Preexisting Carpal and Carpometacarpal Osteoarthritis Has No Impact on Function after Distal Radius Fractures

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Abstract

Background Functional outcomes of distal radius fractures vary widely regardless of treatment methods.

Purpose This study aims to verify whether preexisting carpal and carpometacarpal (CMC) osteoarthritis (OA) will negatively impact wrist functional outcome in patients with distal radius fractures.

Patients and Methods A retrospective case–control study was done using a prospective trauma database. Patients were matched 1:1 in two groups based on the presence of wrist or carpal arthritis (OA). The groups were matched for sex, follow-up, and treatment type. Patients were followed up for a minimum of 1 year and functional outcomes were assessed using validated scores.

Results A total of 61 patients were included. Mean age was 63 years (range: 20–85) and average follow-up was 26 months. There were 31 patients in the OA+ group and 30 in the OA– group. Forty-one patients were treated surgically and 20 nonoperatively. None of the patients in the OA– developed OA during follow-up. Both groups were comparable for sex, residual deformity, and follow-up. There was no significant difference for the visual analog scale, Short Form-12, Quick Disability Arm Shoulder Hand, and Patient-rated Wrist Evaluation, or for radiographic outcomes.

Conclusion Preexisting OA in the wrist or CMC does not seem to impact outcomes of distal radius fractures, regardless of treatment, age, or sex. Although this is a negative study, the results are important to help counsel patients with distal radius fractures. Further work must be done to identify other potential causes for negative outcomes.

Level of Evidence Level III, prognostic study.

Keywords

- ▶ distal radius fracture
- ▶ prognostic
- ▶ factors
- ▶ carpal osteoarthritis

Distal radius fractures are common, accounting for approximately one-sixth of all emergency fracture consultations.¹ Recent studies have examined the impact of many patient and fracture-related factors on functional outcome.^{2–4} Several radiological factors (loss of palmar angle, radial shortening, and articular incongruity > 1 mm)⁵ and patient

factors (third-party claims, injury compensation, a lower level of education, and multiple medical comorbidities)² that negatively impact functional outcome have been identified. Generalized arthritis has also been associated with poorer outcomes,² and there is a paucity of data on the impact of preexisting carpal or carpometacarpal (CMC)

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arthritis. Prevalence of osteoarthritis (OA) of the wrist varies with age,⁶ but has been found to be as high as 91% in patients older than 80 years,⁷ and is generally estimated to affect between 11^{8,9} and 15% of the population.¹⁰

Treatment options for distal radius fractures include casting, with or without closed reduction, closed reduction with percutaneous pinning, external fixation alone, or in combination with pinning, and open reduction and internal fixation.^{11–13} After attempted closed reduction, unreduced fractures should generally undergo surgical correction in active patients.¹⁴ Although many studies have compared these treatments and radiographic outcomes are better with volar plate fixation, functional outcomes are similar between the groups.¹⁴ Determining factors that will help identify patients with the potential for an inferior outcome is important since it gives patients realistic expectations and can guide the choice of treatment, which might be slightly more aggressive, to help balance the potential negative effects of preexisting arthritis.

Our hypothesis is that preexisting carpal or CMC OA affects outcomes of radius fractures because it contributes to pain and lowers function independently of the fracture. Therefore, the type of treatment, although overall showing no difference in outcome, may specifically affect this unique patient subset, and must also be evaluated.

Patients and Methods

To verify whether preexisting carpal or CMC OA will negatively impact functional outcome in patients with distal radius fractures, we designed a case–control study, using a retrospective chart and radiograph review, with approval from the Institutional Review Board. A database was built incorporating all wrist X-rays performed for fracture evaluation at a Level 1 trauma center over a 3-year period. All X-rays were reviewed to identify patients with or without carpal or wrist OA, identified as the OA (+) group or OA (–) group, by orthopaedic surgeons specialized in upper extremities (D.M. R. and J.H.D.). A research assistant then built a matched cohort of patients with and without OA from this database,

