

## Prevention and Management of Calcaneal Apophysitis in Children: An Overuse Syndrome

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**Summary:** Calcaneal apophysitis (Sever disease) is a common cause of heel pain, particularly in the athletically active child. Eighty-five children (137 heels) with calcaneal apophysitis were reviewed. Both heels were affected in 52 (61%) patients. The most common associated foot condition was pronation, occurring in 16 patients. Sixty-eight patients complained that pain was made worse by a specific sport, with soccer leading the list. All patients were treated with a physical therapy program of

lower extremity stretching, especially of the heel cords, and ankle dorsiflexion strengthening. Soft Plastizote orthotics or heel cups were used in 98% of patients. Proper athletic footwear was advised. All patients improved and were able to return to their sport of choice 2 months after the diagnosis. There were two recurrences. **Key Words:** Athletic activity—Calcaneal apophysitis—Heel pain—Overuse syndrome—Physical therapy—Sever disease.

Heel pain is a common complaint in the child and adolescent athlete. Often, the precise etiology remains undetermined. Calcaneal apophysitis is the most common cause of heel pain in the growing athlete. Sever (18) originally described the condition as an inflammatory injury to the apophysis associated with muscle strain in the growing child. He made no mention of its classification as an osteochondrosis, as suggested by later authors (2,4,12,14,16,20). Other authors (5,9,17) reported the cause as an inflammatory process. More recently, the underlying cause has been attributed to overuse and repetitive microtrauma in the young athlete (1,10).

To help in clarifying the cause and results of management of this condition, the natural history and management of children and adolescents with calcaneal apophysitis were reviewed. The purpose of this article is to review our diagnosis and treatment of active young children and adolescents with calcaneal apophysitis.

### PATIENTS AND METHODS

Eighty-five patients (137 heels) with the diagnosis of calcaneal apophysitis seen at the Sports Medicine Clinic at Children's Hospital (Boston, MA) between 1979 and 1983 were reviewed retrospec-

tively. Adequate information for chart review was available for all 85 patients.

There were 64 (75%) male and 21 (25%) female patients (Fig. 1). There was bilateral involvement in 52 (61%) of the cases. In the remainder, involvement was on the right in 22 (26%) and on the left in 11 (13%) patients.

In boys, the average age at presentation was 11 years 10 months, with a range of 7 years 6 months to 15 years 4 months. In girls, presentation averaged 11 years, ranging from 8 years 8 months to 13 years 6 months. The average combined age at presentation was 11 years 7 months, with a range of 7 years 6 months to 15 years 4 months. The mean age was 11 years. The majority of patients (41) presented between 10 and 12 years of age (Fig. 1).

All patients presented with symptoms of heel pain and were reported to be in a "growth spurt." All were healthy and without night pain. No child reported the onset of pain following a single injury. However, 68 patients said the pain was worse after specific athletic activity (Table 1). The sport that most often exacerbated symptoms was soccer, in 21 (29%) patients, all boys. This was followed closely by basketball, gymnastics, and running, occurring in 11, 11, and 10 patients, respectively. Ten of the 11 gymnasts were girls. Other sports included baseball (five patients), football (three), figure skating (two), ice hockey (two), tennis (one), field hockey (one), and ballet (one). Over half of the patients were unable to participate in their desired sport because of heel pain.

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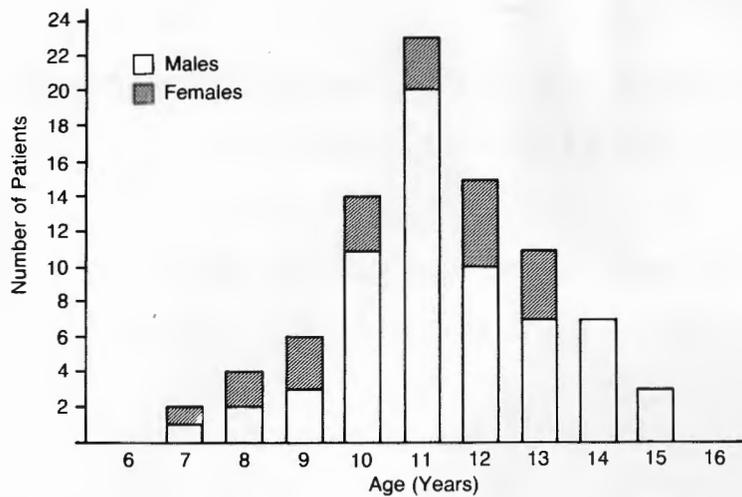


FIG. 1. Age at presentation.

For 69 patients, the interval the patient complained of heel pain before assessment was known. The average time was 5 months, with a range of 2 to 48 weeks. Follow-up averaged 7 months, with a range of one visit to 36 months. The average number of follow-ups for girls was 1.9 and for boys was 2.3.

