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HANDSURGERY

> 10-year outcome of dislocated radial fractures with concomitant intracarpal lesions as proven by MRI and CT

Renata E. Gologan[1] · M. Koeck[2] · A. J. Suda[2] · U. Obertacke[2]

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Abstract
To clarify the role of concomitant carpal lesions in dislocated distal radius fractures (DRF), 104 consecutive patients with DRF underwent a preoperative morphological examination using CT and MRI. The study was performed between 2004 and 2006 with the aim of recording all types of concomitant carpal lesions as well as their consequences after 1 year. Carpal lesions of different types were found in all treated cases of dislocated DRF. A clinical follow-up 1 year (13.9 ± 6.5 months) after surgical treatment showed no correlation between the carpal lesions and the treatment outcome (previously described by Gologan et al. 2011). A second follow-up study (> 10 years postoperative, range 11.2 ± 0.9 years) was initiated to find suspected later decompensations of the concomitant carpal lesions. A total of 37 of the original 104 patients could potentially be followed up: 22 patients had passed through both follow-ups and 15 could only be contacted with restrictions. 27 patients had died, 24 patients were excluded due to the presence of dementia or explicit rejection, and 16 patients could no longer be found. Using the Castaing score, the first follow-up after 1 year resulted in an average of 4.95 ± 3.1 points (range 0–12; "good result") and the second follow-up after 10 years in an average of 5.91 ± 2.9 points (range 2–14; "good result"). Again, there were no correlations with the primarily recognized carpal lesions [comparable groups 22 vs 22 (identical patients in both follow-ups); lost to follow-up rate 15.4%]. These results suggest that concomitant carpal lesions are primarily prevalent and detectable in (nearly) all dislocated DRF cases. However, with the usual protection of the wrist and the carpus after surgical treatment of DRF, these lesions often do not decompensate or require treatment, even after 10 years.

Keywords Distal radius fracture · Carpal lesion outcome · Long-term outcome distal radius fracture

Introduction

In the 1990s, ligamentous and osseous carpal lesions were found in some studies by arthroscopic verification in dislocated distal radius fractures (DRF) [1–4]. The significance of such "accompanying" lesions in terms of disease severity and need for treatment initially remained unclear or controversial since there were only a few systematic investigations of all dislocated DRF cases. Currently, there is a consensus that concomitant carpal lesions are detectable in the majority of dislocated DRF [5–7].

The literature is inconclusive regarding the optimal management of intercarpal injuries in fractures of the distal radius. Some reports support acute treatment, whereas others show fracture treatment alone results in satisfactory outcomes. It is possible, that over the years, treatment of DRF included some period of immobilization, which may have adequately treated most carpal ligament injuries [5].

Concomitant injuries verified by arthroscopy in the 1990s showed in several studies no clinical relevance [5, 8, 9].

These data, together with some doubts about the diagnostic certainty of the lesions found, and the consequences of surgical therapy were critically discussed despite some subsequent similar results [6]. Therefore, a long-term follow-up of this collective took place > 10 years postoperatively.

✉ Renata E. Gologan
renata.gologan@diakonissen.de

[1] Klinik für Orthopädie Und Unfallchirurgie, Diakonissenkrankenhaus Mannheim, Medizinische Fakultät Mannheim der Universität Heidelberg, Speyerer Str. 91-93, 68163 Mannheim, Germany

[2] Orthopädisch-Unfallchirurgisches Zentrum, Universitätsmedizin Mannheim, Medizinische Fakultät Mannheim der Ruprecht-Karls-Universität Heidelberg, Mannheim, Germany

Methods

The surviving patients were contacted again for a new follow-up > 10 years after trauma and operation and were assessed using the Castaing score [8]. Follow-up examination included to contact the patients, physical and radiological examination according to the scheme of Castaing (in addition query for problems, complications and re-OPs, ethics and radiation). Inclusion criteria for the former study of 2004 were dislocated DRF with an indication for surgical care, an age > 18 years, and the patient's informed consent for the examinations and the necessary documentation. Exclusion criteria were consent not given, the need for urgent immediate care (e.g., an open fracture), multiple trauma, double injury or pre-existing functional disability of the affected extremity [7]. The second follow-up took place on average 11.2 ± 0.9 years postoperatively [approval of the local ethics committee (2012–264 Str-MA)].

