Pediatric Tibial Spine Fractures

Exploring Case Burden by Age and Sex

Christopher J. DeFrancesco,* MD, Lauren Wilson,† MPH, Drake G. Lebrun,* MD, MPH, Stavros G. Memtsoudis,‡ MD, PhD, MBA, and Peter D. Fabricant,*§ MD, MPH

Investigation performed at Hospital for Special Surgery, New York, New York, USA

Background: Pediatric tibial spine fractures (TSFs) are a well-known clinical entity, but the epidemiology of these injuries is not fully understood. Further, there are limited data on outcomes after TSF treatment, specifically the proportion of patients requiring subsequent anterior cruciate ligament (ACL) reconstruction.

Purpose: To describe the distribution of TSF case burden by age and sex and to determine the proportion of patients undergoing subsequent ACL reconstruction or developing ACL insufficiency.

Study Design: Descriptive epidemiology study.

Methods: The Truven Health MarketScan database was queried to identify patients aged 7 to 18 years with TSFs between 2016 and 2018. Diagnosis and initial treatment (surgical vs nonoperative) were recorded based on database coding. Case burden by age and sex was calculated. The database, which includes longitudinal data, was then queried for subsequent diagnoses of ACL insufficiency as well as subsequent ACL reconstruction procedures performed among the patients.

Results: We found 876 cases of TSF, 71.3% of which were treated nonoperatively. The male to female ratio for case burden was 2.2:1. Cases peaked at age 13 to 14 years for boys and age 11 to 12 years for girls. Of all cases identified, 3.7% also had either a diagnosis code for ACL laxity entered in a delayed fashion into the database or a later procedure code for ACL reconstruction (considered together to represent "subsequent ACL insufficiency"). Only 15 subsequent ACL reconstructions (1.7% of cases) were found, all of which were among boys and 9 of which were among boys aged 13 to 14 years.

Conclusion: This longitudinal study is the largest epidemiological analysis of pediatric TSFs to date. We found low rates of subsequent ACL insufficiency and ACL reconstruction, with boys aged 13 to 14 years accounting for most of those cases. Rates of subsequent ACL reconstruction were lower than previously reported. Boys accounted for more than two times as many TSF cases as girls.

Keywords: tibial spine fracture; tibial eminence fracture; epidemiology; database

Pediatric tibial spine fractures (TSFs) are a well-described entity among skeletally immature patients.[6,7,13,21] This injury occurs when the anterior cruciate ligament (ACL) is loaded in tension, frequently at low velocity, resulting in bony avulsion of the tibial eminence before the ACL fails in continuity.[18] TSFs result in functional ACL insufficiency and are considered a "pediatric equivalent to ACL rupture." Occasionally, a TSF may present with concomitant interstitial injury or incomplete rupture of the ACL. This is found more commonly in the setting of displaced fractures.[14] Treatment for the patient with a nondisplaced TSF may consist of immobilization without surgery. Displaced fractures may be treated with closed reduction and casting in terminal knee extension. However, displaced fractures, which are frequently accompanied by meniscal or chondral injury,[17] are commonly treated with arthroscopic or open surgical fixation, which may allow for earlier range of motion. Fixation options include screw, suture anchor, and suture-only repairs, with the fixation choice depending on the size and comminution of the avulsed bony fragment.[3,7] Regardless of treatment strategy, some patients treated for TSF will develop clinical knee laxity.[11,15,16,20,22] Although it is not clear which patients will have symptoms[16] older age has been cited as a risk factor for progressing to later ACL reconstruction.[16]

While several studies[1,12,14] have claimed that TSFs tend to occur most often among children aged 8 to 14 years, a 2015 series of 18 patients included children as young as 3 years and as old as 17 years.[6] This suggests that the distribution of case burden by age is actually not yet well described, likely because previous observational studies have been limited by small series sizes. Furthermore, the proportion of patients treated for a TSF that will later be diagnosed with ACL insufficiency or undergo subsequent ACL reconstruction is not known outside of a small, single-center retrospective study.[16]

The Orthopaedic Journal of Sports Medicine, 9(9), 23259671211027237
DOI: 10.1177/23259671211027237

The aim of this study was to use a large payer database to describe the epidemiology of TSFs, including case burden by sex and age. Based on our own experiences, we hypothesized that we would find increased case burden among male patients compared with female patients. We further sought to estimate how often different treatment approaches were used, as well as the proportion of patients later developing ACL insufficiency.

