Author's response to reviews

Title: Relationship between distal radius fracture malunion and arm-related disability: A prospective population-based cohort study with 1-year follow-up

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Version: 4 Date: 6 December 2010

Author's response to reviews: see over
Dear Sir,

Thank you for the second review of our manuscript entitled “Relationship between distal radius fracture malunion and arm-related disability: A prospective population-based cohort study with 1-year follow-up”, and we thank the reviewers for their re-review and comments.

We have addressed the questions raised by Dr. Cooney and made the changes highlighted in the manuscript (in yellow). We hope the manuscript is now satisfactory and we look forward to a rapid editorial decision.

Sincerely,

Elisabeth Brogren and co-authors

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**Reviewer's report**

**Title:** Relationship between distal radius fracture malunion and arm-related disability: A prospective population-based cohort study with 1-year follow-up

**Version:** 3  **Date:** 31 August 2010

**Reviewer:** Rita Patterson

**Reviewer's report:**
The authors have provided a clear organized response to the previous review. I have no further questions.

Thank you.

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**Reviewer's report**

**Title:** Relationship between distal radius fracture malunion and arm-related disability: A prospective population-based cohort study with 1-year follow-up

**Version:** 3  **Date:** 25 October 2010

**Reviewer:** William Cooney

**Reviewer's report:**
Overview: This is a very good study that points out what many clinicians observe. The study demonstrates that the results of distal radius fracture treatment are correlated with accuracy of the reduction and maintenance of reduction to prevent malunion. It is important that the review was conducted at one year after the fracture as improvement clinically can occur up to that point. Another important point is that the older patient desires high levels of activity and should not be discounted as one needing excellent anatomic and functional outcomes

Abstract: None

Background: Good discussion of the controversy. Past studies have suggested that anatomy and function do not necessarily coordinate with outcome. This prospective study helps to better answer the question.
Methods and Material

1. Why was the study delayed in presentation when the data was developed in 2002?

This current study is part of a large research project and the first data to be analyzed and published were epidemiological data about fracture incidence. Although faster reporting of study results is desirable, it was not possible in this case due to several other simultaneous studies, clinical duties and workload. We believe this delay does not affect the relevance of the results, and from Dr. Cooney’s opening remarks we feel he would be of the same opinion.

2. How were the fractures classified? Was classification used in determining treatment options?

The fractures were classified by an experienced radiologist at the conclusion of the study, based on the initial radiographs, using the AO system. The fractures were classified into A, B or C fractures, but were not subclassified. AO classification was not used directly to determine the selection of treatment. However, the treating orthopaedic surgeon chose method based on the clinical evaluation of the patient and the radiographic appearance, and according to the standard management of distal radius fracture at the reported facility severely displaced, comminuted and intraarticular fractures are more likely to be treated with external fixation and less comminuted extraarticular fractures with closed reduction and splinting. Consequently, patients who were treated with external fixation and/or percutaneous pinning had more severe initial fracture displacement than patients treated non-surgically (Table 3). AO type C fractures comprised 32% of the fractures among the surgically treated patients and 18% of the fractures among the non-surgically treated patients. We wish to emphasize that the primary purpose of the study was to assess the relationship between malunion and disability one year after the fracture irrespective of treatment method. However, the conclusions derived from the results of this study should have an impact on choice of treatment in the future. This issue has been commented on in the Result (P11, L2-4) and in the Discussion (P13, L16-19).

3. How was successful reduction assessed and how were some patients switched in treatment after closed reduction and casting?

Post-reduction radiographs at the ER and at one week after the reduction were assessed by the treating orthopaedic surgeon. A clinical evaluation of patient factors (such as age, comorbidity, hand dominance, level of independence etc) and radiographic factors (such as dorsal tilt, ulnar variance, radial inclination, level of intra-articular involvement, step-off, gaps, dorsal comminution, carpal alignment etc) influenced the decision to consider re-reduction and surgical fixation. The final decision to perform external fixation was taken after discussion with the patient. We were interested in assessing the relationship between malunion and disability one year after the fracture, irrespective of initial treatment used. The handling of fractures has been clarified in Results (P4, L11-15, 21).

Treatment Methods

1. How was the decision made to treat in ET Unit with local anesthesia vs. surgical fixation in the operating room?
This decision was made by the treating orthopaedic surgeon as described above. Fractures that were judged to be severely displaced and unstable, were considered for surgical fixation and less displaced or potentially less unstable fractures were treated with closed reduction under local anesthesia. The difference in anesthesia is part of the difference between the two treatment methods. The differences in anesthesia are pointed out in the Discussion (P13, L22-24).

2. Classification or fracture grading used?
AO classification was not used directly to determine the selection of treatment. However, the treating orthopaedic surgeon chose method based on the clinical evaluation of the patient and the radiographic appearance, and according to the standard management of distal radius fracture at the reported facility severely displaced, comminuted and intraarticular fractures are more likely to be treated with external or percutaneous pin fixation and less comminuted extraarticular fractures with closed reduction and splinting. No other treatment methods for displaced distal radius fractures were routinely used at the time of the study.