The Federal Office for Radiation Protection approved the second follow-up study (BfS-approval Z 522462/2-2012-108), based on the X-ray examination required for the Castaing score.

Results

Basic information was obtained on 75 of the 104 original patients who were available after > 10 years. A total of 37 patients (13 male and 24 female, current average age 69 years) could be contacted again and for 22 of them, complete results (Castaing score) were available for both follow-up occasions. 15 patients did not have a complete dataset at either the first or second follow-up (e.g., missing X-ray image). 27 patients had died in the meantime, for 24 patients a follow-up examination was not possible (rejection, dementia, etc.), and 16 patients could no longer be found even via the civil registry office (Fig. 1). The lost to follow-up rate was calculated as 15.4% and additional 19.2% patients refusing the second follow-up.

5 of the 37 patients received an implant removal due to a subjective disorder. Further reoperations or local

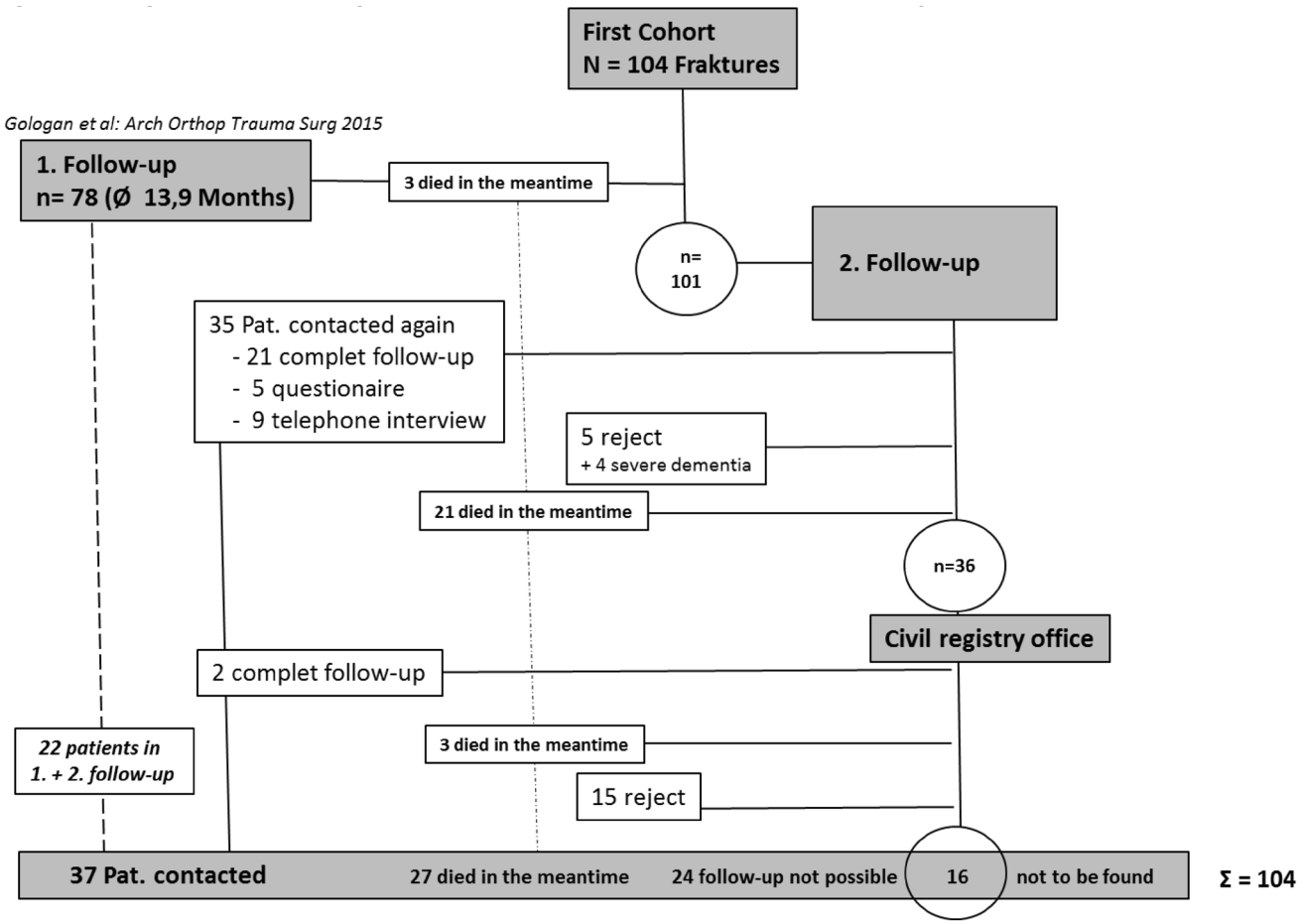


Fig. 1 Development of follow-up cohorts and information on the further life of patients

complications were not detected. The scars were completely non-irritating in all checks of the local findings.

For 22 comparable patients, the mean Castaing score at the first follow-up examination was 4.95 (range 0–12) and at the second follow-up examination after > 10 years 5.91 (range 2–14) (Fig. 2). All 22 patients received internal fixation by palmar plate. The postoperative splinting was removable, physiotherapeutic exercises were performed immediately after operation. The group of patients available for both follow-up examinations, therefore, showed no significant change in their overall Castaing score > 10 years. No SL-dissociations or carpal collapse could be seen radiographically even after 10 years. The variety of concomitant injuries by CT and MRI scan is shown in Fig. 3. The technology of MRI and CT scan in the primary study (11 years ago) allows only differences between bleeding (as sign for a partial rupture) and complete rupture with identified gap.

3 of the 22 patients improved by 1 Castaing point value ("sufficient" to "good result"), and 4 of the patients worsened by 1 point value ("good result" to "sufficient"). The improvements were due to a better objective function, whereas the deteriorations were due to subjective complaints and radiographic findings. One single patient worsened over two point values ("good" to "fair"). The ROM was nearly