using three patient factors: treatment type (surgical or conservative), length of follow-up, and gender. Both groups were built by a research assistant blinded to the clinical outcome. Postoperative functional outcomes were evaluated using the validated Patient-rated Wrist Evaluation (PRWE).^{15,16} This scoring system evaluates wrist function, including those linked to CMC, with a validated French translation by Voche et al.¹⁵ Secondary outcomes were measured using the Quick Disability Arm Shoulder Hand (QuickDASH),¹⁷ the visual analog scale, and the Short Form-12. All questionnaires were administered either in person, by telephone, or by mail, by the same research assistant. All three questionnaires have been validated for self-assessment and do not require any clinical evaluation.^{15–19}

All patients between 18 and 80 years of age, treated either operatively (including volar plating, external fixation, percutaneous pinning, or a combination of techniques) or conservatively (casting, with or without closed reduction) were included. All operated or nonoperated fracture patients followed the same rehabilitation protocol. They were immobilized 4 weeks in a forearm cast and a removable splint is then applied for 2 weeks with range of motion (ROM) exercises four times a day. Hand therapy is initiated with progressive ROM and strengthening. A minimum follow-up of 1 year, with available initial injury and final follow-up X-rays, was required. Patients’ ability to answer functional outcome questionnaires was also necessary. Patients with prior wrist operations, diagnosis of systemic inflammatory arthritis, reoperation of the affected wrist for prosthesis removal (excluding external fixator removal), or a diagnosis of complex regional pain syndrome were excluded.

All initial wrist X-rays were then classified by two independent observers as either OA+ or OA – , based on the presence or absence of wrist or carpal OA (including radiocarpal, mid-carpal, and carpometacarpal). Any case of discrepancy was re-evaluated and consensus was achieved. Disease severity was graded according to the Eaton and Glickel’s²⁰ and Sodha et al’s classifications⁷ (►Table 1). Fracture types were classified according to Melone’s classification²¹ (used for intra-articular fractures). Measurements of

Table 1 Severity of OA according to the classification described by Eaton and Glickel (1987) and Sodha et al (2005)

Eaton and Glickel	Characteristics	Sodha et al
I	Synovitis phase, slight widening of the joint space (joint capsule distension due to effusion), normal articular contours, and less than one-third subluxation in any projection	I
II	Significant capsular laxity, at least one-third subluxation of the joint. Small bone or calcific fragments less than 2 mm in diameter are present, usually adjacent to the volar or dorsal facets of the trapezium	
III	Greater than one-third subluxation is present. Fragments greater than 2 mm are present dorsally or volarly, usually in both locations. There is slight joint space narrowing	II
IV	Advanced degenerative changes are now present. Major subluxation is apparent, and the joint space is very narrow, with cystic and sclerotic subchondral bone changes. The margins of the trapezium show lipping and osteophyte formation, and there is significant erosion of the dorsoradial facet of the trapezium	III

Abbreviation: OA, osteoarthritis.

radial angulation (lateral view), radial inclination, radial height, and articular malunion (anteroposterior [AP] view) were obtained on all final X-rays.⁵ Malunion for radial angulation was defined as a dorsal angulation of 10 degrees or more.²² The radial inclination on AP view was used as continuous data, since a clear threshold for poor function has yet to be identified in the literature. The radius was considered to be short when 3 mm or more of displacement, compared with the ulna, was present on the AP view.²²

Statistics

After reviewing the current literature using the PRWE, we found an average standard deviation (SD) of 20 and, based on the 100 points scoring system, a significant difference of 15 was established. Finally, the sample size was calculated, using a set power of 0.8 with an α of 0.05, and was found to be 28 patients per group (56 total). All continuous variables were described with mean, range, and SD. The differences between groups (OA– and OA+) were calculated with Student's *t*-test for continuous variables and chi-square test for dichotomic categorical data with more than two categories. Melone's classification was tested with analysis of variance. Statistical significance was defined as a *p*-value lower than 0.05.

