Intramedullary Fixation for Pediatric Femoral Nonunion in Low- and Middle-Income Countries

***Ryan Furdock, MD**; Lauren Fay Huang, BA; George Ochenjele, MD; Lewis G. Zirkle, MD; Raymond W. Liu, MD*
Rainbow Babies and Children's Hospital, Cleveland, Ohio, UNITED STATES

Purpose: Pediatric femoral shaft nonunions are uncommon in the United States after plating or intramedullary nailing (IMN) but occur more frequently in low and middle-income countries. We sought to describe the efficacy of SIGN Fracture Care International IMN treatment for pediatric femoral shaft nonunion in lower resource settings.

Methods: The SIGN online database was queried to identify all 85 pediatric femoral shaft nonunions (84 patients) since 2003 with available follow-up. Nonunion was defined as failure of initial plate or IMN instrumentation >90 days following placement. Patients were excluded for lack of 3-month follow-up (n = 12), inadequate records (n = 8), missing lateral view on follow-up radiographs (n = 5), additional non-SIGN nail revision implants (n = 2), or nonunion following osteotomies (n = 1). An orthopaedic traumatologist and a pediatric orthopaedic surgeon evaluated each patient's final follow-up radiograph to determine a radiographic union scale in tibial fractures (RUST) score. RUST score ≥9 was considered successful treatment. Patients with complete healing and remodeling on AP radiographs were assumed to have complete healing on the lateral view, if absent (n = 3). Demographics and rates of painless full weightbearing were recorded.

Results: 57 pediatric femoral shaft nonunions (42 males, 15 females; 18 countries) were included. Average age at revision was 13.79 ± 3.0 years (range, 6-17). Median follow-up was 62.6 weeks (range, 13.3 weeks to 7.7 years). Initial failed instrumentation included plate constructs (77.5%), non-SIGN IMN (17.5%), and SIGN IMN (5%). The average RUST score at final follow-up was 11.3 ± 1.2 (range, 8-12). At final follow-up, 54 of 57 cases (94.7%) achieved RUST score ≥9 and 51 patients (89.5%) had painless full weightbearing.

Conclusion: Pediatric femoral shaft nonunion can occur after plate fixation and IMN in low- and middle-income countries. SIGN IMN is an effective treatment for these patients.

Figure 1. A typical SIGN database case file. A 12-year-old Afghan boy with midshaft femur nonunion 4 months after failed plating. Radiographs were obtained (A) preoperatively, (B) immediately after SIGN fin intramedullary nailing, and (C) at final follow-up (1.1 years in this case). These final follow-up radiographs received a RUST score of 12/12 for complete healing at all four cortices.