

Review article

Is there a subpopulation of children with growing pains who really have Restless Legs Syndrome? A review of the literature

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Abstract

Symptoms of Restless Legs Syndrome (RLS) can begin in childhood and persist into adulthood. To our knowledge, no one has done a systematic review of the literature to determine if the descriptions of ‘growing pains’ are consistent with the diagnosis of childhood RLS. Our group and that of Ekbohm have noted that childhood onset RLS can be misdiagnosed as ‘growing pains’. We therefore reviewed the work of seven groups of authors that addressed ‘growing pains’ as an isolated phenomenon in order to determine whether the descriptions of ‘growing pains’ were consistent with the clinical features of RLS. We found no consistent pattern in the descriptions even when articular pain was excluded. Thus, it is unlikely that all patients with ‘growing pains’ have RLS and it is likely that ‘growing pains’ is a heterogeneous disorder. The aforementioned authors were not looking for features unique to RLS and descriptions of the complete symptom complex of RLS are usually lacking. Further complicating the data are problems with methodology, e.g. in some studies small children and their parents were asked to retrospectively recall remote and infrequent events, and in other studies, articular pain was not adequately ruled out. Inconsistent with the hypothesis that RLS and ‘growing pains’ are the same are the high association of ‘growing pains’ with migraine headaches and abdominal pain. However, from this background emerge *subsets* of patients with ‘growing pains’ that are described as having one, some, or all of the following features consistent with the diagnosis of RLS: symptoms that are primarily in the legs, the patients rub their legs to get relief of the discomfort, the symptoms are worse at night, sleep disturbance is present and the discomfort is sometimes accompanied by motor restlessness. A non-painful form of ‘growing pains’ has even been described. Ekbohm and Brenning, a contemporary of Ekbohm, directly addressed the relationship between ‘growing pains’ and RLS. Ekbohm felt that ‘growing pains’ and RLS were probably different since ‘growing pains’ disappear after childhood and one of his patients described her childhood ‘growing pains’ as being different from the sensory discomfort of her adult onset RLS. However, Brenning showed that RLS-like features in adulthood and a previous history of ‘growing pains’ in childhood occurred far more frequently in the parents of children with ‘growing pains’ than in control parents. More work needs to be done on the potential relationship between ‘growing pains’ and RLS. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

In 1995 the International Restless Legs Syndrome Study Group (IRLSSG) defined the major and minor criteria for RLS. The four major criteria are: (a) a desire to move the legs most often associated with a definable leg discomfort such as creeping crawling, burning, tingling, cramping or painful – in most cases this discomfort is described as ‘deep inside the muscles’; (b) motor restlessness – patients move around or provide a counter stimulus to get rid of the leg discomfort by walking the floor, bending or stretching the legs or rubbing the legs; (c) the symptoms are worse at rest,

i.e. lying or sitting, with at least temporary relief by activity; (d) the symptoms are worse later in the day or at night [1]. Other associated features emphasized were sleep disturbance, a pattern of inheritance consistent with an autosomal dominant mode of inheritance in one-third to two-third of patients and the presence of repetitive involuntary leg movements during sleep (Periodic Limb Movements in Sleep or PLMS) in 80% of patients [1,2].

It is now recognized that RLS may begin in childhood in a substantial number of patients [2–7]. On occasions it can be severe and painful [2–7]. To our knowledge no one has reviewed the literature suggesting that there may be a relationship between childhood RLS and ‘growing pains’ which is largely a childhood disorder. This article first reviews the pertinent literature on ‘growing pains’ and second reviews

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the literature that has formally studied a possible relationship between RLS and ‘growing pains’.

2. The literature on ‘growing pains’

This section reviews the literature on ‘Growing Pains’. To our knowledge there have been only eight groups that have conducted extensive epidemiologic studies of ‘growing pains’ and associated conditions. The earliest reference to ‘growing pains’ in the literature is attributed to Duchamp who made the observation that a large number of children during puberty suffer from various muscular aches and pains. He concluded that growth is responsible and coined the term ‘growing pains’ [8]. Most of the reports in the literature for the next 100 years were of an anecdotal nature.

Williams surveyed 1298 children in 1926 and 1927 and found that the prevalence of growing pains was maximal in children aged 8–10 years at 49.4% [9]. However, the criteria for or frequency of the ‘growing pains’ was not stated. It was not stated whether the pains were articular or non-articular nor was the location of the pains described. The study relied strictly upon a retrospective recollection of the children as to whether growing pains were present or not. As justification for her methodology Williams interviewed the subjects for two successive years and found that those who had previously answered in the affirmative continued to do so and vice versa. In each case the subjects were not privy to their previous answers.

