EFFECTIVENESS OF NONOPERATIVE TREATMENT OF THE SYMPTOMATIC ACCESSORY NAVICULAR IN PEDIATRIC PATIENTS

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ABSTRACT

Background: Initial management of symptomatic accessory navicular in pediatric patients is nonoperative. However, efficacy of nonoperative treatment has not been studied or established. If nonoperative treatment is frequently unsuccessful or does not give lasting pain relief, surgery could be offered as first line treatment. This study retrospectively reviewed outcomes of pediatric patients treated nonoperatively for symptomatic accessory naviculae in an effort to provide clinicians success rates for their discussion of treatment options with patients and their families.

Methods: A retrospective analysis of pediatric patients diagnosed and treated nonoperatively for a symptomatic accessory navicular bone at Cincinnati Children's Hospital Medical Center between dates August 1st, 2006 and August 24th, 2016 was performed. Outcome measures consisted of complete pain relief, partial relief without operative intervention, or need for operative intervention. Radiographic imaging for each patient was also used to identify the type of accessory navicular and presence of concurrent pes planus.

Results: A total of 169 patients were included, with 226 symptomatic accessory naviculae. Average age at diagnosis was 11.8 years, with majority females (78%). Type 2 accessory naviculae were most frequent (72.7%), with Type 1 and Type 3 in 9.7% and 17.4%, respectively. Average number of nonoperative trials was 2.1, with 28% experiencing complete pain relief, 30% requiring surgical intervention, and 41% that experienced partial pain relief and did not require surgical intervention, and were recommended as needed (PRN) follow-up based on clinical improvement. Of those that achieved complete pain relief, the average length of non-operative treatment was 8.0 months.

Conclusion: The results of this study can be used by clinicians to frame discussions surrounding treatment options for symptomatic accessory navicular bones with both patients and their families.

Level of Evidence: III

Keywords: accessory naviculae, nonoperative treatment, pediatric

INTRODUCTION

An accessory navicular is considered a normal anatomic variant. They are present in 4% to 21% of the population.[1,2] The accessory navicular was first described by Bauhin in 1605.[3] It has been known by several names including os tibiale, naviculare secundarium, pre-hallux, and bifurcated hallux. Most are asymptomatic and incidentally noticed on a radiograph. However, occasionally an accessory navicular can present with clinically evident symptoms, such as pain and tenderness. These symptoms typically present in the second decade of life which correlates with its ossification.[3] The navicular is the last of the tarsal bones to ossify with variable radiographic appearance between 2.7 to 4 years.[4] The secondary ossification center does not appear until 9 through 13 years of age, occurring two years earlier in females than males.[3,5] When this ossification center fails to fuse to the primary mass, it results in an accessory navicular which can cause medial foot pain.

The first proposed classification system for the accessory navicular was described by Dwight in 1907 and is still used today with only slight modification. Dwight's classification includes three categories of accessory navicular bones (Figure 1). In a Type 1 accessory navicular, the ossicle is completely independent from the navicular as a sesamoid bone in the tibialis posterior tendon.[3] It accounts for 30% of accessory navicular bones.[3,5] The Type 2 accessory navicular is the most common at 60% of accessory navicular bones, and is united to the navicular by a cartilaginous or fibrocartilaginous bridge.[3,5] Lastly,

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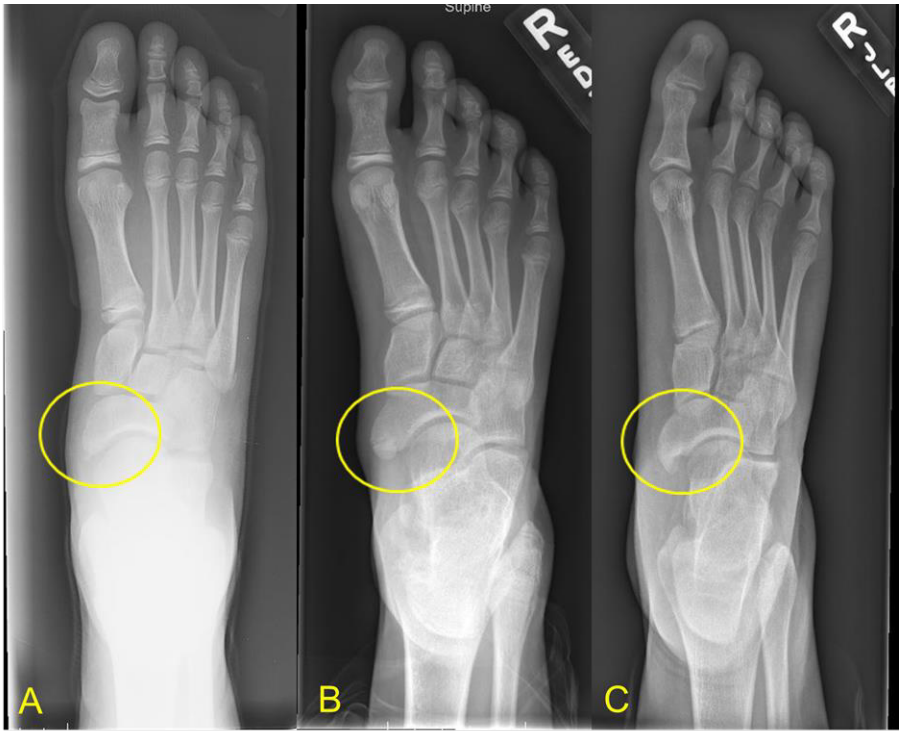

