Transitional Fracture Patterns in Pediatric Patients: Ligaments Are More Important Than the Physis

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Purpose: Transitional fractures are complex injuries occurring in children, often between 12 and 15 years old. It is assumed that closure of the physis determines the injury pattern. In this study, we analyzed whether these injuries indeed correlate to the advancing closure of the physis with age.

Methods: This study used fracture maps, 2-dimensional maps with fracture lines from a cohort of patients, to answer our research question. A total of 131 pediatric patients with a transitional fracture and preoperative CT scan were retrospectively included from 3 different centers between 2010 and 2020. All patients, together with a fellowship-trained pediatric orthopaedic trauma surgeon, were screened and classified as 2, 3, or 4-part triplane or as a Tillaux fracture. Using standardized axial views, fracture lines were recorded manually and superimposed on a template. Fracture maps were visually assessed by a panel of 5 surgeons, and a consensus was reached for interpretation of the fracture maps grouped per age, gender, fracture type (Tillaux vs triplane) and physis (open vs partially closed).

Results: A characteristic Y-pattern can be observed in all fracture maps, regardless of grouping by age, gender, or level of closure of the physis. The fracture map grouped by both age and gender showed no major difference in fracture patterns between different age groups or gender; in addition no shift from anteromedial to anterolateral, following the hypothesized closure of the physis, was observed. There was no significant difference ($P = 0.955$) in mean age at trauma between triplane (13 ± 1.5 years) and Tillaux fractures (13 ± 1.7 years).

Conclusions: No correlation has been found between age (and thus closure of the physis) and the type and configuration of transitional fractures in pediatric patients. These injuries are more strongly influenced by the forces of the tibiofibular ligaments on the distal tibia during these external rotation injuries than previously assumed. Age and gender are therefore not reliable predictors for type and configuration of transitional distal tibial fractures.