METHODS

This study was exempt from institutional review board approval because it utilized a publicly available, deidentified database.

Database

The Truven Health MarketScan database (Truven Health Analytics Inc) was used to identify cases for this study. The Truven database contains one of the largest convenience samples of the privately insured population in the United States, including data from >150 employers and approximately 20 health plans across the United States that submit data directly to Truven. It contains longitudinal data, with information from both inpatient and outpatient visits. This database has been used in several prior orthopaedic studies.[2,4,8] One major limitation of the database as it was used here is that it is not a comprehensive national database, and therefore, while it may be used to generate case counts, it could not be used to estimate the number of people at risk throughout the study period. Because of this, case burden is reported here as raw case counts rather than population incidence estimates.

Case Identification

Patients with an International Classification of Diseases–10th Revision (ICD-10) diagnosis code for TSF (S82.11) reported in the Truven database at any visit between 2016 and 2018 were identified. Index patient age was restricted to 7 to 18 years based on the distribution of cases in a recent study.[6] Including older adult patients would likely have resulted in more adult-type tibial spine avulsion injuries, which are considered a separate clinical entity. The start of the date range for index cases was set at 2016 because older ICD-9 coding, which was used through 2015, did not include a specific diagnosis code for TSF. The range was ended at 2018 to allow a minimum of 1.5 years of potential follow-up for all patients. Further, any patient with the diagnosis code for tibial tubercle fracture (ICD-10 code S82.15) was excluded to reduce patient misclassification, as older ICD-9 codes covering TSFs also covered tibial tubercle fractures.

Treatment Classification

Patients with TSFs were classified into 2 different treatment categories: (1) tibial spine fixation (operative treatment) or (2) nonoperative treatment. Assignment to the fixation group was based on having 1 of several Current Procedural Terminology (CPT) codes reported at a visit within 90 days of TSF diagnosis (according to ICD coding). These codes included that for suture-only fixation of the tibial side of the ACL (29888) as well as those for tibial spine fixation (27540, 29850, or 29851). Laterality indicators affixed to ICD-10 diagnosis codes and CPT modifiers were used to validate that procedures were performed on the ipsilateral leg. All TSFs that were not classified as having undergone surgical fixation within 90 days of diagnosis were classified as having received initial nonoperative treatment.

Subsequent ACL Reconstruction and ACL Insufficiency

Patients with TSFs were considered to have undergone a subsequent ACL reconstruction for symptomatic knee laxity if their longitudinal record included CPT 29888 entered ≥90 days after diagnosis of TSF (for patients undergoing initial operative treatment, this was defined as ≥90 days after surgery rather than diagnosis). Patients were considered to have ACL insufficiency if they had subsequent ACL reconstruction (defined as outlined) or their record included the diagnosis code for ACL injury (ICD-10 S83.51) entered for the first time ≥90 days after the diagnosis of TSF (again, for patients undergoing operative treatment, this was defined as ≥90 days after surgery rather than diagnosis). The outcome of ACL insufficiency was thus a composite outcome, including either subsequent ACL reconstruction or a delayed subsequent diagnosis of ACL injury. The 90-day cutoff was used because it coincides with the global period for billing after surgery, and—perhaps more importantly—a recent series showed that the earliest any patient underwent ACL reconstruction for persistent laxity after TSF was 3.5 months after initial treatment.[14]

§Address correspondence to Peter D. Fabricant, MD, MPH, Division of Pediatric Orthopedic Surgery, Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021, USA (email: fabricantp@hss.edu).
*Division of Pediatric Orthopedic Surgery, Hospital for Special Surgery, New York, New York, USA.
†Division of Biostatistics, Hospital for Special Surgery, New York, New York, USA.
‡Division of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York, USA.
Final revision submitted February 9, 2021; accepted February 28, 2021.
One or more of the authors has declared the following potential conflict of interest or source of funding: S.G.M. has received consulting fees from Sandoz and Teikoku and royalties from Springer, has stock/stock options in HATH, and is the co-owner of FC Monmouth and SGM Consulting. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval was not sought for the present study.