In 1933 Seham and Hilbert administered a questionnaire to 208 children and found that growing pains reached a maximum of 15% at the age of 12 years [10]. A significant relationship was found between ‘growing pains’ and inadequate sleep when comparisons were made to a control group. Of all the children who had adequate sleep, only 15% suffered from ‘growing pains’, whereas 34% of those having inadequate sleep had ‘growing pains’. There was also a relationship to fatigue. Among the children who complained of subjective fatigue 24% also complained of ‘growing pains’ whereas only 6% of those in whom fatigue was absent complained of ‘growing pains’. Seham and Hilbert stated earlier in their paper that ‘growing pains’ are commonly defined as ‘vague, recurrent, afebrile muscular pains’. Although this would seem to exclude articular pain, the authors did not specifically state the ten questions they retrospectively administered regarding ‘growing pains’ to the 208 children. For validation purposes, the questionnaire was administered to each child twice. However, statistics were not provided as to the degree of correlation between the two administrations.

In 1938 Hawksley summarized the results of several previously unpublished studies [11]. Using a very loose definition of ‘growing pains’, 33.6% of 505 children between the ages of 4 and 14 years seen in London at the University College Hospital in 1928 either were suffering from or had suffered from at least a single episode of ‘grow-

ing pains’. A series of 206 children studied by Hawksley during 1930–1931 revealed a somewhat higher percentage [11]. The series of children investigated in 1928 revealed that a history of damp housing was twice as common in the ‘growing pain’ group as in the control group. In 98 out of 115 cases seen in 1934 by Hawksley the pain was predominantly muscular but tenderness was uncommon [11]. However, in the group studied, pain around the joints or in the joints was allowed suggesting that arthritis was not adequately excluded. Nonetheless, Hawksley later clarified that on closer examination the pain was usually found to be near, rather than in the joint as would be true of arthritis [13]. The fronts of the thighs and calves and also the backs of the knees and instep were most frequently affected. The growing pains were said to make the sufferers unsociable, cross, and irritable. Hawksley stated that sleep disturbance was common in his study population, but no percentages were given. In a series published by Hawksley in 1931 dark and brown-eyed children with dark hair were thought to be much more likely to develop ‘growing pains’ than blue-eyed children with blonde or light-colored hair [12]. Hawksley reported in a 4-year follow-up article in 1939 that none of 64 of the 115 ‘growing pain’ children seen in 1934 had developed carditis [13]. Hawksley concluded that there was no relationship between rheumatic fever and ‘growing pains’. Hawksley noted a number of other associations with ‘growing pains’ including minor orthopedic and postural abnormalities, upper respiratory tract infections, vague ill health, psychological maladjustment, sleep disturbance and fatigue, and vasomotor instability [11–13]. As opposed to later authors, Hawksley did not attempt to identify whether these associations were more likely to occur in children with ‘growing pains’ primarily in the legs or in those who had symptoms primarily at night. No criteria were given by Hawksley for the frequency of ‘growing pains’ required for entry into the studies making it likely that small children would be subject to recall bias for remote and infrequent events [11–13].

In 1951 Naish and Apley investigated 721 children for the presence or absence of ‘growing pains’ and applied more rigid criteria for entry into the study in an attempt to eliminate the problem of more remote recall bias and to try to separate articular from non-articular pain. They insisted that pains be of at least 3-months duration, not specifically located in the joints, and of sufficient severity to cause some interruption of normal activities. Both the children and their mothers were interviewed and the prevalence of ‘growing pains’ was 4% [14]. For further analysis the data from those with ‘growing pains’ who completed the survey were combined with the data from patients with known ‘growing pains’ recruited from a clinic. In two-thirds of the cases the pains occurred only in the lower limbs and in no single case were they confined to the arms alone. In 27% of those with ‘growing pains’ the pains were predominantly nocturnal and those pains occurring only at night were almost exclusively confined to the lower limbs. The

pains in the nocturnal group were described as occurring in the shins, calves, and thighs and rubbing the legs provided some temporary comfort, but no permanent relief. The other common association in the nocturnal group was a history of 'growing pains' in other members of the family. There was no association of 'growing pains' with respiratory infection, complexion, color or with limb circulation. 'Growing pains' seemed to be brought on by exertion primarily in patients with diurnal pains (26% in those with nocturnal pains and 73% in those with diurnal pains). There was an associated family history of 'acute rheumatism' or 'fibrositis' in four of 19 (21%) of patients with nocturnal limb pain as opposed to 21 of 45 (46.7%) of patients with diurnal limb pain. In a later study of 168 children with 'growing pains' the pain was found to not involve the joints on closer questioning. In only one of these children was an orthopedic/rheumatologic abnormality found (Osgood-Schlatter disease). With only one exception was there any relationship of 'growing pains' to cardiac involvement from rheumatic fever in these 168 children [15]. In the original study only two of 19 patients with nocturnal limb pain had postural abnormalities as opposed to 23 of 45 patients with diurnal limb pains (10.5 versus 51.1%). Emotional instability was much less frequently present in those with nocturnal limb pain as opposed to those with diurnal limb pain (21.05 versus 42.2%) [14]. Although Apley later suggested that there might be a relationship between 'growing pains', headaches, and abdominal pain, no information was given as to the percentage of children with two or more of these conditions as opposed to the number with only one of these conditions [16].

