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Reoperations After Tarsal Coalition Resection: A Population-Based Study

Amir Khoshbin, MD [1,2], Maryse Bouchard, MD, MSc, FRCSC [1,3], David Wasserstein, MD, MSc, FRCSC [1,4], Timothy Leroux, MD [1], Peggy W. Law, MSc [2], Hans J. Kreder, MD, MPH, FRCSC [1,4,5], Timothy R. Daniels, MD, FRCSC [1,3], James G. Wright, MD, MPH, FRCSC [1,2]

[1] *Division of Orthopaedic Surgery, University of Toronto, Toronto, ON, Canada*
[2] *Division of Orthopaedic Surgery, The Hospital for Sick Children, Toronto, ON, Canada*
[3] *Division of Orthopaedic Surgery, St. Michael's Hospital, Toronto, ON, Canada*
[4] *Division of Orthopaedic Surgry, Sunnybrook Health Sciences Centre, Toronto, ON, Canada*
[5] *Institute for Clinical Evaluative Sciences, Toronto, ON, Canada*

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ABSTRACT

Few studies have evaluated the incidence of subsequent operations after tarsal coalition resection. Using administrative databases, we followed up a cohort of patients who had undergone tarsal coalition resection to determine the rates and possible risk factors for subsequent resection or arthrodesis. Patients (aged 8 years or older) who had been treated from July 1994 to August 2009 in Canada were identified and included. Those with nonidiopathic coalitions were excluded. The time-to-event data for the earliest subsequent procedure were fit to a Cox proportional hazards model that evaluated the patient, operative, and provider factors. Controlling for covariates, the hazard ratios were computed; however, the laterality of any subsequent operation could not be confirmed. A total of 304 patients underwent tarsal coalition resection at an average age of 24.2 ± 17.5 years. Of these 304 patients, 26 (8.6%) underwent subsequent resection and 16 (5.3%) mid- or hindfoot arthrodesis. Of all the factors, the need for future fusion was more likely only if the primary resection had been performed at an academic hospital or if the patient had undergone concomitant arthrodesis at primary resection of the coalition (hazard ratio 3.0, 95% confidence interval 1.1 to 8.5; and hazard ratio 9.7, 95% confidence interval 1.7 to 56.1, respectively). The incidence of reoperation after primary tarsal coalition resection was low in our cohort. More than 85% of our patients never required additional operative intervention an average of 9 years after the initial resection. Our data also suggest that primary treatment of tarsal coalition with resection and concomitant arthrodesis increases the risk of requiring a second fusion in the future.

Tarsal coalition (TC), the abnormal fusion of 2 or more joints in the midfoot or hindfoot, has a reported prevalence of 2% (1–3). Talocalcaneal coalition (TCC) and calcaneonavicular coalition (CNC) have been the most common types (4–6). Although the condition can be present at birth, symptomatic pain will usually not be experienced until adolescence, when ossification or maturation of a fibrous coalition will occur (3,7). Coalitions can be asymptomatic in up to 75% of patients (1,2). Of those requiring treatment, nonoperative approaches should be considered initially (5,8,9).

When nonoperative approaches have failed to alleviate functional impairment or pain, operative treatment should be considered. The procedures to treat persistent painful coalition include resection and/or primary concomitant arthrodesis (5,9). TC resection (TCR) involves removal of the bar, with interposition of fat, tendon, muscle, or bone wax at the coalition site (5,10,11). Resection has generally been believed to preserve the range of motion and does not preclude secondary arthrodesis (7,9,10,12). Resection of CNCs has tended to have better and more predictable results, with success rates of 85% generally reported, than resection of TCCs, which have presented more frequently with degenerative changes and deformity (22). The rate of good outcomes with TCC resection has been reported to be 50%

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Address correspondence to: Amir Khoshbin, MD, Division of Orthopaedic Surgery, The Hospital for Sick Children, S107, 555 University Avenue, Toronto, ON M5G 1X8 Canada.

E-mail address: amir.khoshbin@mail.utoronto.ca (A. Khoshbin).

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to 75% (4,11,13). Isolated arthrodesis of the subtalar joint has generally been recommended for large TCCs (>50% of the middle facet) or in the presence of significant subtalar degenerative changes (14–16). Triple fusion has been described for patients with coalitions, severe degenerative changes, and mid- and hindfoot deformity (13–15). Other indications for arthrodesis have included inadequate pain relief after resection and coalition recurrence.

To date, few published studies have reported on the reoperation rates after primary TCR. In the present retrospective cohort study, we identified a large cohort of patients who had undergone TCR and followed them long term to examine the reoperation rates and to identify the possible risk factors for subsequent resection or arthrodesis.

Patients and Methods

Administrative Databases

The present study was a population cohort study using the administrative health databases in Ontario, Canada. The research ethics boards of our institutions approved the study before the study was begun. The public healthcare system of Ontario provides an excellent opportunity to capture patient data because the health insurance plan covers greater than 95% of health services administered for Ontario residents.

All data were collected from the (1) health insurance plan's Physicians' Billing Database, (2) Registered Persons Database, (3) Canadian Institute for Health Information Discharge Abstract Database and the Same Day Surgery Database, and (4) Institute for Clinical Evaluative Sciences Physicians' Database. Such databases have been used in previous orthopedic and nonorthopedic studies (17–20).

We confirmed the accuracy of our database for identifying relevant patients by also performing a manual review of the medical records to identify patients with the same inclusion criteria at the largest pediatric hospital in Ontario, Canada. The database search identified nearly all patients found using the manual audit (4 of 5). We, therefore, considered this method to be reliable.

