



Calcaneal apophysitis (Sever's disease) in children: diagnosis and management

Apofisitis calcánea (enfermedad de Sever) en niños: diagnóstico y manejo

Michel Oria Saavedra¹ 
Carolina Ortiz Martínez¹ 
Cecilia Capriles Lemus^{1,2} 

¹ Instituto Universitario de las Naciones Hispánicas. Pachuca de Soto, Hidalgo, México.

² Universidad Veracruzana, México.

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ABSTRACT

Calcaneal apophysitis, or Sever's disease, is a traction apophysitis of the calcaneal apophysis and one of the most frequent causes of heel pain in children and adolescents. This narrative review synthesizes the evidence on its diagnosis and conservative management. The condition presents with activity related heel pain, tenderness over the apophysis and a positive calcaneal squeeze test, and radiographs, ultrasound and magnetic resonance imaging are used to exclude alternative causes rather than to establish the diagnosis. Risk is higher with obesity, high impact sport and male sex, and repetitive traction on an immature apophysis modulated by skeletal maturity underlies the process. Randomized trials show comparable short term benefit from wait and see, heel lifts, foot orthoses, braces and exercise, without superiority of one modality. The course is self limited and most children return to sport within weeks with preserved function. Standardized diagnostic criteria, a core outcome set and longer randomized trials remain the priorities for future research.

Keywords: calcaneal apophysitis; Sever disease; heel pain; child; diagnosis; conservative treatment.

RESUMEN

La apofisitis calcánea, o enfermedad de Sever, es una apofisitis por tracción de la apófisis del calcáneo y una de las causas más frecuentes de dolor de talón en niños y adolescentes. Esta revisión narrativa sintetiza la evidencia sobre su diagnóstico y manejo conservador. El cuadro se presenta con dolor de talón relacionado con la actividad, dolor a la palpación de la apófisis y prueba de compresión del calcáneo positiva, y la radiografía, la ecografía y la resonancia magnética sirven para descartar otras causas más que para establecer el diagnóstico. El riesgo es mayor con obesidad, deporte de impacto y sexo masculino, y la tracción repetida sobre una apófisis inmadura modulada por la madurez esquelética subyace al proceso. Los ensayos aleatorizados muestran un beneficio a corto plazo comparable entre esperar y ver, taloneras, ortesis plantares, férulas y ejercicio, sin superioridad de una modalidad. El curso es autolimitado y la mayoría de los niños retornan al deporte en semanas con función preservada. Criterios diagnósticos estandarizados, un conjunto central de desenlaces y ensayos aleatorizados más prolongados siguen siendo las prioridades para la investigación futura.

Palabras clave: apofisitis calcánea; enfermedad de Sever; dolor de talón; niño; diagnóstico; tratamiento conservador.

INTRODUCTION

Heel pain is among the most frequent musculoskeletal complaints of school age children and accounts for a substantial share of visits to pediatric, sports medicine and podiatry services, a burden that has grown in parallel with the rising participation of children in organized sport.(1,2) Calcaneal apophysitis, or Sever's disease, is a traction apophysitis of the calcaneal apophysis and is described as the leading cause of heel pain between 8 and 15 years of age, particularly in children who run, jump and change direction repeatedly.(3,4) A retrospective audit of health records in Northwest Istanbul reported a four year incidence of 0.35% (74 of 20,967 patients aged 6 to 17 years), and a ten year record of a German youth soccer academy found 0.36 cases per 100 athletes per year, with a mean time lost from sport of about two months.(5,6) The clinical burden is concentrated in growing, physically active children, in whom the condition produces pain, functional limitation and reduced health related quality of life, and the same audit notes that its benign course leads many physicians to overlook it and to order unnecessary radiological examinations.(5,7) A systematic review of 28 studies with 1,362 cases confirms the scale of the problem, with boys representing 71.4% of presentations and bilateral involvement in 43.2%.(8) Despite this frequency, the condition has attracted less research attention than other pediatric overuse injuries, and its incidence in the general population remains known only from a small number of local registries.(5,9)

The evidence on how to diagnose and treat the condition nonetheless remains dispersed across small observational studies, imaging descriptions and a limited number of randomized trials, and systematic reviews disagree on its risk factors and on whether any single treatment is superior.(8,10,11) Diagnostic criteria are not standardized, imaging findings overlap with normal apophyseal development, and the comparative trials report short term advantages that dissolve at longer follow up, which leaves clinicians to choose among options of unproven relative value.(12,13) The objective of this review is to synthesize the current evidence on the epidemiology, diagnosis and conservative management of calcaneal apophysitis in children and to identify the gaps that condition clinical practice and future research.

DEVELOPMENT

Epidemiology, pathophysiology and risk factors

Calcaneal apophysitis belongs to the family of traction apophysitides, the load related conditions of the growing skeleton that also include Osgood-Schlatter disease of the tibial tubercle and Sinding-Larsen-Johansson disease of the patella, and the shared terminology reflects a shared mechanism of tendon pull on a vulnerable secondary ossification center.(14) Calcaneal apophysitis arises from repetitive traction of the Achilles tendon on a maturing calcaneal apophysis, and its clinical window tracks the period of apophyseal ossification and fusion.(1,3) Three dimensional computed tomography of 568 pediatric scans places the onset of ossification at a mean age of 5.2 years in girls and 7.2 years in boys, with fusion beginning around 11.2 and 13.3 years respectively, a sexual dimorphism that explains the concentration of the condition in the second half of childhood.(15) These data also show that the apophyseal cap forms around 10 years in girls and 12.4 years in boys, that the earliest complete fusion occurs at 10 years in girls and 14 years in boys, and that the medial and lateral processes ossify later and fuse more slowly, which provides the anatomical substrate for the traction injury.(15) Normal magnetic resonance imaging development confirms that fragmentation and irregularity of the apophysis are expected findings rather than pathology in this age range.(16) The condition is therefore best understood as a developmental load injury rather than as a disease of the bone itself.(1) Two mechanistic accounts compete in the literature: the first attributes the pain to repetitive microtrauma and traction on the apophysis, and the second invokes inflammation or ischemia of the secondary ossification center, with the imaging and elastography data reviewed below favoring the mechanical account even though the terms apophysitis and osteochondrosis are still used interchangeably.(1,17)

