

## [ Primary Care ]

# Growing Pains: When to Be Concerned

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**Context:** The term *growing pains* describes a common, benign syndrome of recurrent discomfort that occurs in young children. First described in the 1800s, the etiology of this condition remains unclear. The peak incidence does not correspond to a time of rapid growth. Children typically report bilateral pain in the lower extremities that occurs late in the day or at night.

**Evidence Acquisition:** The PubMed database was searched using the keywords *growing pains*, *benign nocturnal limb pains of childhood*, *recurrent limb pain of childhood*, and *limb pain in childhood*. Articles were also found by reviewing references from the initial PubMed search. Only English-language articles published from 1900 through 2016 were included in the review.

**Study Design:** Clinical review.

**Level of Evidence:** Level 3.

**Results:** When a patient's history is classic for growing pains and physical examination is normal, laboratory and radiographic evaluation are not needed to make the diagnosis. Findings typical for growing pains include bilateral lower extremity pain usually experienced in the early evening or at night. The pain is not caused by activity and will not cause a limp.

**Conclusion:** Additional workup is warranted for children with an atypical history, systemic symptoms, or for those individuals with physical examination abnormalities such as allodynia, focal tenderness, joint swelling, or decreased joint range of motion. Management of growing pains generally consists of symptomatic care with massage and over-the-counter analgesics, as well as reassurance to children and parents about the benign, self-limited nature of this condition. This review article summarizes data on the epidemiology, etiology, and management of growing pains and provides a framework for distinguishing this entity from other causes of extremity pain.

**Keywords:** growing pains; musculoskeletal pain; pediatrics

The term *growing pains* refers to a common syndrome of recurring discomfort in children. The French physician Duchamp first described this syndrome in 1823.<sup>4</sup> His description of recurrent leg pains in children was included in his book, *Maladies de la Croissance*, or “diseases of growth.” Since there is no evidence to link growing pains with a phase of especially high growth velocity, physicians have coined new terms for this condition including “benign nocturnal limb pains of childhood” and “recurrent limb pain of childhood.” Growing pains are one of the most common causes of recurrent musculoskeletal pain in children. Parents often describe various musculoskeletal pain complaints in their growing children as “growing pains” even if the symptoms are caused by a different condition. As a result, clinicians are frequently called upon to

determine whether a patient's presentation is consistent with growing pains or with another entity.<sup>15</sup> This review aims to provide some guidance on differentiating growing pains from other causes of pain in children. A secondary goal includes providing general recommendations for laboratory and imaging workup when historical and examination elements indicate a need for further investigation.

The peak age of onset for growing pain is unclear. In a retrospective epidemiologic analysis of 532 Mediterranean children, investigators found that 130 patients aged 4 to 12 years had symptoms consistent with growing pains within the past year.<sup>13</sup> The mean age of children who had growing pains in their investigation was  $8.6 \pm 2.5$  years, with discomfort usually beginning between the ages of 3 and 6 years of age. The

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prevalence of growing pains was decreased as children became older in a study from the *Lancet* in 1928.<sup>24</sup> Specifically, during the routine examination of 1298 children, 44.4% of 8- to 10-year-olds, 39.8% of 10- to 12-year-olds, and 21.2% of children older than 12 years had growing pains. It should be noted that they did not study children younger than 8 years. No particular predominance based on sex has been found when comparing girls with boys.<sup>16,18</sup> A study from the *Journal of Pediatrics* found the prevalence of growing pains in 4- to 6-year-old patients to be 36.9% in a heterogeneous Australian population,<sup>7</sup> although a wide range of estimates of prevalence from 2.6% to 49.9% have been found. The discordant prevalence estimates seen in these studies highlight several of the difficulties related to studying this condition, including variable demographics between studies<sup>7,13</sup> and lack of a standard definition for growing pains.<sup>7,8,13,20</sup>