On physical examination, all patients had tenderness on medial and lateral heel compression (Fig. 2). There was no erythema, skin changes, swelling, or other local abnormalities. Associated heel cord tightness was found in most patients. Passive range of ankle motion with knees extended was documented in 62 patients (Table 2). Although plantar flexion was equal in all patients, including those with unilateral involvement, differences in dorsiflexion were noted. The maximal passive ankle dorsiflexion on the involved side ranged from -8 to 15°. Measurements were equal in bilateral cases and averaged 6° dorsiflexion. In unilateral cases, the difference in dorsiflexion range averaged 5° with left side and 4° with right side involvement,

when compared with the contralateral asymptomatic ankle. Results of manual muscle testing of plantar flexion and dorsiflexion were normal.

Associated foot malalignments were noted in 23 patients, 17 boys and six girls. There were no associated foot conditions in 62 patients, of whom 47 were boys and 15 girls. Sixteen patients, 14 of whom were boys, had forefoot pronation. Other foot conditions included pes planus in four patients, pes cavus in two, and pronation and hallux valgus in one.

In all patients, management included supervised therapeutic exercises and the prescription of either heel lifts or total foot orthotics. All exercise regimens included not only gastrocnemius-soleus stretching exercises, but also dorsiflexion strengthening, under the supervision of a physical therapist. Discontinuation of running sports was recommended while the child remained symptomatic.

In addition to the exercise program, molded soft

TABLE 1. Sport causing symptoms

Associated sport	No. of patients		Total
	Boys	Girls	
Soccer	21	0	21
Basketball	9	2	11
Gymnastics	1	10	11
Track/running	9	1	10
Baseball	5	0	5
Football	3	0	3
Figure skating	0	2	2
Ice hockey	2	0	2
Tennis	1	0	1
Field hockey	1	0	1
Ballet	0	1	1
Nonsport	7	1	8
Unknown	6	3	9
Total	65	20	85



FIG. 2. Calcaneal compression test.

TABLE 2. Range of motion in dorsiflexion

Involved	No. of patients	Average maximal dorsiflexion	
		Left	Right
Left	7	4	9
Right	15	10	6
Bilateral	40	6	6

orthotics (Fig. 3) or heel supports made of Plastizote were used in 98% of the patients. Bilateral orthotics were prescribed. Soft Plastizote orthotics were used in 64 (75%) patients. Viscoelastic heel cups were used in 15 (18%) patients, heel wedge in 4 (5%), and no orthotics in 2 (2%). These foot supports were removable and were used in both regular shoes and athletic shoes. It was emphasized that the patient should not go barefoot, even at home. Antiinflammatory medications were not used. Radiographs were not routinely obtained on the first visit. If pain was unusual in character or persistent despite an adequate therapy and orthotic program, calcaneal roentgenograms were obtained.

### RESULTS

All patients improved with the treatment regimen. The average time until symptomatic relief, including return to desired athletic activity, was well documented in 50 patients, averaging 2 months. The range was 1 to 6 months. For boys, the average time until symptomatic relief was 2.2 months, and that for girls was 1.6 months.

Two patients had recurrent heel pain. Both of these patients were boys. One with bilateral involvement first presented at 11 years 9 months of age. The other recurrence was in the right heel of a boy who initially presented at 11 years 8 months of age. Both recurrences occurred 1 year after the initial onset of symptoms. Both were treated success-



FIG. 3. Molded Plastizote orthotics used for correction.

fully with a similar regimen and returned to unlimited activity.

### DISCUSSION

Several series (6,9,14,15) on calcaneal apophysitis have been reported. McKenzie et al. (9) reported on a series of 20 patients with calcaneal apophysitis and stressed the importance of physical therapy. Half of their patients had subtalar and forefoot varus, and six had genu varum. Overall, 75% of their patients had reduction of symptoms within 1 month and 95% by 3 months. Kvist et al. (6) reported on 68 athletes with Osgood-Schlatter disease and 40 patients with Sever disease. In their series, the average age at onset of Sever disease was 12.2 years, with a recurrence rate of 20% after a 3-month symptom-free period. Sever disease interfered with sports for 1.6 months. Orava and Saarela (14) studied injuries in young track-and-field athletes and reported that one-third were "growth-related disorders," whereas two-thirds were typical exertional injuries. More exertional injuries occurred as the number of training times per week increased. In a later study, Orava and Vitanen (15) reported that Osgood-Schlatter disease was most prevalent and Sever disease was second of the two osteochondroses occurring in athletes. In both studies, the exacerbating sports were track and field in 50% and cross country in 8% of the patients. The underlying cause was not delineated.

The precise etiology of heel pain in children and adolescents often remains obscure. At present, the most common cause is repetitive microtrauma, or overuse, resulting in injury at the calcaneal apophysitis. However, the differential diagnosis of heel pain in this age group includes infectious, developmental, inflammatory, rheumatologic, malignant, and neurologic conditions (Table 3). The incidence of overuse injuries about the foot in children may be increasing, particularly in athletically active children, and the child complaining of foot pain must be carefully assessed.