Figure 1. Examples of type 1, 2, and 3 accessory naviculae labeled as A, B, and C, respectively. Identified in external rotation view and represented within circle.

the Type 3 accessory navicular, which is only 10% of accessory naviculae, occurs when the secondary ossification center fuses during adolescence but leaves a very prominent medial projection.[3,5] Some authors argue that the Type 3 accessory navicular may represent the final stages of the Type 2. Medial sided foot pain is almost exclusively seen in the Type 2 accessory navicular.[2]

The initial management of a symptomatic accessory navicular in pediatric patients is nonoperative. The first line of treatment is shoe wear modification to wider, more comfortable shoes which alleviate the pressure on the medial side of the foot.[4] In addition, activity modification to limit or stop any strenuous activities along with nonsteroidal anti-inflammatories are common. Another conservative option is casting to assure compliance and prevent any repetitive microtrauma.[4] When nonoperative treatments fail to mitigate symptoms, surgery is indicated.

While operative outcomes and efficacy has been extensively studied in the accessory navicular, in contrast, the efficacy of nonoperative treatment for alleviating pain or preventing surgery in the symptomatic accessory navicular has not been established. If nonoperative treatment is frequently unsuccessful or does not give lasting pain relief, then surgery could possibly be offered as a first line treatment. This study retrospectively reviewed the outcomes of pediatric patients treated nonoperatively for symptomatic accessory naviculae which will provide clinicians success rates for their discussion of treatment options with patients and their families.

MATERIALS AND METHODS

After obtaining IRB approval, all accessory naviculae diagnosed and treated by the senior author (J.R.D.) and colleagues at Cincinnati Children's Hospital Medical Center between August 1st, 2006 and August 24th, 2016 were retrospectively reviewed. Medical records were used to identify demographic information, type of accessory navicular, duration, and total trials of nonoperative treatment, additional foot comorbidities, response to nonoperative management, and need for surgery if nonoperative management failed. To be included in this study, subjects were required to be under 18 years of age at presentation during the specified time frame, experienced medial sided foot pain, had radiographic evidence of an accessory navicular, and underwent at least one course of nonoperative treatment. Patients with a previously operated on accessory navicular or other diagnosed painful foot conditions were excluded. Outcome measures consisted of pain relief, no operative intervention, or need for operative intervention. Imaging for each patient was also reviewed to determine type of accessory navicular and identify presence of concurrent pes planus. Radiographic pes planus was determined using both Meary's angle (measuring greater than 10 degrees) and calcaneal pitch (measuring

