

Growth pain vs. sports-related pain: a systematic review

Dolor de crecimiento vs dolor traumático-deportivo: revisión sistemática

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ABSTRACT

Background: Growing pain is a common cause of musculoskeletal discomfort in childhood and may be confused with pain related to trauma or sports overload. Correct clinical differentiation is essential to avoid unnecessary diagnostic studies and to recognize warning signs early. Methods: A systematic review of the literature was conducted using PubMed, Scopus, and Web of Science, including studies that compared clinical characteristics of growing pain and traumatic or sports-related musculoskeletal pain in children aged 2 to 14 years. Observational studies, systematic reviews, and clinical guidelines published in English, Spanish, or Portuguese were included. Results: Growing pain is characterized by bilateral nocturnal lower limb pain without inflammatory signs or functional limitation during the day, whereas traumatic or sports-related pain presents a clear temporal association with physical activity, focal tenderness, and objective physical findings. Variability in diagnostic criteria among studies limits the comparability of evidence. Conclusion: Growing pain represents a benign and clinically distinct entity. The accurate application of clinical diagnostic criteria and the recognition of alarm features can optimize diagnostic decision-making and reduce the unnecessary use of complementary studies.

Keywords: Growing Pains; Musculoskeletal Pain; Pediatrics; Differential Diagnosis; Sports Injuries.

RESUMEN

Introducción: El dolor de crecimiento es una causa frecuente de consulta en pediatría y puede confundirse con dolor musculoesquelético traumático o relacionado con la actividad física. Diferenciar clínicamente ambas condiciones es fundamental para evitar estudios innecesarios y detectar oportunamente signos de alarma. Métodos: Se realizó una revisión sistemática de la literatura en PubMed, Scopus y Web of Science sobre características clínicas diferenciales entre dolor de crecimiento y dolor traumático o deportivo en niños de 2 a 14 años. Se incluyeron estudios observacionales, revisiones sistemáticas y guías clínicas publicados en inglés, español o portugués. Resultados: La evidencia sugiere que el dolor de crecimiento se caracteriza por dolor nocturno bilateral en miembros inferiores, sin limitación funcional ni hallazgos físicos inflamatorios, mientras que el dolor traumático o deportivo presenta relación clara con actividad física, localización focal y signos físicos objetivos. La falta de criterios diagnósticos estandarizados limita la comparabilidad de resultados entre estudios. Conclusión: El dolor de crecimiento es una entidad clínica diferenciada y benigna. La aplicación rigurosa de criterios clínicos y la identificación de signos de alarma permiten un diagnóstico preciso y reducen el uso innecesario de estudios complementarios.

Palabras clave: Dolores de crecimiento; Dolor musculoesquelético; Pediatría; Diagnóstico diferencial; Lesiones deportivas.

INTRODUCTION

Musculoskeletal pain is among the most common reasons for pediatric consultations, affecting between 4% and 20% of school-aged children and accounting for up to 6.1% of outpatient visits in the pediatric population. Within this clinical spectrum, “growing pains” emerges as a highly prevalent syndrome, affecting 10–37% of children between the ages of 4 and 12 according to recent epidemiological studies [2,3]. However, its validity as a distinct clinical entity remains controversial in the scientific literature, primarily because of the absence of objective diagnostic markers and significant symptomatic overlap with other musculoskeletal conditions.

Critical diagnostic challenges currently persist in the clinical differentiation between growing pain and musculoskeletal pain of traumatic or sports-related origin. While trauma accounts for 44% of cases of musculoskeletal pain in pediatrics, growing pain is characterized by a distinctive clinical pattern: intermittent nocturnal pain, bilateral involvement, localization in the lower limbs (especially calves/thighs), the absence of persistent morning pain, and a normal physical examination [5,6]. However, current clinical guidelines show inconsistencies in the application of these criteria, with recent studies reporting that up to 65% of cases are initially misdiagnosed. This situation poses significant clinical risks, including the underdiagnosis of serious conditions such as osteomyelitis or leukemia, as well as the overuse of resources in self-limiting conditions.

