

The Gustilo-Anderson Classification System as Predictor of Nonunion and Infection in Open Tibia Fractures

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Purpose: Open tibia fractures are known to have a very high risk of complications. However, previous large studies, including the SPRINT trial (Study to Prospectively evaluate Reamed Intramedullary Nails in Tibial fractures), have focused primarily on closed injuries or excluded higher grade open fractures. The purpose of this study was to conduct the largest retrospective study to date of open tibia fractures and describe incidence of complications and evaluate potential predictive risk factors for complications.

Methods: After IRB approval, patients treated for open tibia fractures by intramedullary nailing across a 10-year period were identified by a CPT code search at a Level I trauma center. Charts were reviewed and potential risk factors including age, gender, American Society of Anesthesiologists (ASA) score, hospital length of stay (LOS), type (T) of open fracture, distance of fracture from the plafond, and the sum of 31 comorbidities were recorded. Patients under the age of 16 were excluded from analysis. Charts were reviewed for complications leading to reoperations including infection, nonunion, and amputation. A multivariate analysis was conducted to determine if any of the potential risk factors described above were associated with a greater risk of complications.

Results: 486 patients with open tibia fractures were analyzed (TI: 63, TII: 202, TIIa: 140, TIIb: 73, TIIc: 8). The average age was 33 years (± 15 ; range, 16-85). 78% of patients were male. Overall 13% (n = 64) of patients had infections, 12% (n = 56) had nonunions, and 1% (n = 7) had amputations. Infection rates were TI, 2%; TII, 8%; TIIa, 14%; TIIb, 30%; and TIIc, 62%. Nonunion rates were TI, 6%; TII, 7%; TIIa, 11%; TIIb, 26%; and TIIc, 25%. Amputation rates were TI and TII, 0%; TIIa, 1%; TIIb, 7%; and TIIc, 12%. TII fractures had much higher rates of infection, nonunion, and amputation than TI and TII fractures (Table 1). After examining all potential risk factors described above, we found that fracture type was a highly significant risk factor for both nonunion and infection. The risk of nonunion was 4 \times higher with TIIb fractures and 5 \times higher ($P = 0.001$) with TIIc fractures ($P = 0.06$) compared to TI and TII fractures. In terms of infection, the risk was 2 \times higher for TIIa fractures, 6 \times higher for TIIb fractures, and 29 \times higher for TIIc fractures compared to TI and TII fractures.

Grade	Infection	Nonunion	Amputation
I (n=63)	2% (1/63)	6% (4/63)	0% (0/63)
II (n=202)	8% (17/202)	7% (15/202)	0% (0/202)
IIIa (n=140)	14% (19/140)	11% (16/140)	1% (1/140)
IIIb (n=73)	30% (22/73)	26% (19/73)	7% (5/73)
IIIc (n=8)	62% (5/8)	25% (2/8)	12% (1/8)
Overall	13% (64/486)	12% (56/486)	1% (7/486)

Grade	Nonunion		Infection	
	OR	p	OR	p
IIIa	1.409	0.368	2.132	0.036
IIIb	3.810	0.001	5.993	<0.001
IIIc	5.320	0.062	28.570	<0.001

Conclusion: This study, which is the largest analysis of open tibia fractures to date, determined that the Gustilo grade of open tibia fractures is by far the greatest predictor of nonunion and infection. The risk of nonunion and infection was 5× and 29× higher, respectively, for Type IIIc fractures compared to Type I/II fractures. Similar findings were found for Type IIIb fractures. Our findings can be used to compare similar fractures at any institution or study and develop a risk calculator for open tibias, which can be used by surgeons to predict care and advise patients with this high-risk injury.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an “off label” use). For full information, refer to page 600.