

**Single- Versus Two-Stage Repair for Infected Tibial Nonunions**

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**Background/Purpose:** The standard treatment of an infected diaphyseal tibial nonunion involves removal of hardware, irrigation and debridement, followed by an appropriate course of systemic antibiotic administration. The eradication of the infection is required before proceeding with the repair nonunion. The assessment of this aseptic state is typically achieved through infectious laboratory measurements, namely white blood cell count, erythrocyte sedimentation rate, and C-reactive protein. However, the possibility of false negative infectious indices does exist and attempting a nonunion repair in a septic environment is suboptimal. Therefore, a two-staged approach is often used that includes a first-stage bone culture and Gram stain to prove the absence of bacteria at the nonunion site, followed by a second-stage repair nonunion procedure after negative culture results. To our knowledge, no study has directly compared the single- (1S) versus two-staged (2S) repair of infected diaphyseal tibial nonunions. The purpose of this study is to directly compare these two techniques with regard to infection recurrence and union.

**Methods:** After IRB approval, a retrospective chart review was performed at a Level I academic trauma center of patients treated for infected tibial diaphyseal nonunions from 2005 through 2013. Inclusion criteria included skeletal maturity with diaphyseal infected tibial nonunions that underwent appropriate irrigation and debridement, and hardware removal, followed by a minimum of 6 weeks of systemic antibiotics, and minimum 1-year follow-up after nonunion repair procedure. Data collected included patient demographics, comorbidities, history of open fracture or soft-tissue reconstruction, use of antibiotics and antibiotic cement for the treatment of osteomyelitis, single- versus two-stage repair nonunion, culture and infectious indices results, chronic antibiotic use, union, and infection recurrence. Recurrence was defined as the evidence of deep infection after the completion of antibiotic course and nonunion repair.

**Results:** 34 patients were treated for infected diaphyseal tibial nonunions. 16 patients were treated via 1S, and 18 patients underwent the 2S approach. The average age of the 1S group was 47 years, 81% were male, 100% originally had open tibia fractures, and 69% required soft-tissue reconstruction. Similarly, the 2S average age was 45 years, 67% were male, 89% originally had open fractures, and 83% required soft-tissue reconstruction. 50% (8/16) in 1S and 44% (8/18) in 2S experienced recurrent infections and persistent nonunion ( $P = 0.61$ ). 50% (8/16) in 1S and 56% (10/18) in 2S achieved successful union ( $P = 0.75$ ). Three of the eight (38%) patients who achieved union in 1S required chronic antibiotic oral antibiotics, compared to one of ten (10%) patients in 2S ( $P = 0.27$ ).

**Conclusion:** There are no significant differences found between a single- versus two-staged approach to infected tibial nonunion repair in this study. After the appropriate removal of hardware, irrigation and debridement, followed by an appropriate course of systemic antibiotics, the additional operative trip to obtain a bone culture before the definitive nonunion repair appears to be unnecessary and does not circumvent false negative infectious indices. Further investigation is warranted with larger sample sizes.