This study addresses this issue through a systematic review that aims to critically synthesize the available evidence on the clinical differences between the two conditions. The specific objective is to systematically compare the presentation patterns, predisposing factors, physical findings, and clinical course of growing pain versus traumatic/sports-related musculoskeletal pain in the pediatric population. This synthesis is particularly relevant considering that, according to longitudinal data, up to 70% of misdiagnosed cases receive inappropriate management for more than two years. The standardization of differential diagnostic criteria, derived from this review, could optimize pediatric clinical practice, reduce parental anxiety, and prevent sequelae resulting from misdiagnoses.

METHODS

Study Design

A systematic review of the literature was conducted following the basic principles of the PRISMA 2020 statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The objective was to identify and synthesize the available scientific evidence to clinically differentiate growing pain from musculoskeletal pain of traumatic or sports-related origin in the pediatric population.

Search Strategy and Information Sources

A systematic search was conducted in the PubMed/MEDLINE, Scopus, and Web of Science databases, covering the period from January 2000 to December 2024. The search strategy used controlled terms (MeSH descriptors) and free-text terms combined using Boolean operators.

Example of a search string in PubMed/MEDLINE:

“growing pains”[MeSH] OR “benign nocturnal pains”[tiab] OR “recurrent limb pains”[tiab] AND (“child”[MeSH] OR “pediatric”[tiab] OR “school child”[tiab]) AND (“trauma”[MeSH] OR “sports”[MeSH] OR “sports injuries”[MeSH] OR “overuse”[tiab]) AND (“differential diagnosis”[MeSH] OR “clinical features”[tiab] OR “diagnostic criteria”[tiab])

Additionally, a manual search was conducted on the bibliographic references of the selected articles and on the websites of relevant scientific societies (POSNA, Sociedade Brasileira de Pediatria).

Inclusion and exclusion criteria

Inclusion: Studies published in the past 10 years in English, Spanish, or Portuguese that meet the following criteria will be included:

Population: Children aged 2 to 14 years who were previously healthy.

Clinical condition: studies evaluating

growing pains and/or musculoskeletal pain associated with physical activity or overuse, without a recent history of trauma.

Clinical information: Studies describing clinical, epidemiological, or semiological characteristics that allow for the differentiation of both conditions.

Study types: observational studies (cohorts, case–control studies, case series ≥10 patients), clinical trials, systematic reviews, and clinical guidelines with clear methodology.

Exclusion criteria:

Studies without direct clinical comparisons between growing pains and traumatic/sports-related pain.

Case reports with fewer than 10 patients.

Narrative reviews without explicit methodology.

Studies with patients older than 14 years.

Patients with predisposing conditions that cause pain (rheumatological, infectious, metabolic, neoplastic, or neuromuscular).

Patients without adequate clinical follow-up, where the progression of the condition cannot be distinguished.

Study Selection

The selection process was conducted in two stages:

Review of titles and abstracts: Potentially relevant studies were identified and evaluated.

Full-text evaluation: Studies that passed the first phase were analyzed.

To minimize bias, a standardized evaluation form was used, and the number of studies identified, evaluated, and included was documented following the PRISMA 2020 flowchart. The reasons for exclusion at each stage were recorded in detail.

Assessment of methodological quality

The quality of the included observational studies was assessed using the Newcastle–Ottawa Scale (NOS), which consists of three domains: sample selection (4 points), comparability of groups (2 points), and outcome determination (3 points). Studies with 7 points or more were considered high quality, whereas those with 5 points or fewer were analyzed with caution in the final synthesis.

Synthesis of the evidence

Owing to the methodological and clinical heterogeneity of the identified studies, a structured qualitative synthesis was conducted organized around three main axes:

Distinct temporal patterns: comparison between the nocturnal pattern of growth pain and the pattern related to physical activity in traumatic/sports-related pain.

Differential topographical characteristics: bilateral versus specific focal localization.

Predictive physical findings: the absence of inflammation and objective signs as diagnostic differentiators.

Ethical considerations

This study did not require ethics committee approval, as it is based exclusively on previously published secondary scientific literature, without the collection of original patient data or clinical interventions. The intellectual property of all the sources consulted was respected through citations and references in the Vancouver format.

RESULTS

Study selection

The initial search identified 84 records. After 18 duplicates were removed, 66 titles and abstracts were reviewed. Twenty-four full-text articles were evaluated; 12 were excluded because they failed to present a direct clinical comparison between growing pains and traumatic/sports-related pain. Finally, 12 studies were included in the qualitative synthesis (Figure 1).