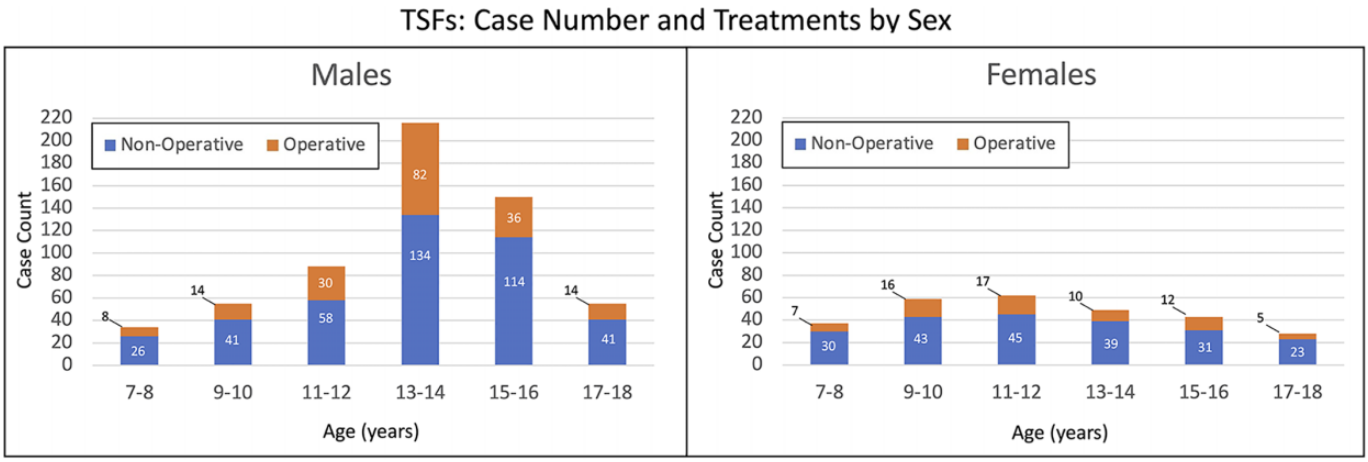

Figure 1. Tibial spine fracture (TSF) case numbers from the Truven Health MarketScan database (Truven Health Analytics Inc), broken down by sex, age group, and initial treatment approach.

Statistical Analysis

Subgroups were identified as detailed earlier, and patients were stratified by sex and age at the time of TSF. Given small cell numbers, age binning was done in 2-year increments, resulting in 6 age strata. SAS Version 9.4 (SAS Institute) was used to perform the chi-square or the Fisher exact test to analyze differences among subgroups. All analyses were 2-tailed, and a threshold for significance of $P \leq .05$ was used for all statistical comparisons.

RESULTS

Cases

The database yielded 876 cases of TSF among patients aged 7 to 18 years. We found that, among boys, the subgroup aged 13 to 14 years had the highest case count. For girls, cases peaked earlier and plateaued around ages 9 to 12 years (Figure 1). TSF case count was higher among boys, with this group accounting for 68.3% of cases. However, case counts were nearly equal for boys and girls up through ages 9 to 10 years (n = 89 vs 96, respectively). After age 10 years, the number of cases among boys and girls diverged sharply.

Treatments

Most cases of TSF (n = 625/876 [71.3%]) were treated nonoperatively. Girls were more commonly treated nonoperatively in this sample (75.9% vs 69.2%; $P = .042$). The incidence of nonoperative treatment varied across sex and age strata, ranging from 62.0% to 82.1%.

Among the 12 sex and age strata, boys aged 11 to 12 and 13 to 14 years were the most likely to undergo surgery as their initial treatment (34.1% and 38.0%, respectively).

Outcomes

Of the 876 overall cases of TSF identified in the data set, 32 cases (3.7%) resulted in subsequent ACL insufficiency (n = 26/598 [4.3%] in boys, n = 6/278 [2.2%] in girls; $P = .108$). Fifteen subsequent ACL reconstructions were performed, all among boys (2.5% of boys vs 0% of girls; $P = .004$). Eight of these were among boys treated nonoperatively, 7 of these were among boys treated with surgery. Detailed outcomes are listed in Appendix Table A1. Boys aged 13 to 14 years represented the sex and age stratum with the greatest likelihood of both subsequent ACL reconstruction and subsequent ACL insufficiency (n = 9/216 [4.2%] and 17/216 [7.9%], respectively).

