Heel Pain in Youth: A Guide to Potential Management Strategies

Michelle L. Weber, ATC; Kelsey J. Picha, ATC; and Tamara C. Valovich McLeod, ATC, FNATA • A.T. Still University

Calcaneal apophysitis, or Sever's disease, is common among physically active youth between the ages of 8–15. This condition is related to skeletal growth during maturation and relief often comes once growth is complete. However, it is not feasible to limit participation in physical activity until growth ceases; therefore, it is important to determine effective interventions to regulate pain while continuing participation. A search of the literature yielded nine studies that met the inclusion criteria and were included for data analysis. Within these publications, many treatment methods were suggested, including nonsteroidal anti-inflammatory drugs (NSAIDs), taping, orthoses, heel lifts, stretching, activity modification, and ice. However, few of the treatment options were compared with a control group. Analysis revealed that clinicians should provide treatments with caution when treating patients suffering from Sever's disease, understanding that strong evidence is not supportive of one treatment option alone. Data are limited for individual treatments related to calcaneal apophysitis and more research in this area is warranted. Clinicians should work with patients on an individual basis to determine if one form of treatment provides a reduction of pain and allows that patient to continue with activity. **Key Words**: calcaneal apophysitis, Sever's disease, intervention, treatment, adolescents, pediatrics, pain regulation, physical activity

Reference

James A, Williams C, Haines T. Effectiveness of interventions in reducing pain and maintaining physical activity in children and adolescents with calcaneal apophysitis (Sever's disease): a systematic review. *J Foot Ank Res,* 2013;6:16. doi:10.1186/1757-1146-6-16

Clinical Question

For children and adolescent patients with calcaneal apophysitis, which treatment is effective in reducing pain while allowing the patient to continue physical activity?

Data Sources

Data were retrieved from sources as early as available until May 2012. Databases searched were CINAHL, PubMed, Web of Science, Scopus, EBSCOhost, Google Scholar, Physiotherapy Evidence Database (PEDro), and the Cochrane Library. Search terms included "heel pain AND children," "heel pain AND adolescent," "calcaneal apoph*," "Calc* apoph*," "Sever's disease," "calcaneal apoph* AND treatment," "Sever's disease AND treat*," and "calcaneal apoph* AND manage*." The truncation character allows for terms to be searched and retrieved with varying endings of the search terms used.

Study Selection

The initial search yielded 408 articles; only nine studies met the inclusions criteria and were included in the analysis. Studies were excluded if they were not published in English, did not provide a treatment, were non-peer reviewed publications, or were author

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opinions. Included studies comprised children 6–15 years old, who had a diagnosis of calcaneal apophysitis, underwent an intervention (e.g., orthoses, heel lifts, stretching, icing, strapping), and used an outcome measure (pain, physical or sporting activity). Designs of the included studies consisted of retrospective case reviews, randomized control trials, case series, and case studies.

Data Extraction

Level of evidence was assigned for each of the articles according to the Oxford Centre for Evidence-based Medicine criteria (levels 1–5). In addition, the PEDro scale was used to assess the methodology, quality, and bias. Treatment recommendations were extracted from studies selected and placed into one of two groups. Studies that aimed to minimize inflammation and pain to promote healing were sorted into the first group (e.g., modify activity or complete termination of sport participation), while mechanical strategies were sorted into the second group (e.g., use of taping or padding, heel raises, orthoses, or stretching).

Data Synthesis

Of the nine articles reviewed there were three randomized control trials, two case series, two retrospective case reviews, and two case reports. Table 1 includes each study, study design, interventions performed, and if an intervention group was used. Table 2 shows which treatment strategy each study was categorized into, treatments used, statistical findings, and clinical findings. Within these publications, many treatment methods were suggested, including nonsteroidal anti-inflammatory drugs (NSAIDs), taping, orthoses, heel lifts, stretching, activity modification, and ice. However, few of the treatment options were compared with a control group. Effect size and any pooled statistical analysis of all studies were not conducted due to the limited amount of data available. Heel orthoses, in the form of heel cups, medial orthoses, and heel raises provided short-term pain relief. Two studies examined the use of orthoses and heel lifts, finding that both decreased pain according to the Borg CR10 scale.[1,2] A third study examined the use of a heel cup compared with a control group.[3] All three studies reported significant results ($p \leq .001$) when using heel cups,[1–3] however one study only reported the median for pain reduction during postintervention assessment and failed to report means or confidence intervals.[1] Median pain values reported were with orthoses use being 0.5 out of 10 and 5 out of 10 for the control group using the Borg CR10 scale. Their findings suggest a reduction in pain with activity for those in the treatment group. Heel raises were suggested to be effective at reducing pain in a crossover randomized trial when compared with no intervention ($p < .001$). Taping for biomechanical modification was shown to be statistically significant in relieving pain ($p = .001$); unfortunately, no time frame was noted.[4] Another study reported padding and strapping were effective in reducing pain over a one month period ($p < .01$). Padding applied during this study was a neoprene device holding one-quarter in. foam rubber in the shape of a horseshoe. The device was then positioned to relieve pressure over the injury, or the horseshoe was turned upside down and used as a counterforce brace to reduce stress at the Achilles tendon.[5]