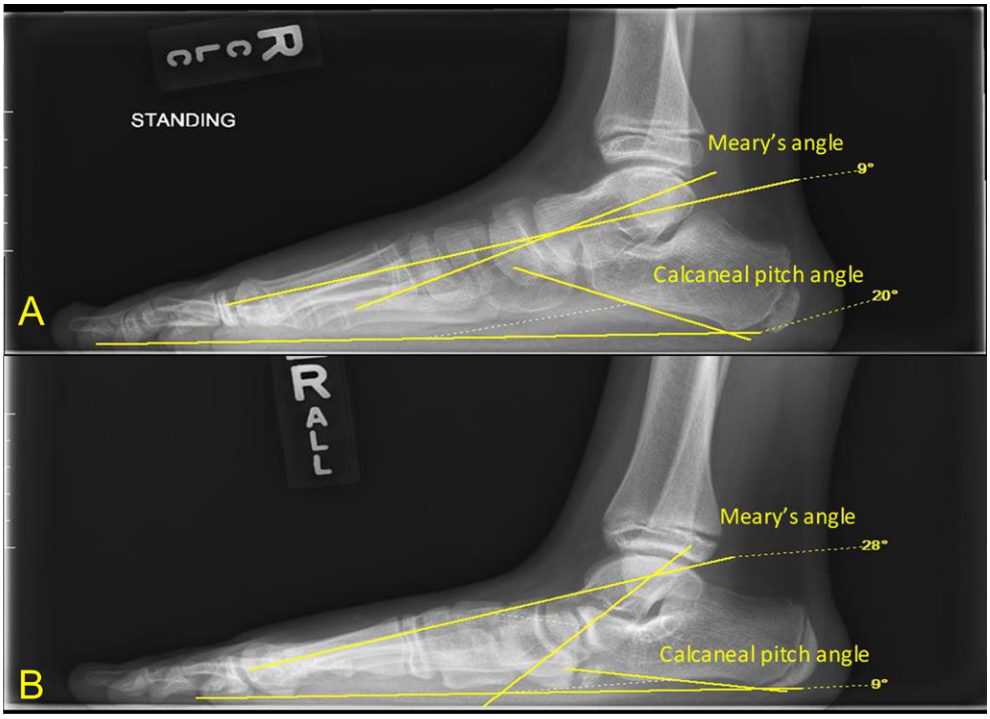

Figure 2. Measurement of Meary's (talar-1st metatarsal angle) and calcaneal pitch angles. A) Measurement of patient's right foot without pes planus demonstrating normal Meary's and calcaneal pitch angles. B) Measurement of patient's right foot with pes planus demonstrating abnormal Meary's and calcaneal pitch angles. Meary's angle was measured between the long axis of the talus and first metatarsal on a weight-bearing lateral view as shown. Calcaneal pitch angle was measured between plantar-most surface of calcaneus to inferior border of distal articular surface and transverse plane.

less than 15 degrees) (Figure 2).

Descriptive statistics were used to characterize the sample, including nonoperative treatment type, duration of nonoperative treatment, treatment response and need for additional surgery. The response to treatment was assessed by the patient's ability to return to baseline or sporting activities at described in follow-up visits, depending on activity level of patient. Treatment response was also judged by patient and families not seeking further treatment. A chi-squared test was used to analyze the different conservative treatments and the outcomes achieved. The percentage of patients failing conservative management and requiring surgery was also calculated.

RESULTS

A total of 169 patients with 226 symptomatic accessory naviculae were identified which met all inclusion criteria, and had complete medical records necessary for data analysis. Average age at diagnosis was 11.8 years, with 78% females and 22% males. Fifty-three (32%) were left symptomatic accessory naviculae, 56 (33%) right, and 60 (36%) bilateral. Type 2 accessory naviculae were most frequent (72.7%), with Type 1 and Type 3 accounting for 9.7% and 17.4%, respectively (Figure 1). Fifty-six percent of the symptoms were chronic in nature, with 31% due to acute injury. Average number of nonoperative trials was 2.1, with 28% experiencing complete pain relief, 30% requiring operative intervention, and 41% that experienced partial pain relief, did not require operative intervention, and were recommended PRN follow-up based on clinical improvement. Of those that achieved complete pain relief, average length of nonoperative treatment was 8.0 months. In contrast, of those patients who failed nonoperative treatment and went on to receive operative intervention, the average length of nonoperative treatment prior to receiving operative intervention was 11.7 months. A total of 47 (27.8%) patients underwent immobilization alone as nonoperative treatment, 40 (23.6%) underwent shoe inserts alone as treatment, and 82 (48.5%) underwent both immobilization and shoe inserts as treatment (Table 1).

Thirteen percent of patients received advanced imaging (CT or MRI) during their initial work-up. Associated pes planus was identified using radiographic measurements from available standing radiographs. There were 18 patients (17.6%) which demonstrated pes planus using Meary's angle, while 22 patients (21.5%) demonstrated pes planus using calcaneal pitch (Figure 2).

