

Decreased Pain Threshold in Children with Growing Pains

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ABSTRACT. Objective. To investigate whether children with recurrent musculoskeletal pain termed growing pains (GP) have lower pain thresholds than children without GP.

Methods. We measured the pain threshold of 44 children with GP and 46 controls. Pain thresholds were measured by use of a Fisher type dolorimeter with pressure applied to areas associated with increased tenderness in fibromyalgia (FM), control points, and anterior tibia, the usual region of pain in children with GP. Unpaired Student's t test and chi-square tests were used to compare the pain threshold and number of tender points in patients and controls.

Results. The pain threshold in characteristic tender points of FM, control points, and anterior tibia in the children with GP was significantly lower in children with GP (3.5 ± 0.6 kg/cm² in GP versus 4.0 ± 0.7 in controls, $p < 0.001$, 3.8 ± 0.7 versus 4.4 ± 0.8 , $p = 0.005$; 5.1 ± 1.1 versus 5.9 ± 1.5 , $p = 0.004$). Children with GP had a significantly greater number of tender points in response to an applied pressure of 4 kg/cm².

Conclusion. Children with GP have more tender points and lower pain thresholds than children without GP indicating that GP may represent a variant of a noninflammatory pain syndrome in younger children. (J Rheumatol 2004;31:610-3)

Key Indexing Terms:

CHILDREN PAIN DOLORIMETER FIBROMYALGIA GROWING PAINS

The most common cause of recurrent childhood musculoskeletal pain is termed growing pains (GP)¹⁻¹¹. The diagnosis of GP is based on typical clinical characteristics. The pain is usually non-articular, mostly in the lower extremities, and usually bilateral. The pain appears late in the day or is nocturnal, often waking the child. Parents often report pain on days of increased physical activity. The duration ranges from minutes to hours, and the intensity can be mild or very severe. There are no objective signs of inflammation on physical examination. GP is episodic, with pain-free intervals from days to months. In severe cases the pain can occur daily. GP mainly affects children between the ages of 3-12 years.

GP is not associated with serious organic disease, and usually resolves by late childhood. However, frequent episodes may have a major impact on the child and his

family's daily routine, including absences from school and work, daytime fatigue, reduced physical activity, and chronic use of pain relief medications.

Several studies have found a greater prevalence of pain syndromes in families of children with GP^{1,2}. These noninflammatory pain syndromes can involve various organs in diverse clinical patterns. It is possible that GP represents the pattern of noninflammatory pain syndromes in early childhood. Noninflammatory pain syndromes, especially fibromyalgia (FM), are associated with a lower pain threshold and with more characteristic tender points when measured by dolorimeter as compared to persons without pain syndromes^{12,13}. Since GP is also a pain syndrome, we hypothesized that children with GP have lower pain thresholds and more tender points than control subjects without GP.

MATERIALS AND METHODS

Patients. Forty-four children aged 4-12 years old with GP were included in the study. Patients were recruited from pediatric rheumatology clinics and participating child community health centers. The initial diagnosis of GP was confirmed by a pediatric rheumatologist based on the typical clinical characteristics outlined in the introduction and after exclusion of other causes for the pain. The control group included 46 children with similar age and gender, but not individually matched. They were recruited from primary clinics or were the children of medical personnel. Informed consent was obtained from the children's parents. The study was approved by the hospital's Helsinki committee.

Clinical data, including age, gender, ethnicity, weight, height, prior health, and family history of pain syndromes (migraine headaches, irritable bowel syndrome, FM, GP, etc.) were collected. The clinical characteristics

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of GP, including duration, frequency of attacks, location of pain, and the use of various analgesic therapeutic measures, were recorded.