## PROPOSED PATHOPHYSIOLOGY

The cause of growing pains remains unclear, but there are many theories about the etiology.<sup>3,5</sup> The anatomic theory is that musculoskeletal variants such as generalized hypermobility, pes planovalgus, genu valgum, or scoliosis cause altered gait mechanics and subsequent pain.<sup>5,6</sup> Research has not supported this theory, and a recent study comparing children with and without growing pains did not find any significant differences in hindfoot position between groups.<sup>6</sup> The fatigue theory postulates that increased levels of physical activity lead to growing pains.<sup>16</sup> This is supported by the observation of many parents that growing pains are worse on days when children are especially active.<sup>13,14</sup> The proposed mechanism for pain can be separated into muscular or skeletal fatigue. Because many older patients describe pain as “crampy” in nature, muscle fatigue leading to subsequent muscle cramps is a potential contributing factor. No studies have assessed the muscular fatigue theory directly, and this postulate continues to be based on observations.<sup>1</sup> Friedland et al<sup>9</sup> found that 39 patients with growing pains had significantly lower tibial bone density than their age-matched peers on ultrasound, supporting the skeletal fatigue theory. They concluded that decreased bone density combined with activity could place these children at risk for an “overuse syndrome” and contribute to growing pains. The psychological theory asserts that psychological stress leads to somatic symptoms.<sup>16</sup> A study of 160 children from Australia examined parents’ and teachers’ perceptions of the temperament of children who experience growing pains. Parents of children with growing pains described their children as having a negative mood, being more intense, and having more behavior problems than their peers.<sup>17</sup> Teachers did not share the same observations as the parents but did describe the children who had growing pains as being more anxious. The authors noted that it is impossible to tell whether these changes in the temperament or behavior of children were secondary to growing pains.

Uziel et al<sup>21</sup> examined whether children with growing pains presenting to a rheumatology clinic demonstrated decreased

pain thresholds when compared with children without growing pains. Children with growing pains that persisted for more than 5 years had a decreased pain threshold compared with healthy controls and children with resolved or resolving growing pains.<sup>21</sup> Children with a prolonged course of growing pains were more likely to have family members with pain syndromes.<sup>21</sup> Over the 5 years that these children were studied, none developed a clinical diagnosis of fibromyalgia. However, the study size was small (44 patients) and likely did not have significant power to detect the development of fibromyalgia or other pain syndromes. Some children with growing pains also have a history of functional abdominal pain and nonmigraine headaches,<sup>18</sup> supporting the idea that an “emotional disturbance” is contributing to all 3 of these pain experiences and that they are related.

The observation that many children with growing pains experienced very sudden onset of pain led to the development of a more recent theory that postulates that a deficiency in skeletal vascular perfusion may cause growing pains.<sup>5</sup> However, a small study of 11 patients with growing pains and 12 healthy controls showed no differences in vascular perfusion as assessed by uptake on technetium-99 bone scans.<sup>11</sup> There also was no significant difference in uptake of the technetium-99 in the “painful areas” in comparison with the “nonpainful areas” in children with growing pains.

In a study of 120 Turkish children with growing pains age 4 to 12 years old, researchers hypothesized that hypovitaminosis D may be a contributing factor and that supplementation of vitamin D would decrease the intensity of discomfort experienced. Investigators found 61.6% of these children were vitamin D insufficient (25-hydroxyvitamin D level <20 ng/dL) and 25.0% were vitamin D deficient (25 hydroxyvitamin D level <10 ng/dL).<sup>22</sup> Each of these children received supplementation with vitamin D for 3 months, and there was a significant decrease in pain scores over that time period. The serum 25-hydroxyvitamin D levels also increased significantly over that period of time. A drawback of this study was that there was no control group used for either hypothesis tested, and further studies are warranted.