Results

A total of 61 patients (47 women) were included. Mean age was 63.3 years (SD: 10.3) and average follow-up was 2.2 years. A total of 31 patients had OA (OA+) and 30 patients presented without OA (OA–); there was no missing data (►Fig. 1). Across both groups, 41 patients treated surgically and 20 patients nonoperatively. Examples of patient X-rays with and without OA are shown in ►Figs. 2 and 3. No patient from the OA– group developed OA during follow-up. The most frequent fracture type was type 1 with 29 patients. All OA patients are presented in ►Table 2, and the most frequent site of OA was the CMC joint with 26 patients (83.9%). Both groups were comparable for the following confounders: sex,

Fig. 1 Flowchart diagram. CMC, carpometacarpal; OA, osteoarthritis; STT, scaphotrapezotrapezoidal.

Fig. 2 X-ray of a left distal radius fracture treated with locking plate and presenting OA of the first CMC joint with no other intracarpal OA. CMC, carpometacarpal; OA, osteoarthritis.

Fig. 3 X-ray of a right distal radius fracture treated with a volar locking plate and presenting no OA of the wrist or CMC joint. CMC, carpometacarpal; OA, osteoarthritis.

Table 2 Description of patient group with OA

Criteria	Number of patients (%)
OA localization, N = 31	
STT	2 (6.4)
CMC	26 (83.9)
RS	0
Other	3 (9.7)
OA grade Eaton and Glickel, N = 31	
I	5 (16.1)
II	11 (35.5)
III	11 (35.5)
IV	4 (12.9)
OA grade Sodha et al, N = 28 ^a	
I	13 (46.4)
II	11 (39.3)
III	4 (14.3)

Abbreviations: CMC, carpometacarpal; OA, osteoarthritis; RS, radio-scaphoidal; STT, scaphotrapezotrapezoidal.

^aRhizarthrosis only.

treatment type, follow-up, and fracture severity (►Tables 3–5). Despite recruitment efforts, there was a significant difference in age.

Overall, we found that preexisting carpal OA did not negatively impact functional outcome in patients with distal radius fractures. Indeed, the patients included in this study had a good functional outcome (►Table 3). No significant

Table 4 Treatment done in both groups ($p = 0.929$)

Treatment	OA+ (N, %)	OA– (N, %)
Surgical	21 (68)	20 (67)
Cast	10 (32)	10 (33)

Abbreviations: OA+, osteoarthritis present; OA–, osteoarthritis not present.

difference was seen between the two groups (OA+ vs. OA–) with regard to functional outcome scores, residual deformity, and radiological findings (►Tables 3 and 5). Furthermore, QuickDASH and PRWE were strongly correlated to each other ($p < 0.001$), and no difference was found in outcomes based on treatment type. A post hoc power analysis revealed a power of 0.99 and a β of 0.01.

Discussion

Distal radius fractures are common and, generally, patients recover well after sustaining these fractures.^{1–3} Nonetheless, several patients have poor outcomes following treatment for distal radius fractures.^{2,5,23} Our primary goal was to evaluate disability due to preexisting wrist arthritis, as determining specific patient or fracture characteristics leading to these bad outcomes could help surgeons counsel patients, and potentially alter treatment protocols.

There are several limitations to this study. First, it is retrospective in nature, despite the collection of outcome scores. As with all studies evaluating fracture outcomes, accurate preinjury functional levels are difficult (if not impossible) to obtain. Although every effort was made to recruit

Table 3 Description of both groups with demographic data and functional outcome scores

Criteria	All patients	OA+ (SD)	OA– (SD)	p-Value
Age (y)	63.3 (10.3)	68.3 (7.5)	58.2 (10.4)	0.001
Sex female (%)	77	84	70	0.198
Follow-up (y)	2.2 (1.0)	2.4 (1.0)	2.1 (1.0)	0.297
PRWE	16.6 (22.9)	18.1 (24.1)	15.2 (22.2)	0.638
QuickDASH	16.2 (22.3)	16.2 (22.6)	16.1 (22.5)	0.984
SF-12P	47.8 (11.1)	45.9 (12.1)	50.3 (9.3)	0.229
SF-12M	48.4 (9.9)	49.1 (8.7)	47.5 (11.5)	0.623
VAS	1.4 (2.2)	1.7 (2.5)	1.0 (1.7)	0.210
Melone's classification				
Type 1	29	15	14	0.455
Type 2	3	2	1	
Type 3	27	12	15	
Type 4	0	0	0	
Type 5	2	1	1	