Actual pain thresholds were assessed in predefined body area points using Fisher type dolorimeter (PDT Inc., NY, USA, model PTH pressure threshold meter 10 kg range, 1/10 kg). The pressure was increased gradually in increments of 1 kg/second until patients reported feeling pain. The same experienced physician (YU), who was aware of the clinical status of the part of the subjects, performed all measurements. We measured the pain threshold in the 18 predefined points of FM, 3 control points (distal right arm, forehead, and left thumb). We also examined the mid-anterior tibia below the tibial tuberosity in both legs, where patients usually report pain during attacks and the lower back for possible referred pain. Overall 25 points were measured.

Unpaired Student's t test and chi-square were used to compare data of patients and controls, as appropriate. Pearson correlations were performed to evaluate the relationship between pain thresholds and clinical characteristics of GP. To determine whether the measurements of pain thresholds within an individual patient are independent from one another, we performed a hierarchical statistics model to account for variation between pain thresholds within individual subjects and between patients.

RESULTS

The study group included 44 patients with GP, 27 boys (mean age 8.3 ± 2.5 years) and 17 girls (mean age 8.1 ± 2.4 , Table 1). The control group included 46 healthy children, 28 boys (mean age 8.5 ± 1.4), and 18 girls (mean age 8.7 ± 1.8). There were no significant demographic differences between the groups. Fifty-two percent of the children with GP reported use of medication for relief of pain, and 20% had symptoms of pain in other systems including headaches, irritable bowel syndrome, anxiety, lethargy, and disturbed sleep (Table 1). A family history of GP, FM, and headaches (presenting other pain disorders) was reported in 17 (39%), 1 (2%), and 18 (41%) patients, respectively. In the control group 5 children had a family member with GP and 3 had a family member with headaches. Dolorimeter thresholds (kg/cm^2) of the 18 tender point sites of FM, 3 control points, and mid-anterior tibia region were significantly lower in children with GP compared to children without GP (Table 2, Figure 1). However, the pain threshold of the lower back pressure point was not significantly lower in children with GP ($p = 0.14$). The pain threshold in control points was higher than points associated with tenderness in FM in both patients with GP and control subjects. The pain threshold in the anterior tibia, the painful region in most patients with GP, was significantly higher than all other measured points ($p < 0.001$). The tenderness in the medial knee fat pad was significantly greater than the epichondyle point, in both patients and controls (3.51 vs 4.27 , $p < 0.001$; 3.71 vs 5.02 , $p < 0.001$, respectively).

Pain thresholds were slightly lower in girls. However, these differences were not significant at all study points in both children with and without GP. There were also no significant differences in the pain threshold between various ethnic groups. No significant correlations were found between pain thresholds and clinical characteristics of GP, including length of disease, frequency of pain attacks,

Table 1. Clinical characteristics of patients with growing pains (GP) (n = 44).

Gender (%)	
Male	27 (61)
Female	17 (39)
Age, yrs, mean \pm SD	
Male	8.3 ± 2.5
Female	8.1 ± 2.4
Ethnicity (%)	
Ashkenazi Jew	7 (16)
Sephardic Jew	17 (39)
Arab Moslem	12 (27)
Druze	2 (5)
Mixed	6 (14)
Locality of pain (%)	
Legs	39 (89)
Hands	2 (4)
Both	3 (7)
Duration of GP (%)	
< 6 mo	3 (7)
6–12 mo	4 (9)
1–3 yrs	20 (45)
> 3 yrs	16 (36)
Unknown	1 (2)
*Frequency of attacks (%)	
> 1/wk	19 (43)
< 1/wk, > 1/mo	8 (18)
> 1/mo	17 (39)
Use of medication (%)	
No	21 (48)
Yes	23 (52)
School days missed due to GP in last year (%)	
< 5 days	24 (56)
> 5 days, < 10 days	15 (35)
> 10 days	5 (9)
Other symptoms (%)	
Headaches	5 (12)
Irritable bowel	4 (10)
Fatigue	2 (5)
Poor sleep	2 (5)
Parasthesias	2 (5)
Anxiety, depression	4 (10)

* > 1/wk: more than once a week; < 1/wk, > 1/mo: at least once per month but not weekly; > 1/mo: less than once a month.

school absence due to GP, medication use, and the presence of other symptoms. There was also no correlation of pain threshold with age in both groups at all study points (Figure 1).