Patient Population

The criteria for cohort inclusion were any patients aged 8 years or older (determined a priori as the youngest age at which TC could present) who had undergone TCR (from July 1, 1994 to August 31, 2009). Cohort entry allowed a minimum 3-year "look back" period and a minimum 2-year follow-up period. The index TCR served as the cohort entry date into the present study.

To ensure the underlying etiology was idiopathic, we excluded patients with rheumatoid arthritis, cerebral palsy, Charcot-Marie-Tooth disease, mid- or hindfoot or ankle fusion, and treated mid- or hindfoot or ankle fractures. Those who were not residents of Ontario, Canada were also excluded, because accurate follow-up would have been difficult (17). Although the removal of those with hindfoot and ankle fractures might have inadvertently eliminated some of the most troublesome coalition cases, the actual number of patients excluded was minimal (n = 8) (3,5).

Covariates and Reoperation

The patient demographics were recorded at the initial TCR, along with any concomitant procedures performed (including tendo-Achilles lengthening, autogenous bone grafting [as a part of the resection or arthrodesis procedure], subtalar or midtarsal fusion, and pantalar or triple fusion). However, data on laterality, coalition location, coalition size, and degree of deformity were not available owing to database limitations. Subsequent operations (resection and mid- or hindfoot fusion) were recorded until study termination. Patients requiring irrigation and debridement within 1 year of their initial TCR were also identified.

The experience and volume of all primary surgeons was determined at each index TCR performed. This was defined as the years since orthopedic surgery certification from the Royal College of Physicians and Surgeons of Canada until the date of the initial TCR and the annual average number of TCRs performed during the previous 2 calendar years. The status of the hospital at which the index TCR was performed was dichotomized as academic or nonacademic according to membership in the Council of Academic Hospitals of Ontario.

Statistical Analysis

Continuous variables were analyzed using a 2-tailed Student's *t* test, and categorical variables were analyzed using the chi-square test and Cochran-Armitage test for trend. Alpha values for all statistical tests were preset at 0.05. A time-to-event analysis for the earliest subsequent TCR and fusion was performed.

Using a Cox proportional hazards model, the influence of the *a priori*–defined patient, operative, and provider factors on the interval to a subsequent operation was assessed by determining the hazard ratios (HRs) and 95% confidence intervals (CIs).

Table 1
Cohort exclusion criteria

	Sample Size
Total before exclusion	336
Exclusion criteria	
Age <8 y	≤5*
Non-Ontario resident	0
Previous ankle or mid- or hindfoot fusion	6
Previous ankle fracture	8
Previous mid- or hindfoot fracture	13
Rheumatoid arthritis, cerebral palsy, Charcot-Marie-Tooth disease	≤5*
Total after exclusion	304 (90.5)

* Suppressed to protect patient confidentiality.

Patient censoring from the cohort occurred if a patient had died, had emigrated from the province, or had undergone subsequent resection or arthrodesis. All models satisfied the proportional assumption for all covariates in the Cox proportional hazards models. Privacy restrictions and data sharing agreements at the Institute for Clinical Evaluative Sciences and the Ontario Ministry of Health and Long-Term Care have required that small cells be suppressed to protect patient confidentiality. Thus, the covariates or outcomes containing 5 or fewer patients have been denoted as "≤5."

Kaplan-Meier survival curves were created to illustrate the interval free from reoperation after the initial TCR. All statistical analysis was performed using Statistical Analysis System, version 9.3, for UNIX (SAS Institute, Cary, NC).

Results

A total of 304 patients (56% male) from 68 hospitals were included in our cohort (Table 1). The mean patient age at the initial TCR was 24.2 ± 17.5 years (Table 2). Fewer than 28 concomitant procedures (9%) were performed at TCR, with tendo-Achilles lengthening the most common. Postoperatively, fewer than 6 patients (2%) required irrigation and debridement for presumed infection. Approximately one half of all the initial TCRs were performed in an academic hospital. The median follow-up period in our study was 9.5 (interquartile range 5.7 to 13.2) years.

A total of 42 patients (14%) underwent a subsequent operation after a mean of 8.4 ± 4.5 years. Within this group, 26 patients underwent repeat resection and 16 mid- or hindfoot arthrodesis at a median of 7.1 (interquartile range 5.3 to 12.3) years and 7.5 (interquartile range 6.2 to 12.4) years, respectively, after the initial TCR. Kaplan-Meier curves representing the interval free of reoperation are

Table 2
Patient characteristics at initial tarsal coalition resection

Variable	All Patients	Subsequent Surgery	
		Resection	Arthrodesis
Total patients	304 (100)	26 (8.6)	16 (5.3)
Gender			
Male	171 (56.3)	13 (50)	7 (43.8)
Female	133 (43.8)	13 (50)	9 (56.3)
Age at initial TCR (y)	24.2 ± 17.5	15.2 ± 7.9*	20.9 ± 9.0
Concurrent procedures			
TAL or bone graft	13 (4.3)	0 (0.0)	≤5†,‡
Pantalar or triple fusion	≤5†	0 (0.0)	0 (0.0)
Subtalar or midtarsal fusion	10(3.3)	≤5†	≤5†,‡
Surgeon factor			
Volume (TCRs/y)	1.0 ± 1.1	1.2 ± 1.1	0.8 ± 1.1
Hospital status			
Nonacademic	151 (49.7)	6 (23.1)*	7 (43.8)
Academic	153 (50.3)	20 (76.9)*	9 (56.3)

Abbreviations: TAL, tendo-Achilles lengthening; TCR, tarsal coalition resection.
Data presented as n (%) or mean ± standard deviation.
* Comparing patients who required subsequent resection and those who did not, $p < .01$.
† Cells with ≤5 patients were suppressed to protect confidentiality.
‡ Comparing patients who required subsequent arthrodesis and those who did not, $p < .05$.