Abbreviations: OA–, osteoarthritis not present; OA+, osteoarthritis present; PRWE, Patient-rated Wrist Evaluation; QuickDASH, Quick Disability Arm Shoulder Hand; SD, standard deviation; SF, Short Form; VAS, visual analog scale.

Table 5 Mean residual deformity in both groups at final follow-up

Criteria	OA+ (SD)	OA– (SD)	p-Value
Angulation malunion (N, %) (10 deg dorsal or +)	3 (9.7)	1 (3.3)	0.32
Radial height (N, %) (Radius – 3 mm+)	7 (22.6)	6 (20.0)	0.81
Articular malunion (N, %) (> 1 mm)	3 (9.7)	3 (10.0)	0.97

Abbreviations: OA+, osteoarthritis present; OA–, osteoarthritis not present; SD, standard deviation.

a representative sample, the OA+ group had an average older patient population age. It is possible that the older patients in this group had lower functional demands, and therefore, were less impacted by the combination of pathologies. Second, we included CMC joint arthritis in this study as part of wrist arthritis. Although this is factual, we agree that CMC arthritis is a different pathology than radiocarpal and mid-carpal OA. It is possible that including more patients with carpal OA would have changed the outcome, although not likely. Finally, it is possible that with longer follow-up, patients with previous OA could have an accelerated progression due to the injury, although unlikely. Longer term follow-up of this cohort will perhaps be able to definitively answer that question. This study remains a well-designed, matched cohort with excellent power on post hoc analysis.

To prevent selection bias, patient recruitment was done by a research assistant, blinded to the functional outcomes. Among all the available upper limb patient functionality questionnaires we chose: the QuickDASH, PRWE, Brigham and Women's, and Gartland and Werley scores. Changulani et al²⁴ found that while the PRWE has fair external validity, it is the most specific score for the wrist joint,²⁴ and many studies have made this score the mainstay of wrist pain and function evaluation.^{2,3,11–13,18,25} It is therefore unlikely that our validated tools would have missed a significant difference in outcomes among the two groups. Grewal et al² showed that the most significant predictor of pain and disability at 1 year follow-up was third-party compensation.² Injury compensation, lower education, and the presence of other medical comorbidities also negatively affected the PRWE scores at 1 year.² The same study also found that the presence of generalized arthritis was associated with pain and disability. Furthermore, it has been shown that the type of distal radius fracture and initial fracture displacement has an impact on outcomes at 1-year follow-up.^{5,23} To the best of our knowledge, no study had examined the implication of preexisting wrist or carpal OA on functional outcomes after a distal radius fracture. Our results could be generalized to centers using similar treatments and therapy protocols, treating patients suffering mostly from CMC OA. Further studies could also address this topic prospectively.

Although many factors can influence outcome in distal radius fractures, preexisting OA seems to have no impact, regardless of treatment, age, or sex. Surgeons can give

patients affected by this combination of pathologies objective expectations and choose an appropriate treatment without needing to factor in the preexisting OA. These results are also important to identify potential causes of negative outcome. Although our study has shown that preexisting wrist OA does not impact functional outcomes of distal radius fractures, it provides important findings and is very well powered with a probability of a bigger study showing any difference at less than 1%.

Ethical Review Committee Statement

The ethical committee approval number is CÉR-2011-595.

Conflict of Interest

D.M.R. is a consultant for Bioventus and Wright. S.L. is a consultant for Stryker. The institution (Hôpital du Sacré-Coeur de Montréal, Montréal, Québec, Canada) of all the authors has received funding for research and educational purposes from Arthrex, CONMED, Depuy, Linvatec, Smith & Nephew, Stryker, Synthes, Tornier, Wright, and Zimmer.

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