Sixty-six percent of the children with GP had pain thresholds below $4 \text{ kg}/\text{cm}^2$ in all of the study points as opposed to 33% among controls ($p < 0.001$, Figure 2). The pain threshold was below $5 \text{ kg}/\text{cm}^2$ in 98% of children with GP as opposed to 80% among controls ($p < 0.001$). In the 18 points associated with tenderness in FM, 86% of the children had pain thresholds below $4 \text{ kg}/\text{cm}^2$ as opposed to 47% among controls (Figure 2). In the 3 control points, 61% of the children with GP had pain thresholds below $4 \text{ kg}/\text{cm}^2$ as opposed to 42% among controls. In the anterior tibia, 48% of children with GP had a pain threshold below $5 \text{ kg}/\text{cm}^2$, compared to 36% of controls. Eighty-four percent of chil-

Table 2. Comparison of pain thresholds between children with GP and controls. Fibromyalgia points refer to 18 tender points characteristically tender in this condition. Control points refer to left thumb, mid-forehead, distal right radius. Anterior tibia refers to mid anterior tibia below the tibial tuberosity.

	GP Group (n = 44)	Control Group (n = 46)	Significance
Fibromyalgia points, mean \pm SD (kg/cm ²)	3.5 \pm 0.6	4.0 \pm 0.7	p < 0.001
Control points, mean \pm SD (kg/cm ²)	3.8 \pm 0.7	4.4 \pm 0.8	p = 0.005
Anterior tibia, mean \pm SD (kg/cm ²)	5.1 \pm 1.1	5.9 \pm 1.5	p = 0.004
Lower back, mean \pm SD (kg/cm ²)	3.9 \pm 0.9	4.2 \pm 0.8	p = 0.14

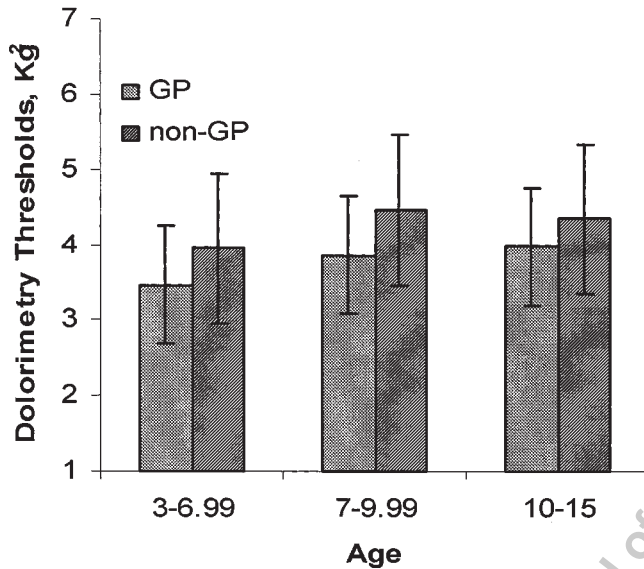


Figure 1. Pain thresholds (kg/cm²) of all study pressure points among children with growing pain (n = 44) and controls (n = 46) by age. Pain thresholds were significantly lower among all age groups.

dren with GP had a pain threshold below 6 kg/cm², compared to 58% of controls (p = 0.04). In a hierarchical model analysis of variance, both the within patient threshold variation and between patient variation were significantly different (p < 0.001), thus demonstrating that pain thresholds at various sites are independent of pain thresholds at other sites.

DISCUSSION

We found the pain threshold of children with GP to be lower than children without GP. These findings support the notion that GP represents a noninflammatory pain syndrome in young children. This is one of the first studies to try to understand the highly prevalent phenomena of GP. Increased pain perception may be a contributing factor in the pathogenesis of GP.