DISCUSSION

There is currently very little literature exploring nonoperative treatment outcomes of symptomatic accessory naviculae. Case reports make up the majority

Table 1. Type of Nonoperative Treatment and Associated Treatment Outcome

Type of Nonoperative Treatment	Pain Relief	No Operative Intervention[£]	Surgery
Immobilization[+]	19 (40%)	12 (26%)	16 (34%)
Shoe Inserts[++]	7 (18%)	31 (78%)	2 (5%)
Immobilization[+] & Shoe Inserts[++]	25 (30%)	29 (35%)	28 (34%)
Total Patients	51 (30%)	72 (43%)	46 (27%)

[£]No operative intervention patients underwent nonoperative treatment and did not receive surgery.
[+]Immobilization defined as patient treated with CAM walker and/or cast.
[++]Shoe inserts defined as patient treated with orthotics and/or cushion inserts.

of current insight, and among those athletes tend to be the focus over the general population.[6,7] In a recent case report comparing two adolescent dancers, one treated operatively and the other treated nonoperatively, it was found that nonoperative treatment of bracing, taping, and foot orthotics provided substantial pain relief and return to activities similar to the patient treated operatively.[7] Despite reported cases of nonoperative treatment outcomes, overall effectiveness of nonoperative treatment and specific effectiveness of various treatment modalities have yet to be investigated. Our results provide further insight into effectiveness of not only nonoperative treatment, but also of specific treatment modalities. The results of our study are meant to provide baseline data for surgeons to utilize when discussing treatment options with patients and families.

Recent literature has suggested that not all symptomatic accessory naviculae respond similarly to nonoperative treatment.[7,8] A retrospective study by Jegal et al. found that athletes with symptomatic accessory navicular pain have symptoms that are more refractory to conservative treatment when compared to the general population.[8] This raises the question of whether surgery could be considered sooner in those patients whose symptoms seem to arise as a direct result of athletic activity. In our study, it is hard to determine cause due to athletic activity versus other trauma, as this is not a common question asked during initial work-up that would ultimately alter treatment decisions. Further, patients that are active in competitive sports may have a lower threshold in which to opt for operative intervention. Based on our results, an average of 2.1 nonoperative trials were required spanning an average of 8.0 months, which could have a big impact on return to sport for those involved in multiple competitive athletic activities.

It is often difficult to differentiate pain from symptomatic accessory navicular from other etiologies, such as tibialis posterior tendonitis. This distinction can be made more challenging when patients have difficulty pinpointing where pain is emanating from. To mitigate this in our study, particular attention was paid to the physical exam with emphasis placed on the patient feeling point tenderness over the navicular bone only rather than along the length of the tibialis posterior tendon. Concomitant pes planus was another contributing factor considered. There are several radiographic angles that have been described for determination of pes planus. The authors prefer to use both the Meary's angle and calcaneal pitch angle to determine pes planus radiographically. A Meary's angle greater than 10 degrees (normal range of 0 to 10°) or calcaneal pitch angle less than 15 degrees (normal range of 15 to 30°) was considered diagnostic of pes planus.[9-11] There were 17.6% of patients which demonstrated pes planus using Meary's angle, while 21.5% demonstrated pes planus using calcaneal pitch. Previous studies have reported prevalence rates of pes planus in the pediatric population ranging from 4 to 44%.[12-14] Rates of pes planus from the current study support these findings, however with the various methods practitioners use to diagnose pes planus there is some variation between studies. Literature also suggests that an accessory navicular does not play a role in the development of pes planus, and vice versa.[15,16] In addition, the degree of pes planus is not associated with severity of symptoms in patients with accessory naviculae.[15,16]

It is also difficult to determine success of nonoperative treatment given pain thresholds vary so greatly between individuals. In our study, 28% of patients experienced complete pain relief with nonoperative management while 31% required operative intervention. The remaining 41% of our patients initially underwent nonoperative treatment and on subsequent visits demonstrated partial pain relief and were recommended follow-up as needed based on clinical improvement. Effectiveness of non-operative treatment also likely varies based on factors such as baseline activity level and age, and subgroup analyses would be beneficial to determine more specific characteristics of those that achieved complete pain relief with nonoperative management. In addition, a more standardized approach to assessing pain relief in children is warranted. While patient reported outcome measures (PROs) have become standard of care in the adult population, in children there is limited evidence demonstrating the efficacy of PROs in pediatric orthopedic practice.[21]

A weakness of our study is the small number of patients from which to make recommendations. However, the patient population represented in this study can suggest trends which are useful in assessment and treatment planning.

There is currently nothing in current literature that explores the potential effectiveness of different nonoperative treatments for symptomatic accessory naviculae. There is also no current literature aimed to help guide discussions for decision-making about available nonoperative treatment. This study is a novel exploration into nonoperative treatment effectiveness in symptomatic accessory naviculae.

In summary, results of this study can be used by clinicians to frame discussions surrounding treatment options for symptomatic accessory naviculae with both patients and their families. Further research is warranted to determine the necessary duration and type of nonoperative treatment, among those most commonly used, that is most successful in providing pain relief.

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