Population estimates are scarce and derive mostly from regional or sporting cohorts. A four year audit in Istanbul reported an incidence of 0.35% among 20,967 patients aged 6 to 17 years, with a male predominance, more bilateral than unilateral cases and more admissions in spring, a seasonality attributed to the resumption of physical activity.(5) A ten year retrospective record of 4,326 injuries in 612 youth soccer players identified 22 cases, an incidence of 0.36 per 100 athletes per year, at a mean age of 11.8 years, with 20 unilateral and two bilateral presentations.(6) A systematic review of 28 studies with 1,362 cases reported that boys represented 71.4% and bilateral

involvement 43.2% of presentations, figures that underline the load dependent nature of the condition.(8)The male predominance is notable because girls reach apophyseal fusion earlier, so the longer exposure of boys to an open apophysis, together with higher sport participation, plausibly contributes to the imbalance rather than any intrinsic sex difference in the apophysis itself.(8,15) Cross sectional data from 336 youth baseball players recorded heel pain in 14.6%, with unilateral pain in 5.4% and bilateral pain in 9.2%.(18)The frequency literature for other apophyseal injuries is richer, and a systematic review showed that robust estimates exist mainly for Osgood-Schlatter disease, whose point prevalence reached 10% among children aged 12 to 15 years and whose risk nearly doubled with sport participation, while calcaneal apophysitis did not report enough data for comparable subgroup estimates.(9)The scarcity of population incidence figures is itself a consequence of the condition's benign course and spontaneous healing, which reduce the incentive for systematic registration and interest among physicians.(5)

The risk profile combines anthropometric, biomechanical and training factors, but the direction of several associations remains contested. A systematic review of 11 observational studies with 1,265 participants identified limitation of ankle dorsiflexion as the most studied intrinsic factor, followed by peak plantar pressures and foot malalignment, while noting disagreement between the included studies on which factors are causes and which are consequences.(10)A case control study of 106 boys found higher body mass index, higher maximum and average heel peak pressures and a slower center of pressure velocity in affected children, each with a large effect size, and an eightfold higher odds of bilateral gastrocnemius equinus, which the authors interpreted as a plausible predisposing factor.(19)In contrast, quasi static foot stiffness did not differ between cases and controls, and the larger foot mobility magnitude in affected children, although 19% greater, fell within measurement error, which questions interventions aimed at modifying foot mobility and stiffness.(20)Vertical ground reaction forces during gait were likewise compared between children with and without the condition to characterize the loading pattern of the symptomatic heel.(21)A preliminary pedobarographic report in 33 children, of whom 24 were boys, described reduced heel loading and a forefoot shift of the center of gravity, attributing the traction to postural defects and overpronation rather than to excess pressure, a reading opposite to that of the pressure based case control studies.(22)In a sample of 430 athletic children distributed across soccer, basketball and volleyball, sex, foot posture index, body mass index, terrain and sport discipline did not differentiate cases, and the condition was instead associated with younger age, fewer weekly training sessions and shorter sessions.(23)A prospective cohort of junior gymnasts linked the condition to a lower arch height ratio and poorer dynamic postural balance, suggesting that medial arch support and balance training might have a preventive role.(24)

Skeletal maturity appears to constrain the diagnosis more tightly than chronological age. Among 39 children with radiographs, 37 were in calcaneal stages 1 to 3, and the mean difference from stage 2 was smaller in cases than in controls, so a child outside this narrow maturity range should prompt an alternative diagnosis.(12)In the baseball cohort, no player reported heel pain during stage 5, when the apophysis had fused, and the maturity stages of the apophysis did not differ between players with and without heel pain, which locates the risk in the open apophysis rather than in the completed fusion.(18)Two recent lines of inquiry extend the risk profile beyond mechanical load: a prospective observational study found attention deficit hyperactivity disorder in 70.5% of 88 children with Sever's disease versus 13.3% of 90 controls, with the association stronger in boys and in children not engaged in sport,(25) and a case report described the onset of the condition in a child receiving growth hormone without a causal relation being established.(26) These observations broaden the clinical frame but do not yet change the causal model, which remains anchored in repetitive traction during a narrow window of apophyseal vulnerability.(1)The wide spread of reported frequencies also reflects definitional problems as much as epidemiology: studies differ in whether the diagnosis requires imaging, in the denominator used and in the capture of recurrent episodes, and most figures come from sports clinics rather than from general practice, so comparisons of incidence across populations should be made with caution until a case definition is agreed.(5,9,27)

Clinical presentation and differential diagnosis

The diagnosis is clinical and rests on activity related posterior heel pain, tenderness over the apophysis and a positive calcaneal squeeze test, a combination regarded as sufficient in the absence of atypical features.(1,3,28)The pain is characteristically provoked by running and jumping and relieved by rest, and the examination localizes tenderness to the posterior and plantar aspects of the calcaneus rather than to the Achilles tendon itself, which distinguishes the condition from

tendinopathy.(3,4) The examination of a child with heel pain also includes inspection for swelling and skin changes, palpation of the apophysis, the squeeze test and an assessment of gastrocnemius-soleus tightness, given the association with equinus reported in the biomechanical studies.(1,19) In the systematic review of 1,362 cases, the presentation was bilateral in 43.2% and unilateral in 31.8%, every recorded treatment was conservative, and improved outcomes were reported in 53.7% of cases while only 2.3% reported no improvement, the remainder lacking prognostic data.(8)The squeeze test is the most cited maneuver, and its centrality reflects the absence of any validated reference standard; a self administered screening tool under development achieved an area under the curve of 83% for the posterior heel in a pilot of 63 children, with a concurrent clinical examination as the comparator.(1,27) The assessment of a child with heel pain therefore combines the characteristic history, the response to compression of the apophysis and the exclusion of alternative explanations, rather than a single confirmatory test.(4)