## HISTORY

The diagnosis of growing pains is based on clinical criteria. A detailed history, including a description of the patient’s pain frequency, quality, and timing is needed to support the diagnosis of growing pains. Typically, the pain is in the lower extremities, with the calves, anterior thighs, shins, and popliteal fossa most commonly affected.<sup>12</sup> There have been studies showing growing pains in the upper extremities as well, but this is seen much less frequently.<sup>11</sup> Between 80% and 90% of patients with growing pains describe bilateral discomfort.<sup>13,19</sup> The pain classically occurs in the early evening or during the night; many children are awakened by leg pain.<sup>13</sup> Most children will have pain-free days, and certain patients only experience pain symptoms on an episodic basis. A small study of 30 children showed that growing pains were present daily in 5% of

patients, weekly in 45%, monthly in 35%, and only once every 3 months in 15%.<sup>19</sup> Older children often describe growing pains as severe and cramping; parents of younger children report that their children cry due to the intensity of the pain.<sup>13</sup> The episodes of pain tend to last minutes to hours. For many children, simple massage will resolve the pain. Analgesics such as acetaminophen and ibuprofen may provide relief.<sup>14</sup> Parents and children often note a connection between increased activity level and subsequent episodes of pain.<sup>8</sup> Pain that leads children to limit their sports participation or other daily activities is not consistent with growing pains.

Other important historical elements include a comprehensive review of systems. Systemic symptoms such as fatigue, malaise, or decreased appetite should prompt evaluation for other conditions. Providers should ask about a history of recurrent fevers, skin changes, recent travel, and antecedent infections. Specific symptoms of acute viral illness such as rhinorrhea, cough, sore throat, or fever with concurrent or subsequent extremity pain may point toward an infectious or postinfectious cause for the pain. However, many school-aged children experience multiple viral infections each year. Thus, a detailed history of the pain in relation to the child's other symptoms is important to obtain. As discussed, there also may be an association between growing pains, nonmigraine headaches, and functional abdominal pain.<sup>18</sup> A family history of a first-degree relative with growing pains may also be helpful. Up to 47% of children with growing pains have a first-degree relative with growing pains as well.<sup>11</sup> Other important conditions in the family include a history of inflammatory arthropathy, especially those that present at a young age such as juvenile idiopathic arthritis (JIA). Clinicians should also ask about family history of cancer. A family history of inflammatory bowel disease (IBD), such as Crohn disease or ulcerative colitis, would also be pertinent as this may signify a genetic tendency toward autoimmune disease, which may have associated arthritis. Along these same lines, children with IBD often experience weight loss, anorexia, and blood in the stool. Systemic symptoms do not support the diagnosis of growing pains; this difference underscores the importance of a complete review of symptoms in patients with recurrent pain episodes.

## PHYSICAL EXAMINATION

In patients with lower extremity pain, physical examination should include an evaluation of gait, the spine, range of motion of lower extremity joints, and palpation of the entire lower extremities. Clinical findings such as joint swelling, decreased range of motion, palpable masses, pain with range of motion, or any tenderness to palpation should prompt radiographic and/or laboratory evaluation. Ligamentous laxity is a common normal variant in young children but can be associated with joint hypermobility syndrome in children reporting activity-related joint pain. Allodynia may be an indication of a nerve injury or pain syndrome such as complex regional pain syndrome (CRPS). Evaluation of large and small joints for

effusions is important, as joint effusions can indicate inflammatory arthritis. Weakness on examination should raise suspicion for other conditions such as juvenile dermatomyositis. Assessing extremity reflexes and sensation is also important as spinal cord compression can present with lower extremity pain. Lower extremity alignment should be evaluated, since anatomic variants such as significant femoral anteversion may predispose children to lower extremity pain. Skin examination may suggest other diagnoses such as focal erythema, and increased temperature could indicate an infectious process such as cellulitis. Abnormal skin findings in children may be associated with rheumatologic disorders. Other important examination elements to assess include vital signs, general appearance, weight trends, pallor, lymphadenopathy, abdominal tenderness, or hepatosplenomegaly; these findings can indicate systemic illness. In contrast to the above, physical examination is generally normal in patients with growing pains.

## DIFFERENTIAL DIAGNOSIS

Growing pains is a diagnosis of exclusion. The differential diagnosis for growing pains or extremity pain in children is quite extensive; history and physical examination tend to be very helpful in directing additional investigation. When evaluating a child with recurrent pain episodes, clinicians must evaluate signs or symptoms of other conditions that may warrant workup or treatment (Table 1).

