Is Fixation Strategy Associated with Complication Risk in Ogden Type IV Tibial Tubercle Avulsion Fractures? A Multicenter Study of the TiTuS Database

Lee Haruno, Neeraj M Patel, Neil Kaushal, John Schlecter[1], Amirhossein Misaghi[2], Folorunsho Edobor-Osula, John S Blanco[3], Caixia Zhao, Lauren Michelle Spirov, Clare Kehoe, Kiran Athreya[1], Layla A Haidar[4], Linda Tate, David Kell, Lindsay Michele Crawford, Sekinat Kassim McCormick[5], Dustin Adam Greenhill[6], Brendan Alexander Williams
[1]Children's Hospital of Orange County, [2]Childrens Hospital of Orange County, [3]Hospital For Special Surgery, [4]University of Texas Health Science Center Houston, [5]University of Texas Health Science Center At San Antonio, [6]St. Lukes University Health Network

INTRODUCTION:
The optimal surgical treatment of Ogden Type IV tibial tubercle avulsion fractures (TTAFs) remains controversial, given the rarity of the injury and its involvement of the entire proximal tibial epiphysis. Small, single-center studies suggest surgical construct variability for type IV fractures and higher rates of complications than other TTAF types. The purpose of this study is to characterize fixation construct variability for type IV TTAFs and identify which approaches are associated with complications.

METHODS:
A retrospective, multicenter cohort study was conducted across 7 institutions examining Ogden IV TTAFs between 2007 and 2022. Exclusion criteria were age >18 years, closed proximal tibial physis and tubercle apophysis, or a proximal tibia fracture not involving the tubercle. Patient demographics, injury characteristics, treatment strategy (including fixation construct), and post-operative complications were analyzed. Fisher exact tests were used to compare complication frequency between various fixation techniques.

RESULTS:
Ninety-nine patients with type IV tibial tubercle fractures were identified, of which 89 (89.9%) underwent operative management. The majority (72/89, 80.9%) were stabilized with screw-only constructs, while nine (10.1%) were treated with pins or hybrid pin/screw constructs and the remainder (9.0%) were treated with a plate. In fractures fixed only with screws, two screws were most common (34/72, 47.2%) followed by three screws in 33.3% of patients. Most screw-only constructs (45/72, 62.5%) utilized 4.5 mm screws. Most patients were treated with a vertically oriented construct (i.e., anteroposterior screws in an “I” or “inverted triangle” configuration), but 11 (12.4%) received a crossed screw configuration (“X” in the coronal plane). Twenty-four patients (27.0%) experienced complications, the most common of which were implant irritation (13, 14.6%) and wound problems (3, 3.4%). One patient (1.1%) had compartment syndrome. When comparing overall complications other than implant irritation, the frequency was lower for screw-only constructs than other types of fixation (6.9% vs. 35.3%; p=0.005). For fractures fixed with screws only, there was no difference in overall complications based on the number of screws used (p=0.21). There were no implant failures or non-unions, so differences in these specific complications between various fixation approaches could not be analyzed.

DISCUSSION AND CONCLUSION:
In this large, multicenter cohort of type IV TTAFs, variation was observed in surgical fixation methods. The overall rate of complications was lower for screw-only constructs compared to other techniques. The frequency of major complications was rare, with no cases of nonunion or implant failure.