The differential diagnosis is broad and includes other apophysitides and osteochondroses, Achilles tendinopathy, calcaneal stress fracture, tarsal coalition, plantar fasciopathy and nonmechanical causes such as osteomyelitis and bone tumors.(4,29) A Delphi consensus on Achilles tendinopathy has defined diagnostic domains and the conditions that require further medical attention, which helps to separate tendon from apophyseal pain in the adolescent heel, a separation that matters because the two conditions share posterior heel pain but differ in their exercise prescription.(30,31) Red flag conditions are repeatedly documented in this population. Two cases of osteomyelitis complicating Sever's disease illustrate that a persistent or febrile presentation cannot be attributed to the apophysitis itself,(32)and inflammatory markers were of limited value in distinguishing pediatric calcaneal osteomyelitis, so normal laboratory values do not rule out infection.(33)Calcaneal tumors and tumor like lesions, including osteochondroma, and apophyseal fracture with subsequent subtalar instability, are likewise reported as mimickers of the condition.(34,35) A qualitative study of podiatrists describes diagnostic uncertainty as a frequent feature of chronic lower limb pain in children, and highlights the value of structured reasoning and safety netting when the expected recovery does not occur.(36)A practical consequence of this differential is a low threshold for further investigation: pain that persists beyond the expected recovery, night pain, systemic features or a presentation outside the apophyseal age window should trigger laboratory tests or advanced imaging, given the documented cases in which osteomyelitis or a bone lesion presented as heel pain in a child.(33,34)

Diagnostic imaging

Imaging supports rather than establishes the diagnosis. Radiographs may show sclerosis, fragmentation or widening of the apophysis in affected children, but the same features occur in asymptomatic children, and no radiographic criteria have been validated.(12,37) The radiographic description of the apophysis as fragmented or sclerotic is confounded by the normal ossification sequence, in which multiple ossification centers appear and coalesce before fusion, so a single radiograph cannot separate disease from development.(15,16) A systematic review found that radiography was used in only 26.3% of 1,362 reported cases, consistent with a diagnosis made mainly on clinical grounds.(8)The classic description of increased sclerosis and fragmentation on plain films is therefore best read as a confirmation of apophyseal immaturity rather than as evidence of disease.(3)Magnetic resonance imaging delineates normal apophyseal development and its imaging pitfalls and can demonstrate signal changes in the apophysis of an affected child, yet it is reserved for atypical or refractory presentations in which an alternative diagnosis must be excluded.(16,37) This position is reinforced by the observation that the disease occurs within a narrow range of skeletal maturity, so imaging is most informative when the clinical picture and the maturity stage disagree.(12)

Ultrasound is emerging as a radiation free alternative for staging apophyseal ossification and for examining the adjacent Achilles tendon. In a pilot of 19 patients with Sever's disease, inter rater agreement was substantial for both radiographic and sonographic staging, with comparable kappa values of 0.692 and 0.713 respectively, and consensus scores showed moderate agreement between the two modalities, supporting the incorporation of ultrasound for staging young patients.(38)Youth athletes with Sever's disease exhibited greater Achilles tendon thickening than controls with a large effect size, whereas tendon thickness and cross sectional area did not differ, a finding consistent with the traction model and with the use of ultrasound in the comprehensive examination of adolescents with heel pain.(39)Shear wave elastography has likewise been applied to Achilles tendon stiffness in the etiology of the condition, extending the mechanical characterization of the tendon-apophysis unit beyond conventional grayscale parameters.(17)A problem based ultrasono-

graphic review positions Sever's disease within the broader differential of pediatric foot pain and shows that high frequency ultrasound can follow the bone surface and the surrounding soft tissue in real time, which is valuable when the clinical picture is uncertain.(29)Advanced imaging therefore occupies a limited but defined place: computed tomography and magnetic resonance imaging quantify ossification and fusion precisely and detect marrow or soft tissue abnormality when the presentation is atypical, and the staging systems derived from them allow a child's skeletal maturity to be read against age and sex specific standards.(15,16) The computed tomography staging used an 11 stage scoring system applied to 568 scans and 266 lateral radiographs, and it yields age and sex specific predictive models for apophyseal stage that could support the diagnosis of heel pain conditions and the detection of developmental delay.(15)This capacity is useful less for confirming Sever's disease than for recognizing when the heel pain belongs to another diagnosis, a role consistent with the narrow maturity window in which the condition is expected.(12)

Conservative management

Treatment is uniformly conservative, and no intervention has demonstrated clear superiority. A systematic review of eight randomized trials reported a mean PEDro score of 6.75 and concluded that conservative methods alleviate symptoms, and a comprehensive review of 17 studies reached the same position while proposing a tiered framework.(11,40) The comparative evidence nonetheless does not identify a single best modality. A pragmatic randomized trial of 124 children aged 8 to 14 years, designed as a factorial comparison of heel raises or prefabricated orthoses with footwear replacement or none, found a relative advantage of heel raises at two months in the physical domain of the Oxford Ankle Foot Questionnaire and no differences at 6 or 12 months, with footwear replacement adding no measurable effect.(13)A randomized trial that compared wait and see, an orthotic device and physical therapy likewise reported no long term advantage of any arm, indicating that treatment selection can defer to clinical judgment, cost minimization and patient preference.(41)A systematic review of heel lifts across lower limb musculoskeletal conditions concluded that their benefit is modest and time limited.(42)The observation that all trial arms improve with time, including the wait and see arm, is the clearest evidence that spontaneous recovery underlies much of the reported benefit, and it argues for measuring treatments against the natural history rather than against each other alone.(13,41) This does not make treatment futile, because symptomatic relief during the painful window is valuable in its own right, but it sets realistic expectations about what a device or an exercise program can achieve.(11)