Commentary

Recent reports estimate that approximately 206.7 million children and adolescents (ages 6 and older) are considered active within the United States.[6] Delgado and Schwartz[6] define inactivity for individuals as those who do not participate in sport and those who participate in activities that need minimal to no physical exertion. More and more of these active children are being pressured to perform well in sports to obtain college scholarships and compete in the Olympics or at other elite-levels. Although this pressure is not the cause of Sever's disease, the drive to succeed at often high-intensity sports does sometimes result in overtraining, making children prone to overuse injuries such as calcaneal apophysitis.[7] One common injury in the pediatric athletic population is posterior heel pain, known as calcaneal apophysitis, or Sever's disease. This condition is reported to occur in 2–16% of all musculoskeletal injuries in children.[8,9] Calcaneal apophysitis usually affects children ages 8–15 and is characterized by heel pain located at the Achilles tendon insertion on the calcaneus.[10] The occurrence of heel pain is common with walking and running, often making physical activity difficult.[10] Highly active and overweight children often are at an increased risk of developing calcaneal apophysitis.[11] Causes for this condition are not well defined, but are thought to include

TABLE 1. SUMMARY OF STUDIES INCLUDED FOR REVIEW

Author	Study Design	Control Group	Rest	Ice	Stretching	Taping	Heel Lifts	Orthosis	Other
Hunt et al., 2007[4]	Case series	No				Arch taping			
Kvist & Heinomen, 1991[13]	Retrospective case review	No	Complete rest of varying duration for each case						
Leri, 2004[14]	Case report	No	7 days without activity	Yes (no parameters provided)	Achilles and plantar fascia (no parameters provided)				Subtalar and forefoot mobilization; electrical stimulation (2500 Hz, 12 son, 8 s off, 3 s ramp)
Micheli & Fehlandt, 1992[9]	Retrospective case review	No			Gastrocnemius-soleus stretching		Heel wedge in 5% of patients, viscoelastic heel cups in 18% of patients	Molded soft orthotics made of Plastazote in 98% of patients, soft plastazote in 75% of patients	Mobile/activity modification (i.e., discontinuation of running sports while symptomatic); dorsiflexion strengthening
Perhamre et al., 2011[1]	Randomized trial	Two intervention phases: one with heel cups/heel wedges (4 weeks), two nonintervention phases (2 weeks, one before and one after intervention phase)					Heel wedge n = 18; heel wedge was 5 mm cork wedge covered with thin elastic surface	Heel cup n = 17; heel cup was a ridged plastic cup applied directly to the bare heel with a molded long arch support	

Author	Study Design	Control Group	Rest	Ice	Stretching	Taping	Heel Lifts	Orthosis	Other
Perhamre et al., 2011[2]	Randomized trial	Two intervention phases: one with heel cups/heel wedges (4 weeks), two noninterventon phases (2 weeks, one before and one after intervention phase)					Heel wedge was 5 mm cork wedge covered with thin elastic surface	Heel cup was a ridged thermoplastic cup applied directly to the bare heel with a molded arch support	
Perhamre et al., 2012[3]	Randomized control trial	Yes						Custom made heel cup, rigid "Wessmark"	
White, 2006[15]	Case report	No	Duration not specified (after fifth physical therapy session)	15 min	Slant board calf stretch (2 for 2 min), hamstring stretch (2 for 30 s), manual stretching of the subtalar joint		Viscoelastic gel heel inserts (wedge shaped and 3/8 to 5/8 of an inch thick at thickest point)		Exercises (Theraband, two sets of 10; ankle dorsiflexion, plantar flexion, inversion and eversion; single leg stance on Airex pad, 1–3 repetitions for 25.3–39s;seated stair-stepper, 5–7 min; knee flexion, 2–3 sets of 10, 5 lbs);

