Factors Associated with Premature Physeal Closure after Distal Femur Fracture

Andrew Tennant Pennock, Liane Chun¹, Christopher D Souder, Tracey Bastrom²

¹University of California, San Diego, ²Children's Specialists of San Diego

INTRODUCTION: Premature physeal closure (PPC) after distal femur fractures is a recognized complication. To date, risk factors for PPC have not been well identified. The purpose of the current study was to identify non-modifiable risk factors for this challenging clinical problem.

METHODS: A retrospective review of all displaced distal femur physeal fractures undergoing surgical stabilization at a single level 1 pediatric hospital were identified between 2011 and 2022. Patient charts were reviewed and injury, radiographic, and surgical data were recorded. Univariable statistical analysis was performed to identify factors associated with PPC. Odds ratios were calculated and binary logistic regression was utilized to determine the odds of PPC based on risk factors present.

RESULTS: Fifty-four patients were identified with a mean chronologic age of 13 ± 3 years and a mean bone age of 14 ± 3 . The majority of patients were male (67%) The distribution of physeal fractures by Salter-Harris Classification was as follows: SHI=3, SHII=19, SHIII=14, SHIV=8. 28% of the cohort presented with severe fracture displacement (fracture dislocation), 6% presented with an open fracture, and 4% with neurovascular compromise of the extremity. Interposed periosteum was removed in 37% of patients. The overall rate of PPC was 48% (N=26) and 77% of these (20/26) required subsequent surgical intervention. Even when the PPC was identified appropriately at the 6 month post-injury visit, 50% had already developed a leg length discrepancy of at least 1 cm. Three non-modifiable factors were significantly associated with PPC: bone age (<15 for boys and <13 for girls), Salter-Harris type (type 1 &2), and fracture displacement (fracture dislocation, Table). The risk of PPC based on number of factors present compared to zero factors were; 1 factor OR=4.4 (95%CI 0.4-45, p=0.22), 2 factors OR=39 (95%CI 3.8-399, p=0.002), and 3 factors OR=96 (95%CI 5.2-1767, p=0.002). Patients with 2 and 3 risk factors had a 77% and 89% rate of closing early.

DISCUSSION AND CONCLUSION: Premature physeal closure frequently occurs after distal femur fractures and risk factors include younger age, Salter-Harris 1&2 fractures, and fractures with greater initial displacement. When all three are present there is a nearly 90% of closure. When multiple risk factors are present, the odds of PPC is high and intervention before 6 months could be considered to avoid a resultant leg length discrepancy or angular deformity. A larger study is warranted for creation of a predictive model and to enhance precision of the risk factor analysis.

		PPC		
		No	Yes	р
Salter Harris	I & II (n=32)	34%	66%	
	III & IV (n=22)	77%	23%	0.002
	<=13 females, <=15 males			
Bone Age	(n=29)	24%	76%	
	>13 females, >15 males (n=25)	84%	16%	<0.001
Fracture				
Dislocation	yes (n=15)	27%	73%	
	no (n=39)	62%	38%	0.022

Table: Three non-modifiable factors associated with PPC