General Characteristics of the Studies

The 12 studies included a pediatric population aged 2 to 14 years, with sample sizes ranging from 70 to 450 participants. Eight studies were observational, two were systematic reviews, and two were clinical guidelines (Table 1).

Table 1. General characteristics of the included studies.

Author (year)	Study type	Sample (age)	Differential clinical findings
Uziel & Hashkes (2007)	Cohort	120 children (4–12)	Bilateral nocturnal pain; no physical findings
Hashkes et al. (2004)	Cohort	90 children (4–12)	Lowered pain threshold; normal examination
Uziel et al. (2010)	Longitudinal cohort	88 children (5–13)	Benign course; spontaneous remission
Evans & Scutter (2004)	Observational	70 children (3–11)	Not related to physical activity
Khuntidar et al. (2024)	Observational	450 children (4–12)	Higher prevalence in children under 10; brief episodes
Kwok et al. (2021)	Review	—	Importance of ruling out red flags
Thomson et al. (2023)	Case–control	60 children (ages 5–14)	No persistent limping; no morning pain
Zapata et al. (2020)	Observational	75 children (4–13)	Red flags: fever, weight loss, focal pain
WJO (2019)	Systematic review	—	Lack of standardized criteria
POSNA (2024)	Clinical guidelines	—	Clinical diagnosis; bilateral involvement
SBP (2024)	Clinical Guidelines	—	Do not order tests in the absence of warning signs
AAP (2022)	Clinical guideline	—	Imaging only if there are abnormal findings

Source: Author’s own compilation based on the included studies.

Table 2. Methodological evaluation of observational studies according to the NOS.

Study	Design	NOS score
Uziel & Hashkes (2007)	Cohort	7/9
Hashkes et al. (2004)	Cohort	7/9
Uziel et al. (2010)	Longitudinal cohort	8/9
Evans & Scutter (2004)	Observational	6/9
Khuntidar et al. (2024)	Observational	7/9
Thomson et al. (2023)	Case–control	6/9
Zapata et al. (2020)	Observational	7/9

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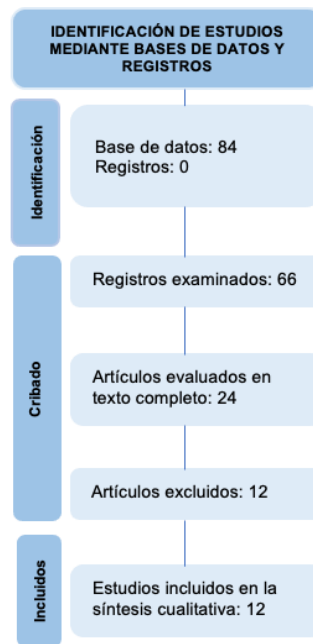


Figure 1. PRISMA 2020 diagram of the study selection process.

Prepared by the authors on Page et al., BMJ 2021.

Main findings

The clinical findings were as follows:

Growth pain occurs mainly at night and bilaterally, without abnormal physical findings.

Traumatic/sports-related pain is associated with physical activity, is unilateral, and presents with tenderness on palpation.

The absence of inflammatory signs and normal physical examination findings were consistent across the included studies.

As shown in Figure 2, growth pain was distributed bilaterally and diffusely in the lower limbs, whereas traumatic/sports-related pain showed a unilateral and focal pattern.

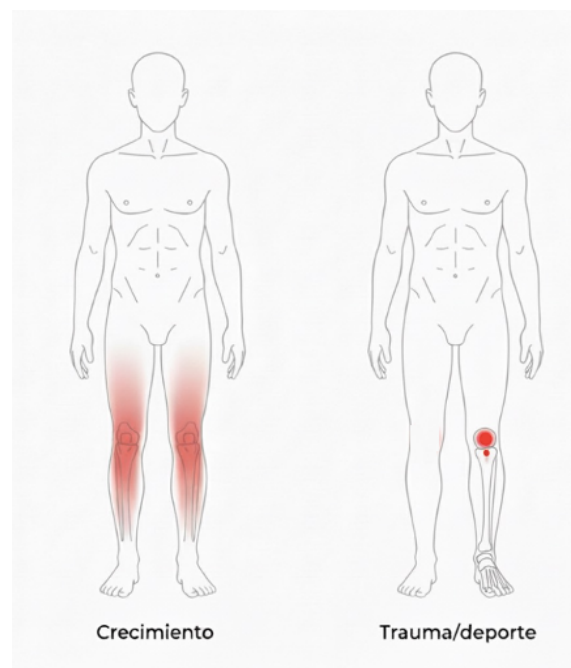


Figure 2. Typical areas of growth pain and traumatic/sports-related pain.