Certain pain characteristics may assist providers in differentiating growing pains from more serious conditions. For example, while unilateral pain is seen in up to 20% of cases, bilateral pain is more characteristic of growing pains.<sup>13</sup> Therefore, other diagnoses should be more strongly considered in patients who present with unilateral pain. Unilateral focal pain may be indicative of a localized condition such as osteomyelitis or osteoid osteoma. Pain that is persistent as opposed to intermittent or pain that is progressively increasing in severity is unusual for growing pains. The timing of the pain is also important. While children may wake at night with growing pains, the pain is typically self-limited and resolves by morning.<sup>5,7,14</sup> Conversely, pain that frequently occurs in the morning or with activities should prompt evaluation for inflammatory arthritis or trauma. Joint stiffness, swelling, or pain localized directly to a joint could also be suggestive of inflammatory arthritis or trauma. Pain localized to a joint may also be indicative of an anatomic abnormality such as a discoid meniscus with a meniscal tear. Although frequent episodes of growing pains can affect a patient's drive to engage in physical activities, they should not occur during activity.<sup>10</sup> Generalized hypermobility of joints is often associated with activity-related joint pain. Common overuse injuries in children such as Osgood-Schlatter disease or Sever apophysitis typically cause activity-related pain. Refusal to bear weight and changes in gait are not consistent with growing pains. Legg-Calvé-Perthes disease (LCP) is an example of a condition that causes gait alterations in young children. LCP is generally unilateral,

Table 1. Differential diagnosis for extremity pain

Category	Examples
Autoimmune/ inflammatory	Juvenile idiopathic arthritis (JIA) Postinfectious arthritis Juvenile dermatomyositis Transient synovitis/enthesitis (with possible relation to inflammatory bowel disease)
Infectious	Osteomyelitis Septic arthritis Viral or bacterial myositis Abscess
Vascular/hematologic	Legg-Calvé-Perthes Sickle cell disease with vaso-occlusive crisis hemophilia Deep vein thrombosis
Neoplastic	Osteoid osteoma Symptomatic osteochondroma Osteosarcoma Leukemia Metastatic lesions (eg, neuroblastoma) Ewing sarcoma
Traumatic/structural	Acute fracture Stress fracture Nonaccidental trauma Apophysitis Nerve injury Slipped capital femoral epiphysis Joint hypermobility syndrome
Metabolic	Rhabdomyolysis Inherited myopathies Vitamin D deficiency
Miscellaneous	Complex regional pain syndrome Fibromyalgia Restless leg syndrome

another factor that distinguishes this entity from growing pains.<sup>23</sup> Extremity pain with systemic symptoms such as fever, weight loss, night sweats, fatigue, or pallor should lead a clinician to investigate systemic conditions such as leukemia.

## EVALUATION

When the history is classic for growing pains and physical examination is normal, laboratory and radiographic evaluation are generally not necessary to make the diagnosis<sup>15</sup> (Table 2). In children with a somewhat atypical history or with abnormal

Table 2. Clinical findings most consistent with a diagnosis of growing pains

Characteristic	Typical Findings Consistent With Growing Pains
Pain location	<ul style="list-style-type: none"> <li>Usually unilateral</li> <li>Lower extremity pain in the calves, thighs, shins, or popliteal fossa</li> </ul>
Pain timing/onset	<ul style="list-style-type: none"> <li>In the evening or sometimes late afternoon; can wake from sleep</li> <li>Resolution of pain by morning</li> <li>Can have pain-free days/weeks</li> <li>Not related to activity</li> </ul>
Pain severity	<ul style="list-style-type: none"> <li>Improves with simple measures such as massage or over-the-counter analgesics</li> <li>Severity does not increase over time</li> </ul>
Physical examination	<ul style="list-style-type: none"> <li>No abnormal findings should be noted, no tenderness with palpation</li> </ul>