The device based comparisons are more favorable to custom devices in the short term. A randomized trial of 208 children aged 9 to 12 years compared custom polypropylene foot orthoses with off the shelf heel lifts over 12 weeks and recorded a 53.4% increase in pain threshold algometry and a 68.6% decrease in visual analog scale pain in favor of the custom devices, although both arms improved.(43) A pretest posttest study of 40 children combining custom insoles with a home exercise program improved step length, stance and swing phase proportions and gait speed while redistributing plantar pressure and reducing activity pain over four weeks, without changes in step width or cadence.(44) In barefoot athletes, two different braces produced comparable improvements in foot function and pain over three months, with brace wear of 82% for the heel cup and 64% for the strap brace and no between group difference in the physical domain of the child reported outcome, so either brace can be offered for barefoot activity.(45)

Adherence and education condition the success of every modality. Because the condition is benign and self limited, the aim of treatment is symptom control while the apophysis matures, and families should be told that pain guides load rather than dictates complete rest, an instruction that prevents both over restriction and premature return to full activity.(1,3) The comprehensive synthesis formalizes this reasoning in a tiered framework that places custom orthoses and physical therapy, including heel cord stretching and dorsiflexion strengthening, in the first tier, heel lifts and kinesio taping in the second, extracorporeal shockwave in the third and off the shelf orthoses in the least favored position, a hierarchy that mirrors the short term trial results described above.(40)

Exercise based approaches are feasible and appear comparable to passive options. A pilot and feasibility protocol is testing standardized Achilles tendon loading and pain guided activity modification in adolescents with posterior heel pain, an approach imported from Achilles tendinopathy management and one that addresses the relative neglect of exercise in this population.(31)Kinesiotherapy improved American Orthopedic Foot and Ankle Society scores at one and three months in a small randomized trial of 22 male athletes, in which the kinesio tape group reached a mean postoperative score of 99.7 points and a visual analog scale of 0.1 against 97.4 and 0.4 in the sham group, a difference that favored function over analgesia, and kinesio taping is therefore

positioned as an adjunct rather than a primary treatment.(46) Focused extracorporeal shockwave therapy has been described in a case series of youth sports related apophyseal injuries, and a tiered synthesis ranks custom orthoses and physical therapy first, with shockwave as an emerging option.(40,47) Nonsteroidal anti inflammatory drugs and cryotherapy were retained for acute symptom management in that same synthesis, and rest, stretching and heel cups remain the pragmatic measures summarized in clinical reviews.(3,40) The main conservative interventions, their proposed mechanism and their supporting evidence are summarized in (Table 1).

Table 1. Conservative interventions for calcaneal apophysitis.

Intervention	Proposed mechanism	Supporting evidence	Conclusion
Heel lifts or raises	Elevate the heel and reduce Achilles traction on the apophysis	12 month factorial RCT; advantage over prefabricated orthoses at 2 months, none at 12 months	Short term relief; selection by cost and preference
Custom foot orthoses	Redistribute plantar pressure and support the medial arch	RCT in 208 children favored orthoses over heel lifts; pretest posttest with exercise	Preferred option in recent syntheses
Prefabricated orthoses	Cushion and offload the heel	Factorial RCT; no advantage over heel raises at 6 to 12 months	Comparable and low cost
Exercise and kinesiotherapy	Load the Achilles tendon and improve strength and balance	Small RCT improved function; feasibility protocol in progress	Feasible adjunct
Kinesio taping	Sensory and mechanical support	Small RCT improved function with limited effect on pain	Adjunct only
Braces	Support the heel during barefoot sports	RCT showed no difference between two braces	Either brace acceptable
Extracorporeal shockwave	Modulate pain and tissue healing	Case series in apophyseal injuries	Emerging, low level evidence
NSAIDs and cryotherapy	Acute symptom control	Narrative synthesis	Acute management only

Note: RCT = randomized controlled trial; VAS = visual analog scale; NSAIDs = nonsteroidal anti-inflammatory drugs.

Prognosis, recurrence and return to sport

The condition is regarded as self limiting, but the long term evidence qualifies that assumption. A systematic review of conservatively treated lower limb apophyseal injuries identified only three studies on Sever's disease and concluded that apophyseal injuries are not always self limiting, with some children reporting pain, secondary structural changes, worse function and difficulty returning to sport beyond one year of follow up.(14) In a German youth soccer academy, the mean time to return to play was 60.7 days, three of 22 cases were recurrent, and recurrent cases recovered more slowly than primary ones, with neither age nor body mass index at diagnosis influencing the time lost.(6) This time loss is substantial for a young athlete and supports early, structured rehabilitation rather than passive observation, while the recurrence rate of 13.6% argues for gradual reloading before full return to play.(6) For clinicians, these figures translate into a practical expectation: most children improve within weeks and return to sport within two months, while a minority take longer and a small proportion recur, which is the question families pose first.(6,14)

During the symptomatic episode, health related quality of life is reduced. A longitudinal study nested in a randomized trial followed 124 children and found that parents initially reported greater impact than their children, with agreement between child and parent converging over the 12 month follow up, which argues for measuring both perspectives during treatment.(7) The randomized comparison of custom orthoses and heel lifts recorded improvements in both arms, with larger gains in the orthosis group, indicating that symptom relief and quality of life improve regardless of the device chosen.(43) Outcome measurement nonetheless varies across studies, which complicates the synthesis of prognosis: pain scales, the Oxford Ankle Foot Questionnaire and definitions of return to play are not standardized, and the long term systematic review could locate only three studies on the condition.(7,14) Pilot self administered screening tools achieved an area under the curve of 83% for the posterior heel, a step toward standardized identification, epidemiological measurement and longitudinal follow up of the condition, and toward reducing the waiting lists that delay assessment.(27) Preventive reasoning follows from the risk profile: graduated loading, attention to the open apophysis during growth spurts and correction of postural

contributors such as overpronation are proposed in the biomechanical and gymnast cohorts, although no prevention trial has tested these measures and the balance training suggested by the gymnast data remains an untested hypothesis.(22,24)

Across the five axes, the literature converges on a clinical diagnosis, a conservative management strategy and a generally favorable course, while the evidence base remains dominated by small samples, short follow up and heterogeneous outcomes (Table 2).