Table 3. Clinical distinguishing features of growth pain and traumatic/sports-related pain.

Clinical variable	Growth pain	Traumatic/sports-related pain	Level of evidence*	References
Typical age	4–12 years	Any age depending on sport/injury	+	Evans & Scutter 2004; Khuntidar 2024
Onset of pain	Gradual, without an obvious event	Following trauma or overuse	+++	Kwok 2021; Thomson 2023
Time of pain	Predominantly at night; may wake the patient	During or after physical activity	+++	Uziel & Hashkes 2007
Duration of episode	Minutes to 1–2 hours	Variable; may be prolonged	++	POSNA 2024
Location	Lower extremities (calves/thighs)	Focal and specific depending on the injury	+++	Kwok 2021
Bilateral	Common (>80%)	Usually, unilateral	++	Hashkes 2004
Pain intensity	Moderate, intermittent	Variable, may be severe	++	Thomson 2023
Physical examination	Normal	Tenderness/specific findings	+++	Kwok 2021
Local inflammation	Absent	Possible swelling, redness, warmth	+++	Zapata 2020
Gait	Normal; no lameness	There may be persistent lameness	+++	Thomson 2023
Daily activity	Not limited	May limit exercise/sports	+++	Curr Opin Pediatr 2021
Triggers	Not related to exercise	Overuse, trauma, sports intensity	+++	POSNA 2024
Response to rest	Spontaneous improvement	Varies depending on the injury	+++	Uziel 2010
Response to massage/heat	Good response	Less predictable	+++	Evans 2004
Systemic symptoms	Absent	If present suspect serious injury or other pathology	++	Zapata 2020
Additional tests	Not indicated without red flags	Relevant based on clinical suspicion	+++	AAP 2022
Red flags	Persistent morning pain, fever, lameness, weight loss, severe focal pain	Signs of structural injury or infection	+++	Zapata 2020
Course	Benign, self-limiting	Depends on the injury/proper management	+++	Hashkes 2004
Prognosis	Complete remission with growth	Variable	+++	Uziel 2010
Association with hyperlaxity/overuse	Low or uncertain	High in athletes	++	Kwok 2021
Recommended management	Education, massage, stretching, clinical follow-up	Rehabilitation, sports modification, testing if necessary	+++	POSNA 2024

Level of evidence: +++ high — ++ moderate — + low (according to the methodological hierarchy of the included studies).
Source: Author's own work based on the studies included in the systematic review.

DISCUSSION

The results of this systematic review confirm that there is moderate but consistent evidence supporting growth pain as a clinical entity distinct from traumatic or sports-related musculoskeletal pain, based primarily on three diagnostic pillars: a nocturnal temporal pattern, bilateral involvement, and the absence of objective inflammatory findings. These findings are consistent with those of previous studies describing intermittent pain in the lower limbs, particularly in the calves and thighs, without daytime functional limitations, which constitute the most distinctive feature of growing pains (Uziel & Hashkes, 2007; Evans & Scutter, 2004). In contrast, pain associated with trauma or sports has a clear temporal relationship with physical activity, focal localization with tenderness on palpation—as in runner’s heel epiphysitis—and, in many cases, objective signs of inflammation or functional restriction, which point toward specific musculoskeletal injuries (Kwok et al., 2021; Thomson et al., 2023).

The methodological quality of the included observational studies was generally moderate to high (NOS scores between 6 and 8), which reinforces the reliability of the identified differential clinical findings (Table 2). However, significant diagnostic controversies persist. The absence of specific biomarkers and the marked heterogeneity in the criteria used hinder a universally accepted classification (World J Orthop, 2019). Furthermore, a proportion of children initially diagnosed with growing pains present clinical signs suggestive of another etiology, highlighting the importance of a systematic and detailed evaluation (Khuntidar et al., 2024). However, longitudinal studies have demonstrated that when the diagnosis is made using strict criteria—such as the absence of persistent morning pain and a normal physical examination—most patients exhibit spontaneous long-term remission (Uziel et al., 2010). This discrepancy indicates that the underdiagnosis of traumatic injuries occurs primarily when differential criteria are not rigorously applied, especially in the presence of predisposing factors such as joint hypermobility or biomechanical imbalances (Kwok et al., 2021).