Outcomes After Nonoperative Treatment. Of the 625 patients who underwent nonoperative treatment, 8 (1.3%) underwent subsequent ACL reconstruction, while 16 (2.6%) were noted to have ACL insufficiency (as defined earlier). Most of the subsequent ACL reconstructions were seen among boys aged 13 to 14 (n = 3/134 [2.2%]) and 15 to 16 years (n = 3/114 [2.6%]). Likewise, most cases of ACL insufficiency were seen among boys aged 13 to 14 (n = 6/134 [4.5%]) and 15 to 16 years (n = 5/114 [4.4%]).

Outcomes After Operative Treatment. Of the 251 patients who underwent surgical treatment for a TSF, 7 (2.8%) were noted to have subsequent ACL reconstruction using the criteria defined earlier, while 16 (6.4%) had either a delayed code for ACL reconstruction or a delayed diagnosis code for ACL injury (collectively considered "ACL insufficiency," as defined earlier).

This rate of subsequent ACL insufficiency was higher than that found among patients treated initially nonoperatively (n = 16/251 [6.4%] vs 16/625 [2.6%]; $P = .007$). Boys aged 13 to 14 years treated with surgery showed a 7.3% rate of subsequent ACL reconstruction (n = 6/82) and a 13.4% rate of subsequent ACL insufficiency (n = 11/82). This rate of subsequent ACL insufficiency was higher than that among boys aged 13 to 14 years treated nonoperatively ($P = .023$). While these differences between operative and nonoperative groups may be interesting, it is important for the reader to note that follow-up for these groups was likely different (eg, following up with a surgeon vs a primary care physician), which may largely account for the differences in recorded knee laxity diagnoses.

DISCUSSION

In this study, consistent with our hypotheses, we showed that the case burden of pediatric TSFs is higher for boys compared with girls, although this difference does not manifest until after age 10 years. Additionally, the peak age for case burden is older for boys than it is for girls (age 13-14 vs 11-12 years, respectively). Case counts for girls also seemed to plateau between ages 9 and 12 years. The finding that most TSFs occurred at the ages typically preceding skeletal maturity supports the theory that some biological aspect of the closing physis leaves the tibial eminence prone to avulsion injury.

All cases of subsequent ACL reconstruction were seen among boys, suggesting that boys may be at higher risk for symptomatic knee laxity after initial treatment for a TSF. Additionally, the rate of ACL insufficiency among boys aged 13 to 14 years was 7.9%, more than double the rate seen in the overall sample (3.7%). The type of initial treatment also showed some correlation with outcomes, with rates of subsequent ACL insufficiency being higher after surgical treatment compared with nonoperative treatment (6.4% vs 2.6%). This may be explained by the fact that patients with displaced fractures—which are more commonly treated with surgery—are more likely to have concomitant ACL injury[14] that might cause future clinical laxity than are those with nondisplaced fractures. However, this finding must be interpreted with caution, as it is also possible that the observed difference in outcomes may be related to increased postinjury surveillance in patients treated operatively compared with those treated nonoperatively. For example, patients treated initially with surgery would likely follow up with their surgeon and undergo detailed knee examinations over the following year, while patients treated nonoperatively would possibly be transitioned to follow up with their primary care physician after several weeks in some underserved regions with fewer orthopaedic surgeons available. In such a possible scenario, patients treated operatively could undergo a higher level of postinjury surveillance, which may account for increased rates of diagnosed (by coding) subsequent ACL insufficiency and ACL reconstruction. For these reasons, we caution readers against interpreting the presented differences in rates of subsequent ACL insufficiency between operative and nonoperative groups as anything more than correlative in the absence of further research that firmly establishes a causal relationship.

This study has several other limitations related to database study methodology. First, because the Truven database does not include those with government insurance or no insurance, who are expected to have worse access to care[9,19] and thus worse outcomes, the sample included here may be somewhat biased to underestimate the actual disease burden. Additionally, population weights provided within the Truven database are limited to predefined, broad age ranges. As mentioned earlier in this article, this means that we could not calculate per capita disease incidence for narrower age ranges. Understanding this and the fact that these weights only represent the population with employer-sponsored health insurance, we elected to report case counts rather than per capita incidence estimates. This is a very important limitation for the reader to note when interpreting our findings; our data show raw case numbers and not true estimates of incidence.