(continued)

TABLE 1 *(continued)*

Author	Study Design	Control Group	Rest	Ice	Stretching	Taping	Heel Lifts	Orthosis	Other
White, 2006[15] *(continued)*									heat; subtalar joint mobilizations; NSAIDs (iontophoresis using dexamethasone sodium phosphate, transdermal NSAID gel of ketoprofen pluronic lecithin organogel)
Wooten et al., 1990[5]	Case series	No		Ice over painful area after activity (duration not specified)	Daily stretching, specific stretching exercises not described ("ankle flexibility exercises")				Neoprene sleeve holding 1/4 in. PPT® foam rubber in the shape of a horseshoe; positioned directly over area of pain to relieve pressure or turned upside down to reduce stress at Achilles tendon; oral anti-inflammatory medication prescribed

Table 2. Summary of Outcomes from Included Studies

Author	Treatment Strategy*	Treatment(s)	Statistical Findings	Clinical Findings
Hunt et al., 2007[4]	Mechanical	Arch taping	Significant reduction in pain following tape application (pre: 6.5 vs. post: −1.4, $p = .001$)	All 11 cases demonstrated lower pain scores after tape application Cliff's Delta (effect size) = .97
Kvist & Heinonem, 1991[13]	Minimizing inflammation	Rest (forced to stop participation because of pain)	N/A	On average, stopped training for 1.2 months; however, 55% only stopped training for less than 2 weeks. Pain interfered with training for an average of 2 months. Pain recurred in 28% of patients after an asymptomatic rest period.
Leri, 2004[14]	Both	Rest, ice, stretching, mobilization, electrical stimulation	N/A	Responded well to home and office treatment and returned to baseball in one week
Micheli & Fehlandt, 1992[9]	Both	Supervised therapeutic exercises and heel lifts or total foot orthotics	Average time of symptomatic relief was 2.2 months for boys and 1.6 for girls.	All patients improved with treatment, averaging a 2 month return to desired activity.
Perhamre et al., 2011[1]	Mechanical	Heel wedge or heel cup and two nontreatment phases without insoles	Reduction of pain with activities A (soccer) and B (running; $p < .001$) when wearing insoles; comparing pain in pre- and posttreatment phases without insoles reduced pain levels, but significant only for activity B. $p = .099$ for A and $p < .030$ for B.	There was a significant reduction in pain level during activity with insoles, comparing pain levels through the phases. Borg's scale used for pain measurement.
Perhamre et al., 2011[2]	Mechanical	Heel wedge or heel cup	Effect of the heel cup was OR = 0.22 ($p < .001$ [0.15, 0.34]) and OR = 0.18 ($p < .001$ [0.12, 0.27]), reducing the odds score for pain to a fifth compared with the wedge	Pain was significantly lower in the heel cup group compared with the heel wedge group; one-year follow-up questionnaire showed pain relief during the study period was good or excellent for the chosen insole and for the nonchosen alternative; only five boys found the insoles inconvenient.

(continued)

TABLE 2 *(continued)*

Author	Treatment Strategy*	Treatment(s)	Statistical Findings	Clinical Findings
Perhamre et al., 2012[3]	Mechanical	Heel cup	Heel pad thickness increased by 3.57 mm (on average) while utilizing a heel cup with a sports shoe compared with standing barefoot ($p < .001$). Heel peak pressure decreased by 25% for patients in a heel cup while standing on heel (mean of 1,056 mmHg) compared with those in shoe only (mean of 1,407 mmHg). In addition, the heel peak pressure decreased by 21% for patients while running when wearing a shoe with a heel cup (mean of 1,109 mmHg) compared with those with shoe only (mean of 1,412 mmHg). Lastly, significant differences in pain were found for those with shoes only (mean pain reported with Borg CR10 scale = 7.0, both control and intervention group) at beginning of trail compared with those in heel cup (mean 2.0).	By utilizing a heel cup, heel pad thickness can increase for the patient, also reducing the peek pressure at the heel and pain. The heel pad may be a viable treatment if the patient is complaining of pain during the contact phase of stance in gait and running.
White, 2006[15]	Both	Rest, ice, stretching, heel lifts, therapeutic exercise, joint mobilizations, and NSAIDs	N/A	Responded well to treatments, returned to full participation in five physical therapy sessions, and was continuing to participate in activity without complaints of pain after eight months follow-up.
Wooten et al., 1990[5]	Both	Ice, stretching, neoprene sleeve/padding, NSAIDs	Pain was significantly reduced while utilizing device and oral NSAIDs at follow-up for pain at rest (t value 2.01), morning pain (t value 1.67), pain during activity (t value 3.76, $p < .01$), and pain after activity (t value 8.02, $p < .01$)	If the clinician has access to a device used in the study and oral NSAIDs, they are a way to significantly reduce pain. The specific device may not potentially be needed. One can use a horseshoe band wrapping it on with dressing to replicate the device.