From a clinical standpoint, properly differentiating these conditions is essential for decision-making in pediatrics. In cases consistent with growing pains, avoiding unnecessary diagnostic tests is recommended, as pursuing invasive or costly procedures for a benign condition can cause parental anxiety without improving the prognosis (SBP, 2024; AAP, 2022). On the other hand, timely recognition of warning signs such as persistent morning pain, limping, fever, or systemic symptoms allows early and appropriate referral to rule out serious pathologies such as osteomyelitis or neoplasms (Zapata et al., 2020). Likewise, while growing pains typically respond to conservative measures such as family education, massage, or night-time stretching, traumatic or sports-related pain often requires specific intervention, ideally with physical therapy assistance or modification of sports activity (POSNA, 2024).

To synthesize these differential criteria and facilitate their clinical application, a diagnostic evaluation algorithm was developed that integrates the key elements identified in this review—temporal pattern, bilateral involvement, localized tenderness, and the presence of warning signs—and guides the differentiation between growth pain and traumatic/sports-related pain (Figure 3).

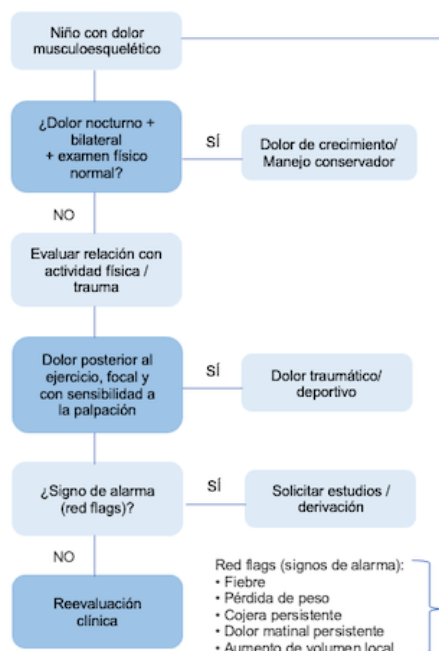


Figure 3. Clinical algorithm to differentiate growth pain from traumatic/sports-related pain. Author's own creation is based on the AAP, POSNA, and SBP guidelines.

With respect to the limitations of the analyzed evidence, significant methodological heterogeneity, a lack of robust comparative studies, and a reliance on subjective pain reports were identified—factors that weaken the strength of the conclusions (Hashkes et al., 2004; World J Orthop, 2019). Furthermore, the lack of standardized diagnostic criteria limits comparability between studies, increasing the variability in the reported results.

Despite these limitations, the findings of this review reinforce the need to establish clear clinical definitions for the diagnosis of growing pains, to strengthen the education of healthcare professionals in recognizing warning signs, and to validate diagnostic algorithms in higher-quality longitudinal studies. In particular, we highlight the importance of expanding research in the pediatric athlete population, where symptomatic overlap with pain due to trauma or overuse is more frequent.

CONCLUSIONS

This study revealed that growing pain is a valid clinical entity that can be distinguished from traumatic or sports-related musculoskeletal pain in the pediatric population, primarily because of its nocturnal temporal pattern, the bilateral nature of the pain, and the absence of inflammatory or objective signs on physical examination. The available evidence indicates that this condition is benign, self-limiting, and not associated with daytime functional impairments or underlying organic diseases; therefore, a correct diagnosis can prevent unnecessary diagnostic tests and reduce family anxiety.

However, the methodological heterogeneity of published studies highlights the need to establish evidence-based standardized diagnostic criteria and to strengthen the training of healthcare personnel in recognizing warning signs that point to potentially serious pathologies. Future research should validate diagnostic algorithms in prospective studies, especially in child athletes, where symptomatic overlap is more frequent. Rigorous clinical application of differential diagnostic criteria will optimize decision-making and ensure a safe, efficient, and patient-centered approach in pediatric care.

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