In a recent study of TSFs by Mitchell et al,[16] 19% of the clinical sample underwent delayed ACL reconstruction after initial treatment, which consisted of nonoperative treatment, arthroscopic fracture fixation, or open reduction and internal fixation. While well designed and timely, this study analyzed cases spread out over 19 years, which limits the generalizability of its findings to modern cases in light of newer treatment strategies. It also represents a retrospective review of 1 institution's experience with TSFs, thus limiting external validity. In contrast, the current study considered multi-institutional, national data collected over a relatively narrow span of time, reporting on almost 9 times as many TSF cases. Compared with the study by Mitchell et al,[16] the current study noted a much lower proportion of patients known to go on to have subsequent ACL reconstruction. While improvements in modern treatments may somewhat account for these lower proportions, the discrepancy may also be due in part to shorter follow-up in our study as well as the fact that some events may not be captured in the Truven database. We also recognize that variations in treatment algorithms by institution may account for differences in rates of delayed surgical treatment and diagnosis of subsequent knee laxity. In this study, we also found that most patients were treated nonoperatively. Additionally, we found no statistically significant relationship between age and the rate of operative treatment; this is in contrast to prior work suggesting that younger patients are more likely to be treated nonoperatively.[10]

In this study, less than one-third of patients who developed ACL insufficiency had a subsequent procedure code for ACL reconstruction. This finding highlights the fact that, although some patients will develop clinical knee laxity after TSF treatment, not all of these patients will be symptomatic or require further reconstructive procedures such as ACL reconstruction. However, this finding is potentially influenced by possible misclassification bias in our definition of ACL insufficiency, which was a composite outcome defined by either a delayed diagnosis code for ACL injury or a delayed code for ACL reconstruction. Defined in this fashion, the cases of ACL insufficiency that we noted may have included some misclassified cases of primary ACL injury after TSF treatment. They may have also included some instances of delayed coding of ACL injury that the clinician related to the initial injury rather than any subsequent problem. Understanding these issues, we recognize that our definition of ACL insufficiency is potentially affected by misclassification error. However, working within the constraints of the database, we believed that this was the most reasonable composite outcome for knee laxity after TSF.

One of the more interesting takeaways from our analysis was the finding that boys represented more than double the cases compared with girls. While we cannot comment definitively on incidence by sex (because of aforementioned limitations in the database), this finding suggests that boys

may be at higher risk for TSF than are girls. Further research may be done to clarify relative risk by sex. If this finding is confirmed, causes for it may include variability in anatomic alignment, differences in risk exposure, and more. However, we hesitate to speculate further before more research shows that this difference in case burden reflects a real difference in case incidence by sex.

The small numbers of subsequent ACL reconstructions and ACL insufficiency cases found among the sex and age strata here—which precluded any high-level analyses of these outcomes—may be partly due to follow-up being limited to <3 years. However, failure of ACL reconstruction typically occurs within the first 2 years after surgery,[5] so 2-year follow-up would likely be sufficient for this study. We also recognize that the number of dropouts from the database could not be quantified because the Truven database is a claims database that does not provide information regarding the timing of any loss of coverage. While such losses to follow-up probably contributed to the low numbers of subsequent ACL insufficiencies and ACL reconstructions observed, this limitation was unavoidable because of the structure of the database.

We were also not able to compare treatment approaches head to head in this study because the database lacks clinical details such as fracture displacement, skeletal maturity, and granular imaging and physical examination findings. Additionally, fixation techniques are known to vary, and details of surgeon experience and surgical methods (eg, arthroscopic vs open, screws vs sutures) were not included in the database.

CONCLUSION

This is the largest study of TSFs to date. It provides longitudinal epidemiological evidence regarding case burden, treatment, and outcomes. Boys aged 13 to 14 years represented the sex and age stratum showing peak case burden for TSF, and nonoperative treatment was the most common approach across sex and age strata. After initial treatment for TSF, boys more commonly underwent subsequent ACL reconstruction when compared with girls (2.5% vs 0%). However, the overall proportion of patients undergoing subsequent ACL reconstruction after initial TSF treatment was found to be lower than that previously reported.[16] While correlations between treatments and outcomes noted in this study may be artifacts of the database used, these observations can inform further studies on the topic. Larger prospective studies will be helpful to examine these correlations further, estimate per capita incidence, describe differences in incidence by sex, and compare the efficacy of different treatment techniques.

