OPERATIVE DECISION-MAKING FOR PEDIATRIC TIBIAL SPINE FRACTURES: ASSESSING THE EFFECT OF SURGEON EXPERIENCE AND RISK-AVERSION AND PATIENT AGE, SEX, INJURY TYPE, AND ATHLETIC LEVEL USING A MIXED EFFECTS MODEL

Alexander J. Adams, BS¹, Nathan N. O’Hara, MHA², Joshua M. Abzug, MD³, Aristides I. Cruz, Jr., MD, MBA⁴, Henry B. Ellis, Jr., MD⁵, Peter D. Fabricant, MD MPH⁶, Daniel W. Green, MD⁷, Mininder S. Kocher, MD MPH⁸, J. Todd Lawrence, MD⁹, R. Jay Lee, MD¹⁰, Scott McKay, MD¹¹, R. Justin Mistovich, MD¹², John D. Polousky, MD¹³, Jason Rhodes, MDzz¹⁴zz, Theodore J. Ganley, MDzz¹⁵zz

¹Children’s Hospital of Philadelphia, Philadelphia, PA, USA, ²University of Maryland School of Medicine, USA, ³University of Maryland School of Medicine, USA, ⁴Hasbro Children’s Hospital, East Providence, RI, USA, ⁵Texas Scottish Rite Hospital for Children, Dallas, TX, USA, ⁶Hospital for Special Surgery, New York, NY, USA, ⁷Hospital for Special Surgery, New York, NY, USA, ⁸Boston Children’s Hospital, Boston, MA, USA, ⁹Children’s Hospital of Philadelphia - Sports Medicine, Philadelphia, PA, USA, ¹⁰Johns Hopkins Hospital, Baltimore, MD, USA, ¹¹Texas Children’s Hospital, Houston, TX, USA, ¹²Case Western Reserve University, Cleveland, OH, USA, ¹³Children’s Health Orthopaedics & Sports Medicine, Plano, TX, USA, ¹⁴Children’s Hospital Colorado, Aurora, CO, USA, ¹⁵The Children’s Hospital of Philadelphia, Philadelphia, PA, USA

Background:
Tibial spine fractures most commonly occur in children aged 8 to 14 years and are occasionally seen in adults. Although the annual incidence is 3 per 100,000 children, they account for 2-5% of pediatric knee injuries with effusions and are associated with substantial complications including ACL deficiency and arthrofibrosis. The rise in competitive youth sports has brought increased public attention to this injury. Meyers and McKeever Type II fractures are displaced anteriorly with an intact posterior hinge. This specific subtype of pediatric tibial spine fractures has controversy in the literature whether they should be treated non-operatively or operatively. The purpose of this study was to identify assess for variability amongst pediatric orthopaedic surgeons when treating pediatric type II tibial spine fractures.

Methods:
A discrete choice experiment was conducted to determine the patient and injury attributes that influence the management of type II pediatric tibial spine fractures by pediatric orthopaedic surgeons. A convenience sample of 14 pediatric orthopaedic surgeons reviewed 40 case vignettes (Figure 1) that included radiographs displaying fractures with varying degrees of displacement (range: 2.5 – 6.0 mm) and a brief description on the patient’s sex, age (8-17), mechanism of injury (fall, collision, hypertension, twist), and predominant sport (swimming, football, basketball, nonathlete).

Surgeons were asked whether they would treat the fracture operatively or non-operatively. Physes were blinded. A mixed effects model was used to determine the patient attributes most likely to influence the surgeon’s decision for operative treatment of a tibial spine fracture. In addition, the association between surgeon propensity for operative treatment based on surgeon training, years in practice, and risk-taking behavior based on the Jackson Personality Inventory subscale was assessed. A receiver operating characteristic curve was used to determine probability of surgical treatment based on the degree of fracture displacement.

Results:
Surgeon demographics are summarized in Table 1. Overall, the 14 respondents selected operative treatment in 75% of the presented cases. The degree of fracture displacement was the only patient attribute that was significantly associated with treatment choice (p<0.001). Surgeons were 29% more likely to treat the fracture operatively with each additional millimeter of displacement. The probability of opting for surgical treatment exceeded 50% when the fracture had...
3.5 or more millimeters of displacement. Significant variation in surgeon’s propensity for operative treatment of this fracture was observed (p=0.01). Nine of the 14 surgeons demonstrated a significant propensity for operative treatment of this injury. Surgeon training, years in practice, and risk-taking scores were not associated with the respondent’s preference for surgical treatment.

Conclusions / Significance:
There is substantial variation among pediatric orthopaedic surgeons when treating type II tibial spine fractures. The decision to operate is significantly based on the degree of fracture displacement. However, there is no standardization regarding how to treat type II tibial spine fractures and therefore better treatment algorithms are needed to optimize patient outcomes. Learning about the current treatment preferences among surgeons given different patient factors can highlight current variation in practice patterns and direct efforts toward promoting the most optimal treatment strategies.

| Table 1: Surgeon Demographics |
|--------------------------------|
| **Age (Mean ± SD)** | 43.3 ± 6.1 years |
| **Sex n (%)** | Male 14/14 (100%) |
| **Years of Practice (Mean ± SD)** | 9.2 ± 6.2 years |
| **Practice Geography** | Northeast 8/14 (57.1%), Midwest 4/14 (28.6%), Southwest 2/14 (14.3%) |
| **Practice Type** | Academic 12/14 (85.7%), Academic and Private Mix 2/14 (14.3%) |
| **Fellowship Training** | Pediatrics 6/14 (42.9%), Pediatrics and Sports 7/14 (50%), Pediatrics and Hip Preservation 1/14 (7.1%) |
| **Average Days Per Week On-Call (Mean ± SD)** | 1.8 ± 0.6 years |
| **Pediatric Tibial Spine Fractures Treated Annually** | 1-3 5/14 (35.7%), 4-6 3/14 (21.4%), 6-9 4/14 (28.6%), 10-14 1/14 (7.1%), ≥15 1/14 (7.1%) |
| **Adult Tibial Spine Fractures Treated Annually** | Rarely (<1) 6/14 (42.9%), 1-3 3/14 (21.4%), 4-6 2/14 (14.3%), 6-9 2/14 (14.3%), 10-14 1/14 (7.1%) |

The Orthopaedic Journal of Sports Medicine, 7(3)(suppl 1)
DOI: 10.1177/2325967119S00129
©The Author(s) 2019