

Clinically Important Subgroups within a Large Cohort of Gustilo Type IIIB Open Tibia Fractures: An Analysis of Surgical Rehospitalizations

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Purpose: Comparison of treatment, outcomes, and resource consumption following major limb trauma require appropriate stratification of injuries by type and severity. At present, the Gustilo-Anderson classification is the most commonly employed grading system for open fractures. There is growing evidence, however, that this classification may not adequately characterize the full burden of injury. A Gustilo Type IIIB tibial fracture with no bone loss and only a 2 ? 2-cm pretibial skin defect that is closed with a rotational flap likely has a different clinical course and outcome than a Type IIIB tibial fracture with severe contamination, a 5-cm bone defect, and loss of the anterior compartment that requires free tissue transfer and bone defect reconstruction. Recognizing the limitations the Gustilo open fracture classification system imposes on extremity trauma research and evaluations of resource consumption, the OTA developed a new Open Fracture Classification (OTA-OFC). The OTA-OFC assigns the fracture an injury severity value (range 1-3) in 5 domains: Bone Loss, Muscle Injury, Skin Injury, Arterial Injury, and Contamination. The purpose of this study is to delineate the various component injuries in open fractures classified as Gustilo Type IIIB by using the new OTA-FC, and to evaluate whether these additional details result in meaningful differences in the incidence of surgical rehospitalization. Surgical hospitalization included all forms of readmission related to the extremity trauma (planned and unplanned) after definitive wound closure.

Methods: Data were obtained from three large prospective, multicenter studies enrolling open tibia fractures. A total of 431 Gustilo Type IIIB tibia fractures with at least 6 months of clinical follow-up were included in this analysis. We documented the 5 parameters of the new OTA-OFC to determine the discrete distribution of injury captured in what is currently being classified as a "Type IIIB" open fracture, and classified each subject according to his or her surgical rehospitalization status at 6 months post injury. For each domain, we evaluated, using the Cochran-Armitage (C-A) test, whether there was a trend in the risk of surgical readmission with injury severity value.

Results: For contamination, bone loss, and muscle injury domains, there was statistically significant evidence of a positive association between the risk of surgical readmission and injury severity (Table I). The evidence was weaker for skin and arterial domains.

Conclusion: All Gustilo Type IIIB tibia fractures are not equal. As currently applied, the OTA-OFC classification includes injuries of varying severity as defined by the extent of bone loss, muscle injury, skin injury, arterial injury, and contamination. These subgroups are clinically important; with increasing severity within each category the risk of hospital

hospitalization increases. The spectrum of injury within the Gustillo IIIB category is too broad to allow for meaningful comparisons for research purposes, resource allocation planning, or reimbursement determination. Extremity trauma research should consider adopting the OTA-OFC for classification of Gustillo IIIB injuries in order to better stratify an individual patient's injuries to enable comparison of treatments, outcomes, and resource consumption.

Table I

	Severity	Cases	% Surgical Readmission	C-A p-value
Contamination *	[1] None or minimal	103	43.7	0.001
	[2] Surface contamination visible	191	63.4	
	[3] Deep tissue or bone or high risk environment	137	64.2	
Bone Loss *	[1] None	67	47.8	0.001
	[2] Bone missing but some contact	202	55.5	
	[3] Segmental bone loss	162	67.9	
Skin Injury	[1] Can be approximated	46	47.8	0.060
	[2] Cannot be approximated	252	59.1	
	[3] Extensive degloving	133	62.4	
Muscle Injury *	[1] No necrosis, some injury intact function	63	41.3	0.036
	[2] Loss of muscle but functional, local necrosis	268	63.1	
	[3] Extensive muscle necrosis	100	59.0	
Arterial Injury	[1] No arterial injury	310	56.1	0.118
	[2] Artery injury w/o ischemia	110	69.1	
	[3] Artery injury with distal ischemia	11	36.4	

*Please refer to OTA-OFC for details in regards to scoring system.