physical examination findings, radiographs of the extremities may be useful to evaluate structural, neoplastic, infectious, and traumatic causes of extremity pain (Table 3). Advanced imaging may be indicated for children with symptoms of focal conditions with normal radiographs. For example, changes to the femoral head secondary to avascular necrosis in LCP may not be seen on radiographs early in the course of the disease, necessitating further imaging such as a bone scan or magnetic resonance imaging. Other conditions may lead to abnormalities on plain radiographs that also require additional imaging for further definition. For example, a child with radiographic findings suggestive of osteomyelitis may require magnetic resonance imaging to support the diagnosis and determine the extent of bony and soft tissue involvement. Magnetic resonance imaging is also useful to evaluate suspected neoplasms. Computed tomography can provide confirmation of a suspected osteoid osteoma lesion. A technetium-99 bone scan may be indicated if there is a lesion that a young child is unable to localize or suspicion of diffuse bone disease such as chronic recurrent multifocal osteomyelitis or metastatic cancer to the extremities.

If there is a suspicion of systemic illness, laboratory evaluation should be initiated. An initial evaluation should include a complete blood count (CBC) with manual differential, C-reactive protein (CRP) analysis, and erythrocyte sedimentation rate (ESR). Anemia can be seen with JIA and leukemia. Thrombocytosis may indicate an inflammatory condition while thrombocytopenia is

Table 3. Examples of conditions that may require radiographs for diagnosis

Condition <sup>a</sup>	Typical Historical Findings	Possible Examination Findings
Legg-Calvé-Perthes	<ul style="list-style-type: none"> <li>• Pain at hip, anterior thigh, or knee</li> <li>• Limp of insidious onset</li> <li>• Unilateral in 80%-90%</li> </ul>	<ul style="list-style-type: none"> <li>• Limited internal rotation/abduction of hip</li> <li>• Atrophy of thighs/buttocks</li> <li>• Limp</li> </ul>
Slipped capital femoral epiphysis (SCFE)	<ul style="list-style-type: none"> <li>• Hip, groin, thigh, or knee pain</li> <li>• Pain with activity</li> <li>• Acute SCFE can present after episode of trauma</li> </ul>	<ul style="list-style-type: none"> <li>• Leg held in external rotation</li> <li>• Pain to palpation over anterior thigh</li> <li>• Limp</li> </ul>
Osteomyelitis	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Usually unilateral, localized pain</li> <li>• May result in refusal to use limb in younger child</li> </ul>	<ul style="list-style-type: none"> <li>• Focal tenderness</li> <li>• Overlying warmth or skin erythema in some cases</li> <li>• Limp or refusal to bear weight</li> </ul>
Osteosarcoma	<ul style="list-style-type: none"> <li>• Localized pain, usually chronic</li> <li>• Common locations include distal femur, proximal tibia, proximal humerus</li> <li>• Fever and other systemic symptoms usually absent</li> </ul>	<ul style="list-style-type: none"> <li>• Frequently will have a palpable soft tissue mass</li> <li>• Point tenderness</li> </ul>
Child abuse	<ul style="list-style-type: none"> <li>• Vague history, historical elements might change between examiners</li> <li>• History may not correlate with examination findings</li> </ul>	<ul style="list-style-type: none"> <li>• Unexplained bruising or bruising in unusual location (trunk, ear, or neck)</li> <li>• Patterned marks such as belt buckle loop</li> <li>• Point tenderness over fracture</li> </ul>
Stress fracture	<ul style="list-style-type: none"> <li>• Worse with activity</li> <li>• Usually older population</li> <li>• Caused by repetitive impact</li> </ul>	<ul style="list-style-type: none"> <li>• Point tenderness over area of fracture</li> <li>• Hopping will increase pain</li> <li>• Pain with application of tuning fork</li> </ul>

<sup>a</sup>Each of these conditions may require additional imaging if there are no findings on radiograph and clinical suspicion for particular disease remains high or to better characterize a lesion seen on radiograph.

more consistent with leukemia. Infection and autoimmune disease may cause an elevation in the white blood cell count. Inflammatory markers (ESR and CRP) are nonspecific but are usually elevated with infection and systemic inflammatory conditions. Many infectious or autoimmune conditions that cause limb pain will present with elevations in both the CRP and ESR. If an autoimmune condition is suspected, laboratory markers such as antinuclear antibody test (ANA), anti-double-stranded DNA test (anti-ds DNA), complement levels, and urinalysis (UA) should be obtained. For example, patients with systemic lupus erythematosus (SLE) classically have elevations in both the ANA and anti-ds DNA and should have low levels of Complement-3 (C3) and Complement-4 (C4). Urinalysis may show proteinuria or hematuria if the patient has developed glomerulonephritis secondary to SLE.

