



Ulnar styloid process nonunion and outcome in patients with a distal radius fracture: A meta-analysis of comparative clinical trials



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ABSTRACT

Purpose: There is no consensus on the relation between ulnar styloid process nonunion and outcome in patients with distal radius fractures. The aim of this study was to analyze whether patient-reported outcome is influenced by the nonunion of the accompanying ulnar styloid fracture in distal radius fracture patients.

Methods: A meta-analysis of published studies comparing outcomes after distal radius fractures with a united versus a non-united ulnar styloid process was performed. In addition, if provided by the authors, the raw data of these studies were pooled and analysed as one study. The outcome measures of the analyses included patient-reported outcome, functional outcome, grip-strength, pain, and distal radioulnar joint (DRUJ) instability.

Results: Data from six comparative studies were included, concerning 365 patients with a distal radius fracture. One hundred and thirty-five patients with an ulnar styloid union were compared with 230 patients with a nonunion of the ulnar styloid. No significant differences were found between groups regarding any outcome measure.

Conclusion: Based on this meta-analysis, there is no relation between the nonunion of the ulnar styloid process and function in patients with a distal radius fracture.

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Introduction

One in six patients who present with a fracture at the emergency department has a distal radius fracture (DRF) [1–3]. Of those patients, 44–65% also have an ulnar styloid process (USP) fracture [4–7]. Displacement of DRFs may result in disruption of the distal radioulnar ligaments, either by direct ligamentous tear or by avulsion of the origin of the ligaments, that is, a fracture at the ulnar fovea or the ulnar styloid [5,6,8–17]. Ulnar styloid avulsion may result in distal radioulnar joint (DRUJ) instability due to triangular fibrocartilage complex (TFCC) disruption, the principal stabilizer of the DRUJ [9,18–22].

Nonunion of the USP fracture has been proposed as a potential source of ongoing ulnar-sided wrist pain and DRUJ instability [9,22,23]. Mentzel and colleagues reported a better residual function if the USP fracture unites [24]. Others found that nonunion of the ulnar styloid did not affect functional outcome or pain following volar plate fixation of a DRF [25–30].

To date, the relation between USP nonunion and outcome in patients with DRFs is unclear, due to the conflicting results and small sample sizes of the published studies. Therefore, a meta-analysis was performed to provide the best available evidence. The primary aim of this meta-analysis was to compare functional outcome between patients with and without the union of an ulnar styloid and a healed DRF.

Materials and methods

The meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [31].

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Types of studies and participants

All studies comparing DRF patients, with and without union of the USP fracture, were assessed for inclusion in the present study.

Inclusion and exclusion criteria

Inclusion criteria were (1) English or German language, (2) reporting patient-reported outcome measure (PROM), pain, function, and/or DRUJ instability, (3) operatively or non-operatively treated patients, and (4) follow-up of 6 months or more. Exclusion criteria were (1) case series, (2) not available as full text article, (3) no reports on outcome data required for analyses, (4) no reports on 95% confidence intervals or standard deviations for outcome data, (5) the required data for this meta-analysis could not be derived from the published data, nor from the raw data, and (6) multi-trauma patients.

Outcome measures

The primary outcome of this meta-analysis was patient-reported outcome based on questionnaires. Secondary outcome measures were range of motion, grip strength, pain, and clinical DRUJ instability. Furthermore, data extracted from the studies included patient characteristics, study design, sample size, type of radius fracture, length and completeness of follow-up, and type of treatment of the DRF.

Search methods for identification of studies

The systematic search was performed by a professional librarian and a member of our research team (M.M.E.W.) without any limit in publication date in PubMed, EMBASE, Web of Science, COCHRANE, CINAHL, Academic Search Premier, ScienceDirect, Springer, Wiley Blackwell, LWW, HighWire, and Informahealth. The search was conducted on October 22 2013. The search strategy combined various terms and synonyms for ulnar styloid fractures and DRFs. The complete search strategy is shown in the [Appendix](#).

Selection of studies

After removing duplicates, two surgical trainees (M.M.E.W. and J.K.) screened the title and abstract of all studies identified in the initial search, using the inclusion and exclusion criteria. If no abstract was available, the full text was assessed for eligibility. Nonrelevant studies were excluded. Full text copies of the remaining studies were independently assessed according to the predefined inclusion and exclusion criteria. In addition, the reference lists of selected articles were screened for relevant studies not identified in the search, using the above criteria. Disagreements were resolved by means of discussion and arbitration by an experienced trauma surgeon (I.S.).

Assessment of methodological quality

The methodological quality of the selected studies was assessed using the quality assessment tool derived from the Grading of Recommendation Assessment, Development, and Evaluation (GRADE) Working Group [32]. The overall quality of evidence was based on study design, study quality, consistency, and directness. To evaluate the limitations in methodological quality, loss to follow-up and consistency of treatment strategy were scored. Disagreements were resolved by means of discussion, with arbitration by an independent trauma surgeon with a master in clinical epidemiology (N.S.).

Data collection

The two surgical trainees (M.M.E.W. and J.K.) independently extracted data from all eligible studies. The corresponding authors of included papers were contacted by e-mail and requested to provide the raw data.

Analysis of raw data

The available raw data were assembled in one database and analysed as if they were results from one study. Scores on patient-reported outcome questionnaires, range of motion and grip strength (expressed as percentage of that of the uninjured wrist), and scores on a visual analogue scale for pain were compared between the union and nonunion groups using the Mann–Whitney test.

Meta-analysis of the primary outcome

In the selected studies, (a combination of) different questionnaires were used to measure patient-reported outcome. If different questionnaires were used within the same study, these data were pooled in the following way, in order to obtain one summary estimate for the PROMs per study. The results for the different questionnaires were adjusted so that they reflected a scale ranging from 0 (maximal disability) to 100 (no disability). Then, the standardised mean difference with 95% confidence interval within each study was calculated using the inverse variance method with fixed effects. These standardised mean differences from the individual studies were meta-analysed using the method of mean differences with random effects.

Meta-analysis of the secondary outcomes

Pronation, supination, flexion, and extension were analysed separately and reported as an absolute range of motion in degrees. Grip strength of the injured wrist was reported as a percentage of the uninjured wrist and could be pooled between studies without further adjustments. Other secondary outcome measures at follow-up included the percentage of patients with pain and the percentage of patients with DRUJ instability determined by clinical tests.

For meta-analysis of the secondary outcomes, means with standard deviations or numbers (%) were extracted from the articles. The meta-analyses for continuous outcome were performed using the method of mean differences with random effects. The meta-analyses for dichotomous outcome were performed using the Mantel–Haenszel method with random effects. Differences in outcome between the union and nonunion groups with $p < 0.05$ were considered statistically significant. The Cochran's chi-squared test (with significance defined as $p < 0.1$) and I^2 -index (with substantial heterogeneity defined as value $> 50\%$) were used to evaluate heterogeneity between studies.

Results

Literature search

The search resulted in 488 potentially eligible studies, of which 17 full text articles were analysed for eligibility (Fig. 1). Eight studies met our inclusion criteria; however, two studies did not report sufficient data to be included in the meta-analysis leaving six studies available for meta-analysis [24–30]. These studies included a total of 135 patients in the union group and 230 in the nonunion group.

Raw data were available for three out of the six studies [26,29,30]. Six patients (three in the union group and three in the

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