*Treatment strategies were predetermined by the authors of the systematic review (James et al., 2013). Strategies included minimizing the inflammation process and pain, along with promoting healing (may include rest or modified rest, pharmaceuticals, and ice.). The second category included mechanical strategies aimed to modify biomechanical factors contributing to Sever's disease (may include use of heel raises, padding or tapping, orthoses, and stretching). OR = odds ratio.

tension on the Achilles tendon during rapid growth during maturation, biomechanical abnormalities in the lower extremity, rigid plantar fascia or Achilles tendon, overuse, high-impact sports, improper footwear, and rigid training surfaces.[10,12]

Due to the uncertainties in probable causes of calcaneal apophysitis, several treatment options are widely used by practicing clinicians. James et al.[12] proposed to evaluate many of these treatment options for efficacy. Possible treatments include ice, rest, orthoses, heel raises, NSAIDs, taping, and stretching. Currently, none of these treatments have been examined on an individual level, but rather, in combination with each other (e.g., ice, stretching, and rest).[12] In everyday practice this can be typical, as clinicians often use more than one form of treatment and management strategy to promote healing.

Results of this systematic review indicate that several treatment combinations may be used to effectively treat patients with calcaneal apophysitis. Treatment combinations included ice, stretching, and rest, or activity modification. Tape was reported to be effective in acute and immediate pain; however, no time frame or taping technique was identified. Therefore, due to unknown measures and design quality, the use of tape as an effective treatment intervention for calcaneal apophysitis is supported with low level evidence. In addition, padding and strapping were used and shown to be effective during and after activity within a one month period; however, this too was examined through lower level study design.[5] Orthoses were found to be effective in reducing pain when compared with heel raises or no treatment. The orthoses used within each of the studies were custom made, which may be a limitation in applying these findings to a typical secondary school athletic training facility, as many clinicians may not be able to custom mold orthotics and instead suggest over-the-counter orthoses for patients. The orthoses used in the various studies included a rigid heel cup (molded plastazote orthosis) and a 5mm heel wedge.[1–3] Lastly, heel lifts were also found to be effective in reducing pain; however, many of the studies examined used heel lifts in combination with stretching and ice, limiting the ability to isolate heel lifts independently.

One finding across several studies was that the patients could remain active with many of the treatments tested. All treatment regimens should be patient-centered and based off of patient symptoms and foot biomechanics.[12] A patient who has normal foot biomechanics, yet still has symptoms, may only require a heel lift or taping for pain alleviation. However, those with abnormal biomechanics may require custom made orthoses. During the initial treatment period, rest may be required to allow symptoms to subside. However, the goal of treatment will be to eventually manage symptoms for Sever's disease while allowing the patient to participate in sport.

Limitations of this systematic review include examination of a combination of treatments (i.e., ice with stretching and taping). In addition, articles reviewed lacked detailed information pertaining to type of orthoses used and specific data analysis required to evaluate efficiency of those orthotics. Future research should focus on efficacy of all treatment methods, as well as certain foot types with predisposition to this condition. As for the practicing clinician, search for the causes of the patient's condition and treat individually. A combination of treatments and management strategies may be most effective.

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Michelle L. Weber, Kelsey J. Picha, and ***Tamara C. Valovich McLeod*** are with the Athletic Training program at A.T. Still University in Mesa, AZ.

Michael G. Dolan, MA, ATC, CSCS, Canisius College, is the report editor for this article.