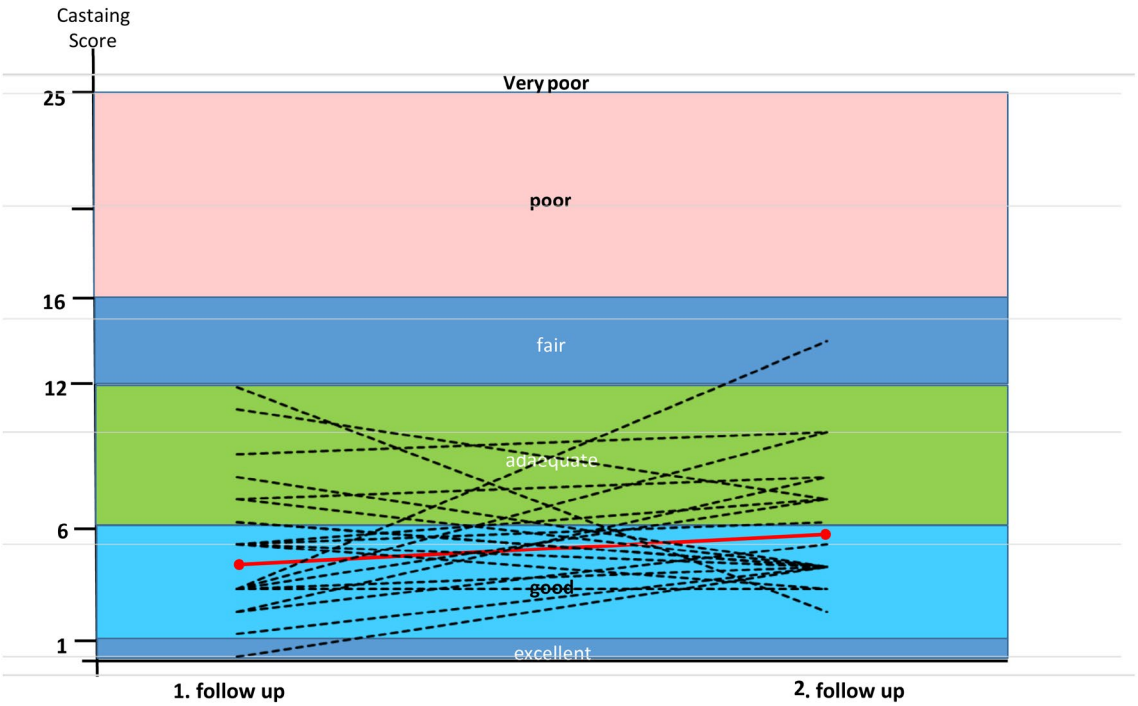
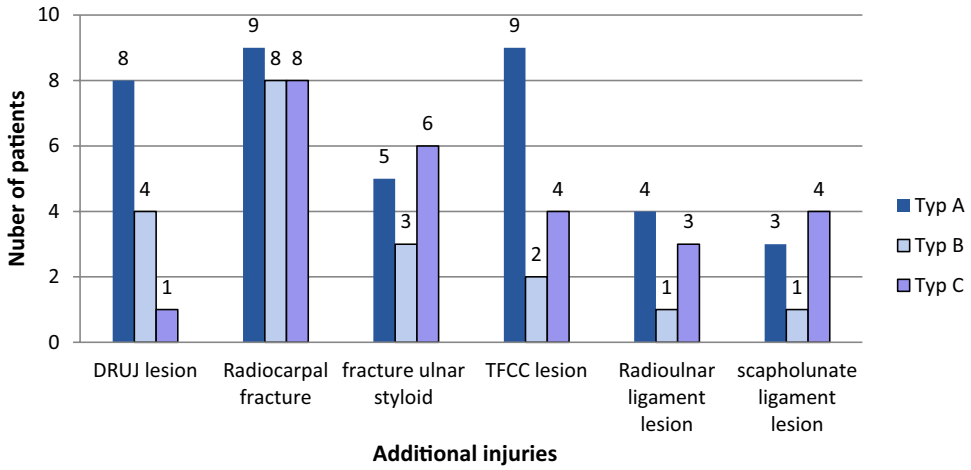


Fig. 2 Individual progressions and mean values (red line) of the 22 patients examined by Castaing score at both time points

Fig. 3 Additional lesions



the same: 1 year after internal fixation the average was 90°, 11 years after operation the average was 95°. There were no reported complications. This was due to high subjective dissatisfaction and radiographic signs of arthrosis. He did, however, show well-compensated objective function. In all patients, there were no correlations between Castaing point values and the primarily recognized concomitant carpal lesions.

Discussion

Nowadays, it can be assumed that carpal lesions accompanying dislocated distal radial fractures (DRF) are the rule [4–7] and they probably do not require any specific treatment over long periods of time. Immobilization of the radiocarpal joint during the usual (even operative) treatment of DRF seems sufficient [3–5, 8, 10].

We started a study in response to the question of identifiable concomitant lesions and their consequences in the case of DRF [7]: in 2004–2006, 104 consecutive patients with DRF were examined preoperatively by means of a CT scan and MRI. The median age of these patients was 60.3 years (21–85 years). The CT scans revealed 84 fractures of the DRUJ, 67 fractures of the PSU and 17 further carpal fractures. MRI revealed 77 morphological tears of the TFCC, 19 SL ligament ruptures and 35 RU ligament ruptures. There was no DRF without concomitant carpal lesion. The above-mentioned 104 dislocated DRF cases were all surgically treated with CT knowledge, and the preoperative MRI findings were blinded to the surgeon (Ethics committee MA 225–04) [7].

The relevance of the concomitant carpal lesions was determined in a first follow-up study after 1 year (13.9 ± 6.5 months) using the Castaing [11] score [33.3% score points each for subjective complaints, objective function and radiographic changes]. 78 of the surviving 101 patients could be followed up after 1 year. The mean Castaing value (point spectrum 0–27) was 4.5 ± 2.5 points ($n = 78$; range 0–12 points) ("good result"). There was no correlation between follow-up study results and primary concomitant lesions [10].

