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Nonoperative treatment of humeral shaft fractures revisited

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Purpose: The purpose of this study was to examine the union rate of humeral shaft fractures treated nonoperatively and to establish whether a particular fracture type is more likely to go on to nonunion.
Methods: Radiographs and patient records of 207 humeral shaft fractures occurring during 5 years were retrospectively reviewed. All patients were initially managed nonoperatively and placed in a U-slab on diagnosis in the emergency department; this was converted to a functional humeral brace at 7 to 10 days after injury. Fracture location, morphology and comminution were assessed radiologically. Union was defined as the absence of pain and movement at the fracture site in the presence of radiographic callus formation. Nonunion was defined as no evidence of bone union by 1 year after injury or fractures requiring delayed fixation, defined as operative fixation undertaken more than 6 weeks after injury.
Results: The study included 138 humeral shaft fracture patients; 18 patients (11%) were lost to follow-up, and 24 went on to nonunion, giving an overall union rate of 83%. Of the 24 nonunions, 15 underwent delayed operative fixation at an average of 8.3 months after injury. The union rate for proximal-third fractures was 76% compared with 88% for middle-third fractures and 85% for distal-third fractures. Comminuted fractures (defined as 3+ parts) had a 89% union rate regardless of position.
Conclusion: A lower threshold for surgical intervention may be considered in proximal-third, two-part spiral-oblique humeral shaft fractures. Brace therapy can be the optimal treatment regimen, but it is not the only option.
Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Humerus; fracture; humeral brace; union

Functional humeral bracing is now widely considered the standard nonoperative treatment option for humeral shaft fractures. This technique was initially popularized in 1977 by Sarmiento. He subsequently published the results of a 98% union rate on a series of 920 patients with humeral shaft fractures treated in a functional brace.[10] However, nearly a third of the patients were lost to follow-up. More recent studies by Koch et al[4] and Rutgers and Ring[9] reported union rates of 87% and 90%, respectively. Koch's study found that predominantly transverse fractures failed

IRB approval was not required for conducting this study.

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to go on to union. Interestingly, in a subsequent study, Ring suggested that the midproximal-third spiral-oblique type of humeral shaft fracture was more likely to go on to nonunion.[7]

The aim of this study was to assess the union rate of a consecutive series of patients with a humeral shaft fracture treated by a functional humeral brace protocol and to see whether there was a particular fracture position or configuration that was more likely to go on to nonunion.

Methods

Using our trauma database, we identified every patient between December 2006 and June 2011 with a humeral shaft fracture that had been seen in the accident and emergency department at our institution. The patient records and the serial electronic radiographs were assessed. Patients who underwent operative fixation within 6 weeks of injury, which included all of the open fractures (23 patients) and polytrauma patients (21 patients), were excluded so that only those reaching current criteria for conservative humeral brace management were included. Patients with a pathologic fracture were also excluded. Pediatric patients were analyzed separately (18 patients).

All of the patients were initially placed in a U-slab in the emergency department. They were then reviewed in the orthopedic fracture clinic within 7 to 10 days after injury, and the U-slab was converted to a functional humeral brace (Beagle Orthopaedic, Blackburn, UK; Fig. 1). The brace was fitted by 1 of 2 experienced plaster technicians who educated the patients on brace management and provided a ''weekday'' drop-in clinic. It was explained to the patients that the use of the brace was an active process with active elbow flexion encouraged but strict advice to avoid leaning on the elbow or to abduct the shoulder until there was evidence of union. We defined union as the absence of pain and movement at the fracture site in the presence of callus formation on radiographs.[10] Patients included in this study were followed up at 6 to 8 weeks, 10 to 12 weeks, 6 months, 9 months, and 1 year after injury.

The serial radiographs and clinic notes of each patient were reviewed independently by 2 orthopedic surgeons. Fracture location (proximal, middle, or distal third), morphology, and comminution were recorded. Where the fracture extended over 2 regions, classification was based on the region in which the majority of the fracture lay. The time to radiologic union was determined.

Radiographic nonunion was defined as no evidence of bone union by 1 year after injury. For the purpose of this study, we also considered patients who underwent delayed fixation (fixation occurring beyond 6 weeks) as nonunion, although not all of those included in this nonunion group underwent operative intervention before 3 months of conservative treatment. Whereas the authors agree that functional outcome is an important outcome measure, no attempt was made to assess fracture angulation or functional deficit at union. We believe this is justified in this situation as any functional deficit present in either the union or nonunion group would not necessarily reflect bone disease and risks confusion. For example, if function was adequate in a patient diagnosed with a nonunion, this would not be relevant to our investigation as our study was re-examining the conservative treatment of humeral fractures and its effect on bone union specifically.

Figure 1 Functional humeral brace.

Results

There were 200 consecutive adult humeral shaft fractures available for review. Of these, 44 underwent early fixation, which included all of the open fractures, and were excluded. The remaining 156 humeral shaft fractures that were treated in a functional humeral brace were then analyzed.

There were 71 male patients and 85 female patients with a mean age of 54 years at the time of injury (18-92 years). Eighteen patients were lost to follow-up (11%); the majority of these were patients who lived or moved out of the local area. Of the 138 patients left, 24 went on to a nonunion (17%). Fifteen of the nonunions underwent delayed operative fixation at an average of 8.3 months after injury (range, 3-12 months). The mean age of the patients with nonunion was 59 years (21-86 years); there were 12 male patients and 12 female patients.

Of the 138 patients included in this study, 54 sustained proximal-third humeral shaft fractures; 58 and 26 patients presented with mid–humeral shaft and distal-third humeral shaft fractures, respectively. Analysis of the union rates by humeral shaft location found that the proximal third had a union rate of 76% (of which 11 of the 13 were spiral and 1 an oblique fracture); the middle third, 88%; and the distal third, 85%. Comminuted fractures (defined as 3+ parts) had a union rate of 89% irrespective of location along the humeral shaft. Those fractures progressing to union did so before 3 months and were therefore not included in our delayed fixation subgroup.

These results underwent statistical analysis by a logistic regression model (Table I). Two patients from the union group were excluded from the model, one because of incomplete data (missing data on fracture pattern and number of parts) and the other as it was the only segmental fracture. Consequently, the analysis was based on 136 patients with the outcome variable