Table 2. Synthesis of the evidence by thematic axis.

Axis	Key findings	Designs	Representative studies
Epidemiology, pathophysiology and risk factors	Incidence of 0.35% to 0.36 per 100 athletes per year; male predominance; traction on an immature apophysis; dorsiflexion limitation and plantar pressures as contested factors	Retrospective audits, case control, cross sectional and systematic reviews	Ceylan 2018; Belikan 2022; Fares 2023; Nieto-Gil 2023
Clinical presentation and differential diagnosis	Activity related heel pain with positive squeeze test; mimickers include osteomyelitis and tumors	Systematic reviews, case reports, qualitative study	Fares 2021; Ramponi 2019; Kumar 2020
Diagnostic imaging	Radiography limited by asymptomatic findings; ultrasound stages ossification and tendon morphology	Case control, pilot and review studies	Rossi 2016; Hanlon 2024; DeJong Lempke 2025
Conservative management	No single superior modality; heel lifts, orthoses and exercise comparable	Randomized trials, pretest posttest, systematic reviews	James 2016; Wiegerinck 2016; Alfaro-Santafe 2021; Hernandez-Lucas 2024
Prognosis, recurrence and return to sport	Self limited course with return to play near 60 days; not always self limiting beyond one year	Retrospective cohort, systematic review, longitudinal study	Belikan 2022; Apers 2021; James 2016

Note: Designs refer to the primary studies that support each axis.

DISCUSSION

This synthesis positions calcaneal apophysitis as a load driven condition of a maturing apophysis whose diagnosis is clinical and whose treatment is conservative, with broadly comparable outcomes across heel lifts, foot orthoses and exercise.(11,40) The finding that no single modality is superior, and that imaging is best reserved for atypical presentations, is the central message that should reach primary care and podiatry practice, where most of these children are first assessed and where unnecessary radiographs and orthopedic referrals are most avoidable.(5,8) The review also shows that the condition is common enough to matter in pediatric foot practice, yet still defined by clinical judgment rather than by a validated test, which is precisely the ambiguity that future work must resolve.(27) Equally important for practice is the reassurance that the condition does not require surgery, and that the interventions in common use differ little in their eventual outcome, which allows cost and preference to drive the choice.(11) The condition is managed across a range of settings, from family practice to podiatry and sports medicine, which means that the message needs to be simple enough to travel across those contexts without distortion.(2,48)

These conclusions agree with earlier narrative and general reviews of Sever's disease in sport and of overuse injury in the pediatric population, which described the squeeze test as sufficient for diagnosis and reserved imaging for differential exclusion.(1,3,49,50) The male predominance, the concentration within the apophyseal window and the association with high load disciplines such as gymnastics parallel the systematic synthesis of 1,362 cases and general reviews of the growing skeleton.(8,51-53) A recent narrative review reiterates the same overuse framing and conservative course, and a systematic review emphasizes the need to separate the condition from benign growing pains, a distinction that changes the advice given to families and the reassurance offered.(54,55) The mechanistic consistency across these sources, from descriptive reviews to elastographic measurements, supports the view that the treatment target is load on the apophysis rather than an inflammatory process that would respond to pharmacological interruption.(17,49) The imaging evidence converges on the same point, because the radiographic and sonographic features of the open apophysis are developmental rather than pathological, and the tendon changes detected

by ultrasound are consistent with mechanical overload rather than with a primary inflammatory lesion.(16,39)

Disagreement persists on risk factors and on the advantage of specific devices. One systematic review associated the condition with ankle dorsiflexion limitation, plantar pressures and foot malalignment, whereas a population based sample of 430 athletic children found no effect of body mass index, sex, foot posture or sport discipline and instead linked risk to younger age and lower training load.(10,23) Case control studies report higher heel pressures and slower center of pressure velocity, while a preliminary pedobarographic report described heel underload and a forefoot shift, a divergence attributable to differences in posture, footwear and the measurement protocol rather than to a single mechanical cause, and one that cautions against treating any plantar pressure variable as a universal risk factor.(19,21,22) Treatment trials diverge in the same way: short term advantages of heel raises and custom orthoses disappear in the pragmatic comparison at 12 months, which reflects outcome timing, the choice of the Oxford Ankle Foot Questionnaire and the inclusion of an active comparator, and it suggests that natural recovery is doing much of the work in every arm.(13,41,43) The frequency literature is equally heterogeneous, with robust estimates available mainly for Osgood-Schlatter disease rather than for calcaneal apophysitis, which limits the calculation of population burden and prevention targets.(9) These disagreements have practical consequences, because they change whether a clinician measures ankle dorsiflexion, prescribes an orthosis or simply advises rest, and they explain why guidelines have not converged on a single pathway.(10,11) Until those differences are resolved, the honest position is to present the options with their uncertainty rather than to promise a superior device.(41)

This review has limitations. The search was not systematic, was limited to four databases and to English and Spanish publications, and did not formally score the risk of bias of every primary study, so relevant literature may have been missed and the synthesis inherits the weaknesses of small, heterogeneous trials.(11) The field lacks a validated diagnostic reference standard, and public information on the condition is often inaccurate, which compounds the diagnostic uncertainty reported by clinicians and may mislead families who search online before consulting.(36,56) Each limitation points to a concrete remedy: prospective cohorts that validate diagnostic criteria and the screening tools under development, a core outcome set for trials, and longer randomized comparisons with blinded assessment would resolve the current ambiguity and move the field from opinion toward evidence.(27,31,57) A further limitation is that most trials measured intermediate outcomes such as pain and function over months rather than recurrence or participation, which are the outcomes families care about most, so future trials should follow children until apophyseal fusion.(7,14) Publication bias is a plausible additional threat, because small positive trials of devices are more likely to be written up than null comparisons, and this asymmetry may inflate the apparent advantage of orthoses.(11)