The pain threshold was lower at all tested points including points associated with tenderness in FM, control points, and the anterior tibia point that we added to this study due to the locality of pain in children with GP. It is

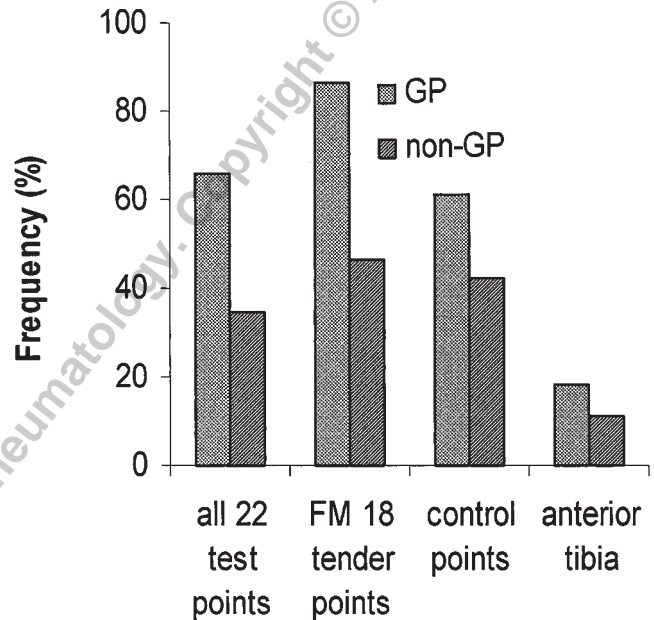


Figure 2. The proportion of children with pain thresholds below 4 kg/cm² at all study points, points associated with tenderness in fibromyalgia, control points, and anterior tibia. The proportion of children with tenderness at all points was significantly greater among those with GP.

interesting to note that the pain threshold at the anterior tibia was the highest in the body, including among children with GP. This is the region most commonly reported by children with GP as painful during attacks. This indicated that GP represents a generalized pain syndrome, not only a localized disorder. Indeed 20% of the children with GP reported having recurrent headaches or abdominal pain.

The natural history of GP is benign with disappearance of most attacks of pain by adolescence. However it is not clear whether these children develop symptoms of other noninflammatory pain syndromes, in the musculoskeletal or other systems. The prognosis of childhood FM has been reported to be good in most children, with a decrease in symptoms and increase in pain thresholds in response to local pressure^{14,15}. It would be interesting to progressively follow the pain thresholds of the children with GP examined in this study and to correlate the findings with their symptoms.

Despite the benign prognosis, GP may have a major

impact on the child and family, especially among children with frequent nocturnal attacks. Some children need to chronically use medications, especially acetaminophen and nonsteroidal antiinflammatory drugs (NSAID). In our study 52% of the children used medications to relieve their pain. Similar to FM, our findings of lower pain thresholds in children with GP may have therapeutic implications. Behavioral intervention to decrease pain sensitivity, as well as physical activity programs to increase fitness may decrease painful episodes. The physical activity of most children in this study was reported by their parents to be normal for age. We are not aware of any studies that have found an association between physical fitness and GP attacks.

Unlike other studies of pain syndromes, including FM in adolescents, we did not find differences in the pain threshold between boys and girls in both children with GP and control subjects¹². The age of children with GP is lower than reported studies of FM. It is possible that the gender differences in pain thresholds are apparent only after late childhood. Even in the control group many tender points were found.

Although FM is associated with hypermobility and the clinical impression of many physicians is that many children with GP are hypermobile, we did not assess hypermobility in this study, since many of the patients and control subjects were of ages in which criteria for hypermobility were not formally established^{16,17}.

In summary we found that children with GP have lower pain thresholds than control children. Therefore, GP may represent a type of noninflammatory pain syndrome in early childhood. Longterm outcome studies should be performed to investigate whether these children are prone to develop other noninflammatory pain syndromes later in adolescence or adulthood.

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