REFERENCES

1. Anderson CN, Anderson AF. Tibial eminence fractures. *Clin Sports Med*. 2011;30(4):727-742.
2. Bawa H, Weick JW, Dirschl DR, et al. Trends in deep vein thrombosis prophylaxis and deep vein thrombosis rates after total hip and knee arthroplasty. *J Am Acad Orthop Surg*. 2018;26(19):698-705.
3. Callanan M, Allen J, Flutie B, et al. Suture versus screw fixation of tibial spine fractures in children and adolescents: a comparative study. *Orthop J Sports Med*. 2019;7(11):2325967119881961.
4. Crijns TJ, van der Gronde BATD, Ring D, et al. Complex regional pain syndrome after distal radius fracture is uncommon and is often associated with fibromyalgia. *Clin Orthop Relat Res*. 2018;476(4):744-750.
5. DeFrancesco CJ, Storey EP, Flynn JM, et al. Pediatric ACL reconstruction and return to the operating room: revision is less than half of the story. *J Pediatr Orthop*. 2019;39(10):516-520.
6. Edmonds EW, Fornari ED, Dashe J, et al. Results of displaced pediatric tibial spine fractures: a comparison between open, arthroscopic, and closed management. *J Pediatr Orthop*. 2015;35(7):651-656.
7. Ganley TJ, Brusalis CM. Surgical reduction and fixation of tibial spine fractures in children: multiple fixation strategies. *JBJS Essent Surg Tech*. 2016;6(2):e18.
8. Han SS, Azad TD, Suarez PA, et al. A machine learning approach for predictive models of adverse events following spine surgery. *Spine J*. 2019;19(11):1772-1781.
9. Iobst C, King W, Baitner A, et al. Access to care for children with fractures. *J Pediatr Orthop*. 2010;30(3):244-247.
10. Jackson TJ, Storey EP, Ganley TJ. The surgical management of tibial spine fractures in children: a survey of the Pediatric Orthopaedic Society of North America (POSNA). *J Pediatr Orthop*. 2019;39(8):e572-e577.
11. Kocher MS, Foreman ES, Micheli LJ. Laxity and functional outcome after arthroscopic reduction and internal fixation of displaced tibial spine fractures in children. *Arthroscopy*. 2003;19(10):1085-1090.
12. Lafrance RM, Giordano B, Goldblatt J, et al. Pediatric tibial eminence fractures: evaluation and management. *J Am Acad Orthop Surg*. 2010;18(7):395-405.
13. Luhmann SJ. Acute traumatic knee effusions in children and adolescents. *J Pediatr Orthop*. 2003;23(2):199-202.
14. Mayo MH, Mitchell JJ, Axibal DP, et al. Anterior cruciate ligament injury at the time of anterior tibial spine fracture in young patients: an observational cohort study. *J Pediatr Orthop*. 2019;39(9):e668-e673.
15. Melugin HP, Desai VS, Camp CL, et al. Do tibial eminence fractures and anterior cruciate ligament tears have similar outcomes? *Orthop J Sports Med*. 2018;6(12):2325967118811854.
16. Mitchell JJ, Mayo MH, Axibal DP, et al. Delayed anterior cruciate ligament reconstruction in young patients with previous anterior tibial spine fractures. *Am J Sports Med*. 2016;44(8):2047-2056.
17. Mitchell JJ, Sjostrom R, Mansour AA, et al. Incidence of meniscal injury and chondral pathology in anterior tibial spine fractures of children. *J Pediatr Orthop*. 2015;35(2):130-135.
18. Noyes FR, DeLucas JL, Torvik PJ. Biomechanics of anterior cruciate ligament failure: an analysis of strain-rate sensitivity and mechanisms of failure in primates. *J Bone Joint Surg Am*. 1974;56(2):236-253.
19. Potak H, Iobst CA. Influence of insurance type on the access to pediatric care for children with distal radius torus fractures. *J Pediatr Orthop*. 2019;39(5):237-240.
20. Reynders P, Reynders K, Broos P. Pediatric and adolescent tibial eminence fractures: arthroscopic cannulated screw fixation. *J Trauma*. 2002;53(1):49-54.
21. Strauss EJ, Kaplan DJ, Weinberg ME, et al. Arthroscopic management of tibial spine avulsion fractures: principles and techniques. *J Am Acad Orthop Surg*. 2018;26(10):360-367.
22. Wiley JJ, Baxter MP. Tibial spine fractures in children. *Clin Orthop Relat Res*. 1990;255:54-60.

