Circular Frame Reconstruction for the Definitive Primary Treatment of Severe Tibial Fractures

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Purpose: We conducted a case-series evaluation of the effectiveness of circular frame treatment for severe open fractures. Secondarily, we sought to establish the effectiveness of a simple two-ring construct for the treatment of grade 3 open tibial fractures. Despite widespread use, there are no large series of spatial frames reported in contemporary practice. Two-ring circular frame constructs may have potential advantages over more complex multiple-ring circular frame constructs.

Methods: Institutional registries and routinely collected prospective outcome data from a single center were used to recruit a consecutive series of patients presenting to a Level I center with a complex tibial fracture requiring a circular fixation construct. Inclusion criteria included all patients with tibial fracture treated by circular frame fixation. Subgroup analysis was undertaken for patients presenting with a simple 2-ring construct and patients without prospectively collected outcome data. The subsequent progress of this cohort toward union was assessed.

Results: Overall, 264 patients were identified who had been treated over a 5-year period. Of these, 236 participants were surviving and contactable. A core data set from records review including complications and outcomes were available for all patients. Overall limb salvage rates were 98%, with a third requiring secondary procedures (including transport, bone graft, docking site procedures, and pin/wire replacement). In addition, contemporary patient-reported outcome measures including quality of life (EuroQol 5 Dimensions [EQ5D]) and disability rating scale were available for 26% of participants. As would be expected, a fall in EQ5D VAS (visual analog scale) was seen from 87 pre-injury to 66 post-injury ($P<0.05$). Disability rating profile yielded final post-injury scores of 42 (rising from 17 pre-injury, $P<0.05$). With regard to grade 3 open fractures treated with a two-ring construct, all patients had Gustilo-Anderson grade 3 injuries with 22% type A, 69% type B, and 9% type C. Of the subgroup, a single patient required a secondary amputation and 1 patient died within 90 days. Overall 21 of 23 patients (91%) progressed toward union and 96% were successfully salvaged. The mean frame time was 11.5 months, with 6 patients returning to theater for an unplanned procedure. There were no malunions in this cohort.

Conclusion: The spatial frame construct gives a high limb salvage rate in severe open fractures and overall 91% success rate as a primary treatment in grade 3 open tibial fractures in this cohort. A 2-ring construct offers advantages that may include reduced cost, reduced operative time, and reduced pin and wire requirement without compromising outcomes.