Small-Fragment Plate Fixation of Humeral Shaft Fractures

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Purpose: Humeral shaft fractures (HSFs) have traditionally been treated surgically with large-fragment (4.5-mm) plates. Orthopaedic traumatologists at our institution often prefer treatment with small-fragment (3.5-mm) plates. Our hypothesis was that fractures treated with a 3.5-mm plate would have an unacceptable complication rate in comparison to patients treated with 4.5-mm plates, particularly in the group allowed full weight bearing on the humerus.

Methods: A retrospective chart and radiographic review was performed of all humeral shaft fractures (OTA 1.12A-C, open and closed) treated with open reduction and internal fixation at a Level I urban trauma center from January 2003 to June 2014. We excluded patients with proximal and distal periarticular extension as demonstrated by use of anatomically contoured proximal or distal plates (n = 169). We also excluded patients who had inadequate follow-up to determine healing (n = 93). Patients were typically managed with immediate weight bearing as tolerated without bracing except in cases such as ipsilateral upper extremity fracture preventing weight bearing, or radial nerve palsy, and in these cases immediate activities of daily living were allowed but weight bearing was limited. Plate thickness (4.5 mm vs 3.5 mm) was based upon surgeon preference. Our primary outcome measure was nonunion and our secondary outcome measure was plate breakage. Our study group consisted of 191 (3.5 mm: n = 150, 4.5 mm: n = 41) fractures that were further subdivided into four groups: (1) 3.5-mm plate with immediate weight bearing (n = 96, 64% of 3.5-mm cohort), (2) 3.5-mm plate without immediate weight bearing (n = 41), (3) 4.5-mm plate with immediate weight bearing (n = 29, 70% of 4.5-mm cohort), and (4) 4.5-mm plate without immediate weight bearing (n = 9). Two-sided Fisher exact was used for the analysis.

Results: Consistent with prior studies, we had a low overall nonunion rate in our study group (n = 191, nonunion = 8.3%, 95% confidence interval [CI]: 4.4%-12.3%). The nonunion rate was similar in the 3.5-mm and the 4.5-mm group overall (8.7% nonunion vs 7.3%, P = 1.00) as well as within the subgroups that did and did not have immediate weight bearing (3.5 mm: 9.38% nonunion vs 4.5 mm: 3.45%, P = 0.46 and 3.5 mm: 9.76% nonunion vs 4.5 mm: 22.2%, P = 0.59). Our secondary outcome measure of plate breakage was also similar between the 3.5-mm and 4.5-mm groups (3.3% vs 2.4%, P = 1.00).

Conclusion: Our data contradict our hypothesis and demonstrate that humeral shaft fractures treated with 3.5-mm plates appear to have a comparable nonunion and hardware failure rate to historical controls treated with 4.5-mm plates as well as our own internal control group. This study is limited by lack of randomization and potential selection bias as 27% of the patients were treated with 4.5-mm plates perhaps indicating that not all humeral shaft fractures were thought to be appropriate for 3.5-mm size fixation. With this caveat in mind, our data support the use of 3.5-mm plate fixation for select fractures as a reasonable alternative, even for cases of immediate weight bearing on the humerus.

See pages 47 - 108 for financial disclosure information.