Thus, the consistently "good" clinical follow-up results of the own collective apply only to the dislocated distal radius fractures, which have been surgically treated and which have received a postoperative splinting of the wrist for 4–6 weeks [4, 10]. All 22 patients who had been examined after 1 and 10 years had incidental lesions on the MRI at the time of the accident. However, at that time (due to the study-related blinding of the MRI findings) they did not receive any operative attention during primary care. The follow-up results—despite the concomitant carpal lesions—were "good" (by Castaing [11]). Even after the long interval of > 10 years, no patient with conspicuous carpal findings, especially no carpal collapse, could be identified radiographically or by functional deficits. Our results are limited by the small number of included patients after 11 years and the relatively older patients, older than 65 years. For a selected young collective, the results may be interpreted carefully.

Similar results are now reported in the literature. However, only small groups with concomitant carpal lesions could be included in the published long-term follow-ups over more than 10 years. Mrkonjic et al. [8] investigated 13–15-year follow-up of SL ligament rupture in DRF. In 38 patients with untreated SL rupture, no adverse effects could be found subjectively or objectively (DASH, ROM, pain scale) or radiographically (scapholunate dissociation or carpal collapse) [9]. In 2012, the same group reported a 13–15-year follow-up of non-symptomatic TFCC lesions accompanying DRF. These lesions were verified by arthroscopy during the osteosynthesis. Out of 17 follow-up patients, only one had more pain and a sense of instability [8]. Bolmers et al. [12] compared AO-B and AO-C fractures in a 20-year follow-up subjectively, objectively (DASH, Gartland and Werley Score, ROM) and radiographically (signs of arthrosis) and they could not show any differences between the surgically treated fracture groups.

Clinical and radiographic results in a follow-up period of more than 5 years remain limited to a small number of cases, as nowadays DRF is usually an injury of old age. Therefore, the relatively small cohort should be critically considered in all follow-up examinations. The few publications available show "good" functional results regardless of fracture classification, type of care, and concomitant carpal lesions [13]. If only the DRF is treated (by plate fixation), no clinically relevant decompensation of primary ligamentous concomitant carpal lesion is to be expected even after 10 years [5, 8, 9].

The Castaing score, currently used to discuss comparable follow-up results on injuries of the wrist [7, 13–16], was published in 1964. The score results are based on the subjective assessment (33%), the objective ROM values (33.3%), and the radiographic changes (33.3%) [11]. The Castaing score is a further development of the score developed by Gartland and Werley [13], in which the score results are based on 30% subjective assessment and 70% objective criteria (ROM, X-ray changes, complications) [13]. The Castaing score was used in 2002 to validate the DASH score: the correlations resulted in a Cronbach's alpha value of > 0.8 for all scales ($n = 107$ patients) [17]. Differences in the determination of subjective well-being and functional outcome was shown in 2010; the latter could be better described by the scores of Castaing and Gartland and Werley than by DASH and the SF-36 [2].

In summary, the conclusion is that in primary treatment of DRF it is not necessary to perform a diagnostic search for concomitant carpal lesions that are not primarily

decompensated. A primary "decompensation" of carpal lesions may be assumed analogous to the assessment of the working group around Lindau et al. [9], for example in primarily radiographically recognizable carpal dislocations. An intraoperative fluoroscopic testing for "dynamic decompensation", especially for the SL instability, is regularly advised for the purpose of a medico-legal documentation of the condition at this point. After anatomical reduction and retention—even with angle-stable implants—no early-functional mobilization of the radiocarpal joint is suggested, but the usual procedure with orthetic protection of the wrist for 4–6 weeks. Following this therapy, no clinically relevant decompensation of primary ligamentous concomitant carpal lesion is to be expected even after 10 years [4, 5, 8, 9].

Author contributions All the authors have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data; (2) drafting the article or revising it critically for important intellectual content; (3) final approval of the version to be submitted.

Compliance with ethical standards

Conflict of interest All the authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) our work.

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