater agreement than other specialists did, and experienced surgeons had greater agreement than less experienced surgeons did. From these data can be concluded that additional CT-scan of the wrist does not improve interobserver agreement in diagnosing coronal split lunate facet fractures, but agreement is dependent on surgical specialism and experience.

To diagnose DRUJ instability several methods using CT-scan of the wrist have been published. Reliability of these methods has only been tested in operatively treated distal radius patients. In Chapter 4 inter- and intraobserver agreement is determined for four methods describing DRUJ translation by use of a CT-scan. Furthermore normal values for the four methods are defined. Two independent observers analyzed the wrist CT-scans of 46 patients treated conservatively for a unilateral distal radius fracture. One observer analyzed the CT-scans two times. Based on the outcome of these measurements inter- and intraobserver agreement was determined. Normal range of motion was based on measurements of the uninjured wrist of the included patients. Best inter- and intraobserver agreement was found using the Epicenter Method (intraclass correlation coefficient (ICC) = 0,73 and 0.82 respectively). Normal values varied widely, dependent on the positioning of the wrist. Based on this study can be concluded that the Epicenter Method is most reliable for determination of DRUJ translation using CT-scan, but normal values vary widely which compromises the use of CT-scan for diagnosing DRUJ instability.

PART III: ACUTE TREATMENT

A distal radius fracture accompanied by an ulnar styloid fracture (USF) may increase the risk of DRUJ instability. This assumption is based on heterogeneous data including several distal radius treatment modalities. The influence of an USF on conservatively treated distal radius fractures remains unclear. Due to a disrupted triangular fibrocartilage complex, an USF may result in increased distal radius fracture instability compared to an intact USF. This would result in more secondary dislocation after closed reduction of a distal radius fracture. In Chapter 5 the influence of an USF on secondary dislocation of a distal radius fracture is analyzed. One-hundred, conservatively treated, distal radius fractures were included after closed reduction. Fifty-eight fractures had an accompanying USF and were compared to the 42 single distal radius fractures, focusing on volar tilt, radial inclination and ulnar variance. In contrast to the pre-reduction situation, no differences in the radiological parameters were found between groups directly after the

closed reduction. After 42 days of follow-up in the USF group, a statistically significant reduction in radial inclination was found. This means decreased distal radius fracture stability in presence of an USF.

In Chapter 6 the assumption that non-union of an USF leads to diminished wrist function is tested, after consolidation of the distal radius fracture. Eighteen distal radius patients with a non-union of the USF were compared to 16 patients with consolidation of the USF, focusing on the outcome of the distal radius fracture. Mean follow-up was 30 months after operative treatment. The two groups were equal in baseline characteristics and no differences in range of wrist motion, DRUJ instability or outcome of subjective questionnaires were found at final follow-up. No plausible explanation could be found for the statistical significant difference in grip strength between groups. From these data can be concluded that a USF non-union has no influence on the outcome of a distal radius fracture. Chapter 7 presents the results of a meta-analysis focusing on the influence of a USF non-union on the outcome of a distal radius fracture. After a literature review, 6 studies were analyzed, including 365 distal radius fracture patients of which 135 had an USF non-union and 230 an USF union. Raw data were available for 105 of these patients. Comparing the USF union and non-union groups revealed no differences in outcome of quality of life questionnaires, functional results, grip-strength, pain or DRUJ instability. From these data can be concluded that an USF non-union should not be a separate target for surgery. The influence of DRUJ instability on the outcome of a conservatively treated distal radius fracture after long-term follow-up is analyzed in Chapter 8. Seventeen patients tested clinically positive for DRUJ instability. These patients were compared to 32 clinical DRUJ stable patients at a mean follow-up of 4.2 years. No statistically significant differences, with exception of wrist flexion, were found between groups, with regard to wrist function, strength, pain or outcome of quality of life questionnaires. Therefore the role of DRUJ instability on the outcome of conservatively treated distal radius fractures seems limited.

PART IV: DELAYED TREATMENT

Posttraumatic DRUJ changes may result in pain or loss of wrist function. A treatment-algorithm for DRUJ instability starts with restoration of the osseous anatomy of both radius and ulna. Correction of a distal radius malunion may be complicated by callus formation. A technique to correct for nascent malunions of the distal radius is the “extended flexor carpi radialis approach” followed by volar plating. Although promising, this technique has never been evaluated formally. In Chapter 9, 35 patients treated with this technique are evaluated, after a mean of 20 months of follow-up, focusing on wrist function, complications and radiological outcome. The mean range of flexion-extension

of the injured wrist was 132°, with a mean pronosupination of 169°. With the exception of the intra-articular step, all radiological parameters showed statistically improvement comparing pre- with postoperative situation. No complications were found except for loss of reduction of 5° dorsal angulation in one patient, without clinical consequences. Based on these results can be concluded that the “extended flexor carpi radialis approach” followed by volar plating is safe and effective for correction of nascent malunions of distal radius fractures.

If anatomic or non-anatomic reconstruction techniques are not successful, a salvage procedure may be indicated. Several treatment options have been described to treat restricting or symptomatic DRUJ abnormalities. Darrach described, among others, an operative technique to relieve pain and improve function by resecting the distal ulna. In Chapter 10 the results are presented of a study focusing on the results of a Darrach procedure with the aim of improving wrist function in, among others, patients with posttraumatic DRUJ changes. After a mean of 21 months, 26 patients were evaluated for postoperative wrist pain and –function. Compared to the pre-operative situation, a statistical significant improvement in both parameters was found. Based on these results can be concluded that the Darrach procedure is successful for pain relief and improvement of wrist function in patients with disruption of the normal DRUJ biomechanics.

PART V: GENERAL DISCUSSION AND FUTURE PERSPECTIVES

In the general discussion (Chapter 11) must be stated that DRUJ instability is still a diagnostic dilemma. The lack of reliable clinical tests and varying individual normal values in radiological findings, increase the risk of malpractice. Future research has to focus on comparison of the DRUJ movement in the injured and uninjured wrist individually, either clinically or radiologically. To improve the outcome of distal radius treatment and its complications, dedicated teams with various specialized specialist for pre-, per- and postoperative care should be formed, which treat a set amount of patients per time frame. The role of ulnar styloid fractures on distal radius fractures has been evaluated thoroughly and is limited, even if resulting in a non-union and should therefore not be seen as a surgical target. Several save and effective operative procedures are available to correct DRUJ instability.