Assessment of Disability
1. Interesting to use a DASH in the immediate post operative period with patient recalling levels of function. Has this technique been used before and validated to accuracy?
This is an important observation. Asking patients to recall pre-injury function within one week from the trauma has been described by Rosberg et al. (Scand J Plast Reconstr Surg Hand Surg 2005). A US study presented at the recent IFSSH meeting, showed good validity of the recall DASH: Thirkannad S, Reynolds N. Recall DASH: a novel tool in clinical research. Presented at the 11th Triennial Congress of the International Federation of Societies for Surgery of the Hand, 31 October - 4 November 2010 Seoul, Korea. We strongly believe that a baseline value is of importance when comparing relative changes in DASH score and to reduce risk of bias in cases of pre-trauma comorbidity that may influence the score. In assessing patients with trauma, getting baseline values may pose a risk of recall bias. Therefore, we clearly explained to the patients that the questionnaire concerned their status before they fractured their wrist. We do believe that most people can recall their ability/disability before fracture when asked few days after injury. Although patients could still have misunderstood the intention of responding to the baseline DASH questionnaire and answered on the basis of current status (i.e. with fracture), we believe that this cannot be a substantial problem since patients’ baseline DASH was very low (mean 5, median 0), which is a normal DASH score. This subject has been discussed (P16, L17-20).

2. Were any patients to receive the DASH during follow-up assessment or all mailed the DASH? How was the success in returning of the DASH?
All patients received the DASH questionnaire by mail at all occasions. The return rate of the DASH questionnaire is presented in figure 1. At baseline and at one year, 103 patients (72%) returned the DASH questionnaire completed (i.e. no more than three questions missing).

3. Why was a wrist score such as the Mayo Wrist Score or Krimmer score or Gartland –Werley score not used in patient assessment? In Europe there is excellent correlation between DASH and Mayo Wrist Score.
The DASH score has been shown to be a reliable and valid evaluation tool of outcome after distal radius fracture (Macdermid et al, J Hand Ther 2004). The purpose was to assess the relationship between malunion and disability and considering that the DASH score is a widely used patient-reported outcome measure of upper-extremity related disability it was chosen as an appropriate outcome measure in this study. Although a wrist score also would be of interest we believe it represents an important but different type of outcome and would be more appropriately presented in a separate study. We have commented on this in the Discussion (P15, L5-8).

Radiographic assessment
4. Assume that the AO Score was measured at the time of the fracture as was dorsal tilt of distal radius? Were all films available?
AO fracture type and radiographic variables (including dorsal tilt) were measured based on the initial fracture radiographs, before reduction was made. Radiographs were missing in nine patients (6.3%) at baseline and in 14 patients (9.7%) at one year (P7, L3-4).

5. Non-respondents: How significant is the loss of 28% of patients in follow-up?
Unfortunately, 28% failed to respond to our primary outcome DASH score. Although loss to follow-up is a common problem in clinical research and potentially significant, the statistical analysis showed that non-respondents did not differ significantly from the respondents with regard to age, sex, treatment method, or fracture type (Table1), which suggests that the potential influence of the loss to follow-up is not likely to be substantial. We have commented on this issue (P15, L4-7).

Statistical analysis: No issues

Results
1. Good presentation of results of malunion and function. Which was more important dorsal tilt or shortening (positive ulna variance)?
The relative importance of dorsal tilt versus ulnar variance was not investigated in this study. However, we have addressed that question in a following project, which shows that shortening appears to be more important.

2. How did complications affect the outcome in patients with excellent radiographic outcomes (lack of malunion)?
Twenty-seven patients healed with no malunion. Six of them had a registered complication (median DASH 5.4) and 19 patients had no complication (median DASH 5.0). These results have been added (P10, L9-10).

Discussion
The discussion is well presented. Correlation with functional outcome (DASH) and radiographic outcome is very nicely demonstrated. The only question relates to lack of a wrist score which the authors address. Studies from Europe demonstrate that there is a good correlation between wrist scores (Mayo score, Krimmer score) and the DASH. These should be referenced if possible.
We have now added references of the correlation between Mayo, Krimmer, Gartland-Werley and DASH scores (P16, L5-8).
The only other question is whether 1 mm of ulna variance (positive with radial shortening) is significant. Other studies suggest 2mm or more. Did positive ulna variance effect forearm rotation as a measure of upper limb function? Otherwise, an excellent study.

It seems that ulnar variance of 1 mm or more is associated with higher DASH score; as shown in Table 4 ulnar variance of 1 mm or more was associated with a significantly worse DASH score compared to ulnar variance of ≤ 0mm. We also investigated the relationship between malunion severity category (but not for ulnar variance as a separate variable) and forearm supination at one year (adjusting for age, sex, treatment method and supination of contralateral wrist) but found no significant relationship between malunion and supination (P11, L15-20).