For practice, the review supports reassuring families about the self limited course, modifying load rather than enforcing complete rest, and selecting heel lifts, orthoses or exercise according to cost and preference, while reserving imaging for atypical presentations.(1,48,58) Clinicians should maintain a low threshold to investigate fever, night pain, swelling or failure to improve, given the documented mimickers and the rare progression to apophyseal fracture, and they should anchor the diagnosis in the clinical picture rather than in the radiograph, a discipline that reduces both missed pathology and unnecessary investigation.(32,33,59) Educating parents and coaches about the benign course and the expected recovery time is itself a therapeutic act, because it reduces the anxiety and the demand for imaging that the public information audit shows to be poorly served.(1,56) For podiatrists specifically, the review underlines that the role of the profession lies in functional assessment, load management and shared decisions about devices, rather than in the pursuit of a single technological fix.(36,40)

CONCLUSIONS

Calcaneal apophysitis is a clinical diagnosis of a traction apophysitis of the calcaneus that affects active children during the apophyseal window and generally follows a self limited, favorable course. Its diagnosis rests on the clinical picture and the squeeze test, with imaging reserved to exclude alternative causes, and its management is conservative, with heel lifts, foot orthoses and exercise producing comparable symptom relief. Standardized diagnostic criteria, a core outcome set and longer randomized trials are the priorities needed to move the field beyond opinion toward measurable evidence.

REFERENCES

1. Fares MY, Salhab HA, Khachfe HH, Fares J, Haidar R, Musharrafieh U. Sever's Disease of the Pediatric Population: Clinical, Pathologic, and Therapeutic Considerations. *Clin Med Res*. 2021;19(3):132-137. doi: 10.3121/cmr.2021.1639
2. Trentacosta N. Pediatric Sports Injuries. *Pediatric Clinics of North America*. 2020;67(1):205-225. doi: 10.1016/j.pcl.2019.09.013
3. Ramponi DR, Baker C. Sever's Disease (Calcaneal Apophysitis). *Advanced Emergency Nursing Journal*. 2019;41(1):10-14. doi: 10.1097/tme.0000000000000219
4. Jokela A, Aho J, Kosola J, Stenroos A, Sinikumpu JJ, Maffulli N, et al. Heel pain in young athletes - not always Sever's Disease: A Narrative Review. *The Foot*. 2024;60:102114. doi: 10.1016/j.foot.2024.102114
5. Ceylan HH, Caypinar B. Incidence of calcaneal apophysitis in Northwest Istanbul. *BMC Musculoskelet Disord*. 2018;19(1):267. doi: 10.1186/s12891-018-2184-6
6. Belikan P, Färber LC, Abel F, Nowak TE, Drees P, Mattyasovszky SG. Incidence of calcaneal apophysitis (Sever's disease) and return-to-play in adolescent athletes of a German youth soccer academy: a retrospective study of 10 years. *J Orthop Surg Res*. 2022;17(1):83. doi: 10.1186/s13018-022-02979-9
7. James AM, Williams CM, Haines TP. Health related quality of life of children with calcaneal apophysitis: child & parent perceptions. *Health Qual Life Outcomes*. 2016;14(1):95. doi: 10.1186/s12955-016-0497-4
8. Fares MY, Baydoun H, Khachfe HH, Salhab HA, Fares J, Musharrafieh U. Clinical and Diagnostic Characteristics of Calcaneal Apophysitis: A Systematic Review and Thematic Analysis. *Journal of the American Podiatric Medical Association*. 2023;113(4). doi: 10.7547/22-083
9. Haines M, Pirlo L, Bowles KA, Williams CM. Describing Frequencies of Lower-Limb Apophyseal Injuries in Children and Adolescents: A Systematic Review. *Clinical Journal of Sport Medicine*. 2022;32(4):433-439. doi: 10.1097/jsm.0000000000000925
10. Nieto-Gil P, Marco-Lledó J, García-Campos J, Ruiz-Muñoz M, Gijon-Nogueron G, Ramos-Petersen L. Risk factors and associated factors for calcaneal apophysitis (Sever's disease): a systematic review. *BMJ Open*. 2023;13(6):e064903. doi: 10.1136/bmjopen-2022-064903
11. Hernandez-Lucas P, Leirós-Rodríguez R, García-Liñeira J, Díez-Buil H. Conservative Treatment of Sever's Disease: A Systematic Review. *JCM*. 2024;13(5):1391. doi: 10.3390/jcm13051391
12. Duong MM, Nicholson AD, Li SQ, Gilmore A, Cooperman DR, Liu RW. Relationship Between Sever Disease and Skeletal Maturity. *Journal of Pediatric Orthopaedics*. 2020;40(2):93-96. doi: 10.1097/bpo.0000000000001145
13. James AM, Williams CM, Haines TP. Effectiveness of footwear and foot orthoses for calcaneal apophysitis: a 12-month factorial randomised trial. *Br J Sports Med*. 2016;50(20):1268-1275. doi: 10.1136/bjsports-2015-094986
14. Apers E, Rombauts M, Bogaerts S. Long-term outcome of conservatively treated lower limb apophyseal injuries in children and adolescents: A systematic review. *Transl Sports Med*. 2021;4(5):565-586. doi: 10.1002/tsm2.252
15. Blythe CS, Reynolds MS, Gregory LS. Quantifying the ossification and fusion of the calcaneal apophysis using computed tomography. *Journal of Anatomy*. 2022;241(2):484-499. doi: 10.1111/joa.13677
16. Rossi I, Rosenberg Z, Zember J. Normal skeletal development and imaging pitfalls of the calcaneal apophysis: MRI features. *Skeletal Radiol*. 2016;45(4):483-493. doi: 10.1007/s00256-015-2320-4
17. Sensoz E, Ediz SS, Sevim OF, Ergun S, Eceviz E. Achilles Tendon Stiffness in the Etiology of Sever Disease: A Shear Wave Elastography Study. *Journal of the American Podiatric Medical Association*. 2024;114(1). doi: 10.7547/22-167
18. Honma Y, Tsutsui T, Sakamaki W, Higuchi A, Nakamura E, Torii S. Exploring the Link Between Calcaneal Apophysis Maturation and Heel Pain in Youth Baseball Players. *Orthopaedic Journal of Sports Medicine*. 2024;12(10):23259671241253861. doi: 10.1177/23259671241253861
19. Rodríguez-Sanz D, Becerro-de-Bengoa-Vallejo R, López-López D, Calvo-Lobo C, Martínez-Jiménez EM, Perez-Boal E, et al. Slow velocity of the center of pressure and high heel pressures may increase the risk of Sever's disease: a case-control study. *BMC Pediatr*. 2018;18(1):357. doi: 10.1186/s12887-018-1318-1
20. McSweeney SC, Reed L, Wearing S. Foot Mobility Magnitude and Stiffness in Children With and Without Calcaneal Apophysitis. *Foot Ankle Int*. 2018;39(5):585-590. doi: 10.1177/1071100717750889
21. McSweeney S, Reed LF, Wearing SC. Vertical ground reaction forces during gait in children with and without calcaneal apophysitis. *Gait & Posture*. 2019;71:126-130. doi: 10.1016/j.gaitpost.2019.04.027
22. Bitenc-Jasiejko A, Walińska A, Konior K, Gonta K, Skomro P, Kijak K, et al. Characteristics of Pressure on the Apophysis in the Course of Paediatric Heel Pain—Preliminary Report. *IJERPH*. 2023;20(7):5403. doi: 10.3390/ijerph20075403
23. Martinelli N, Spreafico A, Tramacere I, Marcolli D, Valli F, Curci D. Prevalence and Associated Factors of Sever's Disease in an Athletic Population. *Journal of the American Podiatric Medical Association*. 2019;109(5):351-356. doi: 10.7547/17-105
24. Kinoshita K, Hoshino Y, Yokota N, Fukuda M, Hirata M, Nishizawa Y. Physical characteristics inducing Sever's disease in junior gymnasts. *Heliyon*. 2024;10(19):e38717. doi: 10.1016/j.heliyon.2024.e38717
25. Gonder N, Demir IH, Özel V, Ilcepinar K, Bilgin MA. Possible association between Sever's disease and attention deficit hyperactivity disorder: a prospective observational study. *J Orthop Surg Res*. 2025;20(1):1. doi: 10.1186/s13018-024-05435-y
26. Kurnaz E, Savas-Erdeve S, Aycan Z, Çetinkaya S. Sever's Disease in a Patient Receiving Growth Hormone with no Causative Relation. *JCDR*. 2018;12(3):SD04-SD05. doi: 10.7860/jcdr/2018/30956.11305

