How Do Open Distal Tibia Fractures Differ from Open Tibial Shaft Fractures?

Ivy Nguyen BS, Christine Ann Ho MD

UT Southwestern Medical Center, Children's Medical Center of Dallas, Dallas, TX

Background

Tibial Shaft Fracture

- Most common long bone fracture
- IM nailing, percutaneous fixation, external fixation options

Distal Tibia Fracture

- Special properties:
  - Articular involvement
  - Proximity to fibula
  - Open physes
- IM nailing not recommended – risk of physeal injury

Tibial fractures are the most common pediatric lower extremity fracture[1] and the third most common fracture in pediatric patients overall[2]. Generally, treatment for these fractures can be done conservatively through closed reduction and casting for 6 to 8 weeks[2].

In more severe cases, as in cases of open fracture, surgical intervention is needed. Pediatric distal tibia fractures are especially difficult to manage compared to tibial shaft fractures. Articular involvement, proximity to the fibula, and open physes all contribute to the complexity of these fractures in pediatric patients[1]. Additionally, certain surgical techniques, such as intramedullary nailing, that are used in tibial shaft fractures are not recommended for distal tibia fractures because of the risk of physeal injury[1].

Therefore, it is important to identify the most effective treatment plans to manage these challenging fractures. The purpose of our study was to compare a cohort of open distal tibia fractures to open tibial shaft fractures in regards to injury severity, method of fixation, and outcomes.

Methods

This is a retrospective review of 49 open distal tibia fractures (group D) with a mean age of 8.7 years and 56 open tibia shaft fractures (group S) with a mean age of 8.6 years, treated from January 2007 – May 2017 at a single level 1 pediatric trauma center. Mann Whitney test was used to compare means between groups.

Criteria for Inclusion of Subjects:

- Male and female
- Skeletally immature (tibia physes still open)
- Treated operatively for open tibial shaft or open distal tibia fractures
- Presented at CMCD for treatment between 1/1/2007 and 5/1/2017
- Age 0-17

Criteria for Exclusion of Subjects:

- Skeletally mature
- Pathological fractures
- Closed tibia fractures

Results

Table 1. Summary of Significant Continuous Variables and Comparison of Distal and Shaft Groups

	1 (Distal)		2 (Shaft)		Wilcox test p-value
Variable	**n**	**mean**	**n**	**mean**	
AIS Lower Ext	47	2.55	50	2.74	**0.043**
ISS	47	9.36	50	13.10	0.053
Length of Stay	48	8.44	56	6.36	**0.006**
Duration of Immobilization	44	134.95	50	100.20	**0.033**
Time to Weightbearing	47	77.06	53	50.68	**0.006**

Mean AIS lower extremity scores were significantly higher in group S compared to group D (2.74 vs 2.55, p=0.043), as were mean Injury Severity Scores (13.10 vs 9.36, p=0.053). While surgical time and fluoroscopy times were not significantly different between the two groups, group D had longer mean length of hospitalization (8.44vs6.36 days, p=0.006), mean duration of immobilization (135vs100 days, p=0.033), and longer mean time to full weight bearing (77vs40 days, p=0.006). Rate of hardware removal (group D-49%, group S-52%) and radiographic angulation at final follow-up were not statistically significantly different between the two groups (p>0.05). Mean time to union was prolonged for both groups (178 days group D-178 days, group S-139 days, p=0.231).

Table 2. Distal and shaft groups by Variables of Interest

Variables	Levels	Distal		Shaft		P-value
		Count	%	Count	%	
MOI	High	43	89.6%	43	76.8%	0.1191
	Low	5	10.4%	13	23.2%	
Gustilo Grade	I	7	14.3%	13	19.0%	0.0622
	II	17	34.7%	27	41.9%	
	III	25	51.0%	16	39.0%	
Fibular Involvement	N	6	12.2%	16	28.6%	0.0544
	Y	43	87.8%	40	71.4%	
Tibia Implant Type	Ex-fix	9	18.4%	4	7.1%	**0.0337**
	Flexible nails	17	34.7%	36	64.3%	
	K-wires	8	16.3%	3	5.4%	
	None	8	16.3%	9	16.1%	
	ORIF	6	12.2%	2	3.6%	
	Rigid IM nail	0	0.0%	1	1.8%	
	Screws	1	2.0%	1	1.8%	

Extremely high energy trauma (ATV, GSW, vehicular collision, lawnmower, crush, fall >8 feet) was the mechanism of injury in 90% (44/49) in group D and 77% (43/56) in group S (p=0.119). There were more Gustilo type II fractures in group S (42% vs. 35%), and more Gustilo type III fractures in group D (51% vs 39%), which trended towards significance (p=0.0622). 88% (43/49) of open distal tibia fractures had ipsilateral fibular involvement, compared to 71% (40/56) of open tibial shaft fractures (p=0.054). Tibial fixation methods were statistically different between the 2 groups (p=0.0377), but incidence of fibular fixation was not statistically different (group D-12% vs group S-5%, p=0.4348).

Conclusions

Open distal tibia fractures are significant for extremely high energy of injury. Alternate methods of fixation for open distal tibia fractures such as external fixation, K wires, and ORIF are more likely to be utilized than flexible intramedullary nailing. Open distal tibia fractures have longer hospital stays, immobilization, and time to full weight bearing, but radiographic outcomes and time to union are comparable.

References

1. Brantley, J., et al., *A Biomechanical Comparison Of Pin Configurations Used For Percutaneous Pinning Of Distal Tibia Fractures In Children.* Iowa Orthop J, 2016. 36: p. 133-7.
2. Bauer, J., C. Hirzinger, and R. Metzger, *Quadruple ESIN (Elastic Stable Intramedullary Nailing): Modified Treatment in Pediatric Distal Tibial Fractures.* J Pediatr Orthop, 2017. 37(2): p. e100-e103.
3. Masquijo, J.J., *Percutaneous plating of distal tibial fractures in children and adolescents.* J Pediatr Orthop B, 2014. 23(3): p. 207-11.