

## The Post-Sarmiento Era: Is It Time to Rethink Expectations of Functional Bracing for Humeral Shaft Fractures?

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**Purpose:** The current belief is that the majority of humeral shaft fractures can be treated nonoperatively with predictable outcomes, and early operative management is taboo other than for very limited indications. Sarmiento reported good success and a relatively low rate of malunion and nonunion in patients who tolerated fracture bracing. However, not all patients accept fracture bracing. Often, patients in whom closed treatment was acutely initiated are later subacutely having to be converted to operative treatment. The purpose of this study is to review our rate of failure of closed treatment of humeral shaft fractures with fracture bracing, requiring conversion to surgical intervention.

**Methods:** 222 patients with a closed humeral shaft fracture managed nonoperatively with a functional brace between 2005 and 2014 were identified in our prospective database and reviewed retrospectively. Patients <18 years old, pathologic and periprosthetic fractures, fractures extending beyond the diaphysis, and patients lost to follow-up (FUP) or with a FUP <12 months were excluded. Data analysis included: demographics, mechanism of injury, fracture characteristics (pattern and location), neurovascular injuries, fracture union, and time to healing. In the event of failure of conservative treatment, time from injury to surgery and reason for surgery was recorded.

**Results:** 60 patients were excluded, leaving 162 fractures (162 patients). The cohort followed a bimodal distribution (young male, elderly female). Overall mean age was 48 years old (range, 18-92) with 49% males. 28% (n = 46) of the fractures occurred in the proximal diaphysis, 50% (n = 82) in the midshaft, and 22% (n = 34) in the distal diaphysis (P <0.001). Fracture patterns included: 33% (n = 54) transverse, 30% (n = 49) spiral, 15% (n = 25) oblique, 11% (n = 18) comminuted, 9% (n = 14) butterfly, and 2% (n = 3) were segmental (P = 0.3). 12 closed fractures (7%) presented with symptoms of radial nerve palsy before application of the brace. Union occurred at an average of 17 weeks (range, 12-36). 60 fractures (37%) required surgical intervention after failure of nonoperative treatment. Time between injury and failure of nonoperative treatment averaged 9.4 weeks (range, 2-24 weeks). Of those, 29 patients (48%) lost their initial reduction beyond the acceptable parameters, 8 (13%) were noncompliant to functional bracing, 4 (6%) had persistent signs of radial nerve palsy (average 15 weeks of observation), and 19 (38%) developed a nonunion (after average 20 weeks of bracing). No patient undergoing surgery for a failure of conservative treatment required a subsequent intervention. All patients with radial nerve palsy fully recovered except one. The failure of functional bracing was analyzed by fracture pattern with the following association found: 44% (n = 8) of comminuted fractures required surgery, 42% (n = 20) of spiral fractures, 35%

(n = 5) of butterfly fragments, 33% (n = 8) of oblique fractures, 33% (n = 1) of segmental fractures, and 32% (n = 17) of transverse fractures (P = 0.88). Comminution (OTA 20/12C3-1/12C3-3) and spiral fracture (OTA 12A-1) patterns were associated with the lowest success rate using conservative treatment.

**Conclusion:** We report a failure rate of nonoperative treatment of 37% with fracture bracing of humeral shaft fractures. These results are markedly higher than previously reported, upon which the current recommendations of bracing are based. The current data call into question what the conservative standard of care should be for comminuted or spiral humeral shaft fractures. Early surgical intervention aiming for a quicker rehabilitation, pain relief, and avoidance of high failure rates with nonoperative management should be considered.