APPENDIX

TABLE A1
Initial Treatment Strategies and Subsequent Outcomes for Patients With Tibial Spine Fracture in the Truven Database[a]

Male		Female	
Age 7-8		Age 7-8	
Cases	34	Cases	37
Cases treated nonoperatively	26	Cases treated nonoperatively	30
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	0	… that went on to ACLI	0
… that did not go on to ACLI	26	… that did not go on to ACLI	30
Cases treated operatively	8	Cases treated operatively	7
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	0	… that went on to ACLI	1
… that did not go on to ACLI	8	… that did not go on to ACLI	6
Age 9-10		Age 9-10	
Cases	55	Cases	59
Cases treated nonoperatively	41	Cases treated nonoperatively	43
… that went on to ACLR	1	… that went on to ACLR	0
… that went on to ACLI	1	… that went on to ACLI	1
… that did not go on to ACLI	40	… that did not go on to ACLI	42
Cases treated operatively	14	Cases treated operatively	16
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	1	… that went on to ACLI	1
… that did not go on to ACLI	13	… that did not go on to ACLI	15
Age 11-12		Age 11-12	
Cases	88	Cases	62
Cases treated nonoperatively	58	Cases treated nonoperatively	45
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	0	… that went on to ACLI	0
… that did not go on to ACLI	58	… that did not go on to ACLI	45
Cases treated operatively	30	Cases treated operatively	17
… that went on to ACLR	1	… that went on to ACLR	0
… that went on to ACLI	1	… that went on to ACLI	0
… that did not go on to ACLI	29	… that did not go on to ACLI	17
Age 13-14		Age 13-14	
Cases	216	Cases	49
Cases treated nonoperatively	134	Cases treated nonoperatively	39
… that went on to ACLR	3	… that went on to ACLR	0
… that went on to ACLI	6	… that went on to ACLI	1
… that did not go on to ACLI	128	… that did not go on to ACLI	38
Cases treated operatively	82	Cases treated operatively	10
… that went on to ACLR	6	… that went on to ACLR	0
… that went on to ACLI	11	… that went on to ACLI	0
… that did not go on to ACLI	71	… that did not go on to ACLI	10
Age 15-16		Age 15-16	
Cases	150	Cases	43
Cases treated nonoperatively	114	Cases treated nonoperatively	31
… that went on to ACLR	3	… that went on to ACLR	0
… that went on to ACLI	5	… that went on to ACLI	0
… that did not go on to ACLI	109	… that did not go on to ACLI	31
Cases treated operatively	36	Cases treated operatively	12
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	0	… that went on to ACLI	1
… that did not go on to ACLI	36	… that did not go on to ACLI	11
Age 17-18		Age 17-18	
Cases	55	Cases	28
Cases treated nonoperatively	41	Cases treated nonoperatively	23
… that went on to ACLR	1	… that went on to ACLR	1
… that went on to ACLI	1	… that went on to ACLI	1
… that did not go on to ACLI	40	… that did not go on to ACLI	22
Cases treated operatively	14	Cases treated operatively	5
… that went on to ACLR	0	… that went on to ACLR	0
… that went on to ACLI	0	… that went on to ACLI	0
… that did not go on to ACLI	14	… that did not go on to ACLI	5

(continued)

Table A1 (continued)

Male		**Female**	
Across all ages		Across all ages	
Cases	598	Cases	278
Cases treated nonoperatively	414	Cases treated nonoperatively	211
… that went on to ACLR	8	… that went on to ACLR	0
… that went on to ACLI	13	… that went on to ACLI	3
… that did not go on to ACLI	401	… that did not go on to ACLI	208
Cases treated operatively	184	Cases treated operatively	67
… that went on to ACLR	7	… that went on to ACLR	0
… that went on to ACLI	13	… that went on to ACLI	3
… that did not go on to ACLI	171	… that did not go on to ACLI	64

[a]Data are reported as counts only. ACL insufficiency (ACLI) includes patients who underwent ACL reconstruction (ACLR) and also those with diagnosis of clinical laxity. ACL, anterior cruciate ligament. Truven, Truven Health MarketScan (Truven Health Analytics Inc).