Infectious studies such as a viral polymerase chain reaction may be indicated if myalgias secondary to pathogens such as influenza are suspected. Elevations in muscle enzyme creatine kinase suggest destruction of muscle cells in conditions such as muscular dystrophies or viral myositis. High levels of lactate dehydrogenase or uric acid can be seen in the presence of high cell turnover, for example, with leukemia.

There are many other causes of extremity pain in addition to those described that may merit laboratory testing. Restless leg syndrome (RLS) may be confused with growing pains. Diagnostic criteria for RLS include the urge to move accompanied by an uncomfortable sensation in the legs that is worse at rest, improved by movement, and experienced most at night or in the evening. Many children who have been diagnosed with growing pains may also meet criteria for RLS.<sup>20</sup> It is important to differentiate these 2 conditions since iron and folate deficiencies have been associated with RLS, and as such, folate and iron studies may be useful for making the diagnosis and determining the need for dietary supplementation.<sup>20</sup> Additionally, consideration should be given for obtaining 25-hydroxyvitamin D level, as a preliminary study suggests an association with vitamin D deficiency and growing pains. However, further research is needed to clarify this relationship.<sup>22</sup>

## TREATMENT

While most cases of growing pains resolve by adolescence without therapy, recurrent pain associated with this condition is

often very concerning to children and their families.<sup>2</sup> Discussing the natural course of growing pains can be helpful in decreasing anxiety. The body of evidence for therapies directed at growing pains is not robust. There is 1 small randomized controlled study (36 patients total) possibly showing benefit to stretching the quadriceps, hamstrings, and calves.<sup>2</sup> For most children though, having the parents massage the areas of pain, sometimes with addition of heat, is enough to provide relief. Some patients have found over-the-counter analgesics such as ibuprofen or acetaminophen helpful. Long-lasting anti-inflammatory medications such as naproxen can minimize overnight pain when parents give the medication on days of increased activity; however, there is no data to support this recommendation. Foot orthotics are sometimes used to treat growing pains in children with hindfoot valgus despite a lack of supporting research.

## CONCLUSION

Growing pains are a common cause of pain in young children. While the phrase “growing pains” is often applied in a nondiscriminatory way to skeletally immature children and teens with extremity pains, this term describes a specific, benign pain syndrome in young children. While the underlying causes of growing pains are poorly understood, growing pains typically resolve and do not have any lasting sequelae. When the history and physical examination for a child with lower extremity pain fit the classic description of growing pains, explanation and reassurance from a health care provider are generally all that is needed. For children with an atypical history or with concerning physical examination findings, clinicians should pursue additional evaluation. Fortunately, serious causes of lower extremity pain are much less frequent than growing pains.



## Clinical Recommendations

### **SORT: Strength of Recommendation Taxonomy Grade**

**A:** consistent, good-quality patient-oriented evidence

**B:** inconsistent or limited-quality patient-oriented evidence

**C:** consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
A comprehensive history, review of systems, and physical examination is critical for formulating a differential diagnosis in a child with recurrent lower extremity pain.	<b>B</b>
Children with a classic history for growing pains and normal physical examination typically do not require laboratory or radiographic evaluation.	<b>C</b>
Children with a history atypical for growing pains may require screening laboratory tests and radiographs. A complete blood count (CBC) and inflammatory markers, such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), can be useful for detecting the presence of inflammation and/or infection.	<b>C</b>
Children with a history and physical examination findings suggestive of systemic illness often require additional laboratory evaluation and advanced imaging as growing pains is a diagnosis of exclusion. Referral to other specialists, for example, pediatric rheumatology, pediatric hematology/oncology, or pediatric infectious disease, may also be indicated depending on the clinical scenario.	<b>C</b>

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