27. Brooks J, Caserta A, Paterson K, Bowles KA, Haines T, Williams C. Pilot development of diagnostic tools for lower limb apophyseal injuries in children and adolescents. *PeerJ*. 2024;12(9):e18101. doi: 10.7717/peerj.18101
28. Dobbe AM, Gibbons PJ. Common paediatric conditions of the lower limb. *J Paediatrics Child Health*. 2017;53(11):1077-1085. doi: 10.1111/jpc.13756
29. Liu L, Wang T, Qi H. Foot pain in children and adolescents: a problem-based approach in musculoskeletal ultrasonography. *Ultrasonography*. 2024;43(3):193-208. doi: 10.14366/usg.24002
30. Malliaras P, Gravare Silbernagel K, de Vos RJ, Bourke J, Sancho I, Hanlon SL, et al. Diagnostic domains, differential diagnosis and conditions requiring further medical attention that are considered important in the assessment for Achilles tendinopathy: a Delphi consensus study. *Br J Sports Med*. 2025;59(13):891-901. doi: 10.1136/bjsports-2024-109185
31. Hanlon SL, Bley BC, Silbernagel KG. Determining the feasibility of exercise therapy and activity modification for treating adolescents with heel pain: a study protocol. *BMJ Open Sport Exerc Med*. 2022;8(3):e001301. doi: 10.1136/bmjsem-2021-001301
32. Kumar S, Jain N, Karpe P, Limaye R. Osteomyelitis complicating Sever's disease: A report of two cases. *Journal of Clinical Orthopaedics and Trauma*. 2020;11(2):310-313. doi: 10.1016/j.jcot.2019.08.010
33. Ingersoll J, Halliday M, Adams DJ, Auten JD, Morrison Ponce D. Inflammatory markers limitations in the diagnosis of pediatric calcaneal osteomyelitis. *The American Journal of Emergency Medicine*. 2019;37(11):2119.e3-2119.e5. doi: 10.1016/j.ajem.2019.158416
34. Calogero V, Florio M, Careri S, Aulisa AG, Falciglia F, Giordano M. Paediatric Calcaneal Osteochondroma: A Case Report and a Literature Review. *Diseases*. 2024;12(8):167. doi: 10.3390/diseases12080167
35. Bombaci H. Calcaneal Apophyseal Fracture Followed by Subtalar Joint Instability in a Young Female: A Case Report. *The Journal of Foot and Ankle Surgery*. 2018;57(2):401-403. doi: 10.1053/j.jfas.2017.08.022
36. Coventry J, Welch JJ, Pacey V, Ta B, Sturgiss E, Smith M, et al. Navigating diagnostic uncertainty in children's chronic lower limb pain: A qualitative study of management strategies using vignette-based focus groups. *Journal of Foot and Ankle Research*. 2025;18(1):e70032. doi: 10.1002/jfa2.70032
37. Dogan MS, Doganay S, Koc G, Gorkem SB, Ciraci S, Coskun A. Calcaneal Apophysitis (Sever's Disease): MRI Findings. *J Nepal Paedtr Soc*. 2016;35(2):172-174. doi: 10.3126/jnps.v35i2.13873
38. DeJong Lempke AF, Whitney KE, Jackson SS, Le HM, Hanlon SL. Absolute and Relative Agreement Between Radiographic and Sonographic Calcaneal Ossification Staging: A Pilot Study. *Sports Health: A Multidisciplinary Approach*. 2025;17(6):1323-1331. doi: 10.1177/19417381251315056
39. Hanlon SL, Whitney KE, DeJong Lempke AF. Youth Athletes With Sever's Disease Exhibit Altered Achilles Tendon Ultrasound Characteristics. *J of Ultrasound Medicine*. 2024;43(7):1303-1312. doi: 10.1002/jum.16454
40. Nweke TC. Conservative Management of Sever's Disease (Calcaneal Apophysitis): A Comprehensive Review of Treatment Efficacy. *Cureus*. 2025;17(7):e88779-e88779. doi: 10.7759/cureus.88779
41. Wiegerinck JI, Zwiers R, Sierevelt IN, van Weert HCPM, van Dijk CN, Struijs PAA. Treatment of Calcaneal Apophysitis. *Journal of Pediatric Orthopaedics*. 2016;36(2):152-157. doi: 10.1097/bpo.0000000000000417
42. Bourke J, Munteanu S, Merza E, Garofolini A, Taylor S, Malliaras P. Efficacy of heel lifts for lower limb musculoskeletal conditions: A systematic review. *Journal of Foot and Ankle Research*. 2024;17(2):e12031. doi: 10.1002/jfa2.12031
43. Alfaro-Santafé J, Gómez-Bernal A, Lanuza-Cerzócimo C, Alfaro-Santafé JV, Pérez-Morcillo A, Almenar-Ara-sanz AJ. Effectiveness of Custom-Made Foot Orthoses vs. Heel-Lifts in Children with Calcaneal Apophysitis (Sever's Disease): A CONSORT-Compliant Randomized Trial. *Children*. 2021;8(11):963. doi: 10.3390/children8110963
44. Feyzioğlu Ö, Öztürk Ö, Muğrabi S. Effects of custom-made insoles on foot pressure redistribution, gait parameters, and pain in calcaneal apophysitis—a pretest and posttest study. *Prosthetics & Orthotics International*. 2021;45(6):532-537. doi: 10.1097/pxr.0000000000000039
45. Sweeney EA, Little CC, Wilson JC, Potter MN, Seehusen CN, Howell DR. Comparison of Braces for Treatment of Sever's Disease (Calcaneal Apophysitis) in Barefoot Athletes: A Randomized Clinical Trial. *Journal of Athletic Training*. 2023;58(5):437-444. doi: 10.4085/1062-6050-0266.22
46. Kuyucu E, Gülenç B, Biçer H, Erdil M. Assessment of the kinesiotherapy's efficacy in male athletes with calcaneal apophysitis. *J Orthop Surg Res*. 2017;12(1):146. doi: 10.1186/s13018-017-0637-5
47. Shafshak T, Amer MA. Focused extracorporeal shockwave therapy for youth sports-related apophyseal injuries: case series. *J Orthop Surg Res*. 2023;18(1):616. doi: 10.1186/s13018-023-04065-0
48. Green A. The Pediatric Foot and Ankle. *Pediatric Clinics of North America*. 2020;67(1):169-183. doi: 10.1016/j.pcl.2019.09.007
49. Naaktgeboren K, Dorgo S, Boyle JB. Growth Plate Injuries in Children in Sports: A Review of Sever's Disease. *Strength & Conditioning Journal*. 2017;39(2):59-68. doi: 10.1519/ssc.0000000000000295
50. Wu M, Fallon R, Heyworth BE. Overuse Injuries in the Pediatric Population. *Sports Medicine and Arthroscopy Review*. 2016;24(4):150-158. doi: 10.1097/jsa.0000000000000129
51. Maruszczak K, Madej T, Gawda P. Lower Limb Osteochondrosis and Apophysitis in Young Athletes—A Comprehensive Review. *Applied Sciences*. 2024;14(24):11795. doi: 10.3390/app142411795
52. Yun L, Fein DM. Osgood-Schlatter and Sever Diseases. *Pediatrics in Review*. 2024;45(7):422-424. doi: 10.1542/pir.2023-006037
53. Hart E, Meehan WP, Bae DS, d'Hemecourt P, Straccioli A. The Young Injured Gymnast: A Literature Review and Discussion. *Curr Sports Med Rep*. 2018;17(11):366-375. doi: 10.1249/jsr.0000000000000536
54. Mota AJ, Buruian A, Agostinho M. Calcaneal apophysitis (Sever's Disease) revisited. *Braz J Hea Rev*. 2024;7(1):2235-2247. doi: 10.34119/bjhrv7n1-176

