Taylor Spatial Frame Stacked Transport for Tibial Infected Nonunions with Bone Loss: Analysis of Use of Adjunctive Stability

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Purpose: The stacked Taylor Spatial Frame (TSF) bone transport technique is an effective treatment for infected tibial nonunions with bone loss. The purpose of this study was to evaluate the efficacy of the TSF bone transport technique in the limb salvage process, and to determine which subset of patients and risk factors required adjunctive stabilization using internal fixation. A secondary aim was to analyze timing of adjunctive stabilization.

Methods: Seventy-five patients were treated for infected posttraumatic nonunions of the tibia with bone loss using stacked TSF transport by a single surgeon at a level one trauma center. Patients were treated with resection of nonunion with application of TSF for bone transport followed by bone grafting the nonunion site. Parameters measured included age, gender, diabetes, smoking, use of a free flap, bone defect size, length in frame, external fixation index, and direction of lengthening. Outcomes recorded included: removal of frame with no additional intervention, BKA, or adjunctive stability. We defined adjunctive stabilization as use of intramedullary nail, plate fixation, or reapplication of TSF to aid in healing of docking or regenerate site. Further analysis of the adjunctive stabilization patients evaluated location of nonunion, timing of adjunctive stabilization, and type of fixation used.

Results:
The average patient age was 45.7 ± 12.5 years, 57 (76%) patients were male, 8 (11%) were diabetic, and 34 (44%) were smokers. 32 (42%) had soft tissue defects that required a free flap performed by plastic surgery. The mean size of the defect was 5.4 cm. The mean length in frame was 9.7 months and mean external fixator index was 1.9 month/cm. 38 patients had removal of frame with no additional operative intervention, while 36 patients required adjunctive stability of TSF with intramedullary nail, plate fixation, or reapplication of TSF. Infection was eradicated and union was achieved in 70 patients (93%). The remaining 5 patients underwent below knee amputation (BKA). Patients who underwent amputation had larger bone defects of 7.0±2.0 versus 5.3±1.9 (p=0.072) and were more likely to have had a free flap, 80% compared to 28% (p=0.081). Patient receiving adjunctive stabilization had a longer length of time in the TSF (p=0.026) and were more likely to require a free flap (p=0.053) when compared to the 38 patients who did not require adjunctive stabilization. Fourteen patients required additional stability with intramedullary nail or plate fixation at time of removal of TSF, while 22 patients required delayed additional stability after TSF removal. Fourteen patients had docking site nonunion, 14 patients had regenerate nonunion and 8 patients had both docking site and regenerate nonunion. Thirteen of the fourteen (93%) docking site nonnuions occurred after the removal of the frame (p=0.032), while eleven of the fourteen (79%) regenerate nonunions occurred before the TSF was removed (p=0.029).

Conclusion: In conclusion, the use of Taylor Spatial Frame for the infected tibial nonunions with bone loss is an effective method for achieving union and eradicating infection in a difficult orthopedic patient population. Use of adjunctive stabilization is a common and reasonable technique to address delayed regenerate and docking site nonunions in the same population. Patients that require adjunctive stabilization are more likely to require a free flap and spend a longer amount of time in the TSF. Docking site nonunions are common, even with bone grafting, but can be addressed with adjunctive stabilization.