Tarsal coalition may become symptomatic in this age group with exertion. This condition can be documented by plain radiographs, computed tomography scan, or tomography. Other less common causes include juvenile rheumatoid arthritis, Reiter syndrome, leukemia, metastases, and tarsal tunnel syndrome. Occult soft tissue or bony infections in children due to puncture or other wounds must also be considered. Unicameral bone cyst of the os calcis may present as heel pain. In the child runner, stress fracture of the tibia, fibula, calcaneus, or other bones of the midfoot should be considered.

Although these less common conditions must be considered, calcaneal apophysitis is the most common cause of heel pain in children and adolescents. It is an overuse syndrome and is analogous to tibial tubercle apophysitis (Osgood-Schlatter dis-

TABLE 3. Differential diagnosis of childhood and adolescent heel pain

A. Overuse/overgrowth/traumatic
1. Calcaneal apophysitis
2. Contusion/strain
3. Stress fracture of calcaneus
4. Fracture of calcaneus
B. Developmental
1. Tarsal coalition
C. Inflammatory
1. Tendinitis (Achilles, patellar, flexor hallucis longus)
2. Plantar fasciitis
3. Retrocalcaneal bursitis
4. Periostitis
5. Os trigonum inflammation
D. Infectious
1. Soft tissue infection
2. Abscess
3. Calcaneal osteomyelitis
E. Rheumatologic
1. Juvenile rheumatoid arthritis
2. Reiter syndrome
3. Miscellaneous
F. Tumorous
1. Benign
a. Osteoid osteoma
b. Osteochondroma
c. Chondroblastoma
d. Bone cyst (solitary or aneurysmal)
2. Malignant (very rare)
a. Leukemia
b. Metastatic
G. Neurologic
1. Tarsal tunnel syndrome

ease). This comparison has been made by other authors (1,6,14,18). In 1912, Sever (18) emphasized this condition, later named after him, is not unusual, occurs only in growing children, and never after puberty. To treat this type of muscle strain, he suggested rest and protection. He never stated that calcaneal apophysitis was an osteochondrosis. Subsequently, however, it was included in the general class of osteochondroses by other authors (2,3,12,16,20).

There is controversy concerning radiographic findings in calcaneal apophysitis (Fig. 4). Sever (18) described radiologic findings that included epiphyseal enlargement and cloudiness along the plate. Increased sclerosis of the secondary ossification center has been added to these radiographic changes by other authors (2,4,12,13,16,20). We agree with those authors (7,10,21) who have stressed that the radiographic appearance is usually normal in patients with calcaneal apophysitis (Fig. 4).

The usual age that the secondary ossification center of the os calcis appears is 9 years, although it may be as early as 7 years, with fusion occurring around 16 years (13,18). The calcaneal secondary ossification center is an extraarticular traction



FIG. 4. Radiograph of heel with calcaneal apophysitis.

apophysis. Growth is related to the amount of muscle force placed on it (13). Apophyseal growth is stimulated by weight-bearing (19). Radiographic differences in appearance of this secondary ossific center are usually due to differences of skeletal age, activity, weight, and flexibility.

In 1917, Kurtz (5) reemphasized the original description of this condition by Sever and added that an overstrain of the epiphyseal junction was the reason for pain. Kurtz stressed the facts that etiology was mechanical and that presentation was always before completion of ossific fusion. His treatment plan was rest until pain subsided, then use of heel supports. He did not use any specific exercise modality or antiinflammatory medications.

Several authors have noted that orthotics or viscoelastic heel cups may be useful in managing this condition (3,8,11). In certain cases, other treatments such as short leg casts for up to 1 month (7,16) or local steroid injection (4) have been advocated. The use of cast immobilization may be necessary in a particularly painful case, unresponsive to the treatment program outlined above, but we see no rationale for the use of corticosteroid injection in this condition. In addition, although use of the term "apophysitis" in this condition suggests an inflammatory condition, we have not found oral antiinflammatory medication useful in managing this condition.

The diagnosis of calcaneal apophysitis is made by the history of sport involvement, growth spurt, physical findings of painful heel compression, and decreased flexibility. It is one of the overuse syndromes encountered in active rapidly growing children and adolescents, second to Osgood-Schlatter disease in occurrence. The results of treatment with physical therapy and proper footwear support the hypothesis that this condition is due to altered biomechanics in the growing child. Successful results are predictable using this treatment regimen.

Prevention of this and similar conditions may be

accomplished by proper education of the athlete, parents, coaches, and trainers. Appreciation of the increased potential for such overuse injuries in an athlete during a rapid growth spurt is necessary. As the intensity of competition in organized athletics increases in this age group, so will the likelihood of microtraumatic injuries.

Micheli (10) has previously outlined the importance of recognizing the increased injury risk in a youngster during a growth spurt. Prophylactic strengthening and stretching during rapid growth phases may help avoid syndromes like calcaneal apophysitis, Osgood-Schlatter disease, muscle strain, spondylolysis, and others. Recognition of tightness of major muscle groups associated with decreased range of motion in the growing athlete is key to prevention of these conditions.

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