55. Lima DG, Perugino M. Growth pain vs. sports-related pain: a systematic review. *SAP Rehabilitation and Sports Medicine*. 2025;5:122.
56. Liu S, Williams CM, Welch JJ. International differences and inaccuracies in the public advertising about calcaneal apophysitis: an audit of websites originating in Australia, UK and USA. *Journal of Foot and Ankle Research*. 2023;16(1):39. doi: 10.1186/s13047-023-00637-9
57. Midtiby SL, Wedderkopp N, Larsen RT, Carlsen AMF, Mavridis D, Shrier I. Effectiveness of interventions for treating apophysitis in children and adolescents: protocol for a systematic review and network meta-analysis. *Chiropr Man Therap*. 2018;26(1):41. doi: 10.1186/s12998-018-0209-8
58. West EY, Jaramillo D. Imaging of osteochondrosis. *Pediatr Radiol*. 2019;49(12):1610-1616. doi: 10.1007/s00247-019-04556-5
59. Schiller J, DeFroda S, Blood T. Lower Extremity Avulsion Fractures in the Pediatric and Adolescent Athlete. *J Am Acad Orthop Surg*. 2017;25(4):251-259. doi: 10.5435/jaaos-d-15-00328

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AUTHORSHIP CONTRIBUTIONS

Drafting – original draft: Michel Oria Saavedra, Carolina Ortiz Martínez, Cecilia Capriles Lemus.

Writing–review and editing: Michel Oria Saavedra, Carolina Ortiz Martínez, Cecilia Capriles Lemus.