In 1972 Oster and Nielsen reported their study of 2178 school children aged 6–19 years in whom the prevalence of 'growing pains' was put at 15.47% [17]. Exclusion criteria were arthritis and other definable causes of limb pain. Eighty-seven percent of the children with 'growing pains' in this study had the pain predominantly in the legs with localization of the pain in the musculature or in the deep structures of the thighs, behind the knees, and in the calves. About 40% of those who could state an opinion said that the pain occurred late in the afternoons, in the evenings, or both. In 12% the pain was frequent and in 22.3% of the children who could express a definite opinion the pain was described as severe [17]. Either headache or abdominal pain occurred in approximately 39.2% of children with 'growing pains'. There was no difference between 'growing pain' children and control children in weight, height, or weight/height ratio. Thus Oster and Nielsen dispelled the notion that growth played a role in the development of 'growing pains'. Unfortunately these studies did not correlate those patients with leg discomfort with those whose symptoms were worse later in the day or night, so one cannot draw any definite conclusions about the possible relationship between 'growing pains' and childhood RLS from this study.

In 1996 Abu-Arafah and Russell used a mail question-

naire to interview 2165 school children aged 5–15 years in Aberdeen, Scotland. The questionnaire was filled out with the assistance of the child's parents. Of these children 2.6% met the criteria for 'growing pains' defined as limb pain that recurred at least twice in the last year [18]. Each episode of recurrent limb pain had to last no more than 72 h, the pain had to be severe enough to interfere with regular activities, there had to be complete remission of symptoms between attacks, and the pain had to be due to no other definable cause. Fifty-three of the children who met the criteria for recurrent 'growing pains' by the questionnaire were invited for a personal interview and examination. Of these 53 children there were 45 who continued to meet criteria for 'growing pains' after examination. In all of the 45 children with 'growing pains' the discomfort was exclusive to the lower extremities. The pain was centered on the major joints in 38% of the children, at the back of one or both lower legs in 36%, in the whole of one or both legs in 11%, and one or both thighs in 11%. The quality of the pain was described as 'just sore' or dull by 56% of the children, cramps by 24% of the children, stabbing or sharp by 11%, tight by 7%, and throbbing by 2%. Pain was severe enough to inhibit all or most normal daily activities in 33%, but permitted some activity in the remaining 67%. Episodes of limb pain occurred on an average of 12 times per year (range 2–50) and each episode lasted an average of 10 h. In 29% of the children the onset of limb pain was consistently after 5 PM. Twenty-four percent found relief by analgesics, and 20% found that the symptoms were improved after sleep. One-third of the children with 'growing pains' obtained some relief by applying a hot water bottle or rubbing the legs. Fifty-three percent of these children also had other types of recurrent pain including headache and abdominal pain. Although arthritis was supposedly eliminated by personal examination, there is some concern that pain was concentrated over the joint spaces in 38% of the children, a pattern not usually seen in RLS.

In 1997 Oberklaid and coworkers [19] received 1605 responses from a broader questionnaire where one question was directed towards the presence of absence of 'growing pains'. The parents were asked whether their children had experienced any pains in the arms, legs, or joints in the previous 12 months. One hundred eighty-three questionnaires (11.3%) were returned with affirmative answers. These 183 subjects were then sent an additional questionnaire. There were 160 responses returned. The responses from these questionnaires were then compared against those of a control group drawn from those who had responded negatively to the original questionnaire. The pain occurred only at night in 39%, both day and night in 53%, and only during the day in 8% of the children. The pain was usually in the lower limbs, and in decreasing order of frequency was described as being in the calf, knee, thigh, ankle, foot, arm, groin, and hand. The pain was sometimes unilateral (13%), but usually bilateral (82%). The majority of the children (85%) described the pain as an ache, with

smaller numbers describing it as throbbing (19%), dull (16%), sharp (14%), burning (5%), or tingling (3%). More than half of the children with 'growing pains' (83 of 160) also complained of restlessness. In 25% of the children with 'growing pains' the pain awakened them from sleep. There was a family history of similar pains in 66% of the children with 'growing pains' and a family history of 'arthritis' was present in 51%. On the Child Health Questionnaire the parents of 'growing pain' children were twice as likely to rate their children as having headaches and abdominal pain than the parents of control children. On the Child Behavior Questionnaire children with 'growing pains' were more likely to be described by their parents as having more overall behavior problems ($P < 0.01$), and also to be more aggressive ($P < 0.05$), more anxious ($P < 0.05$), and more hyperactive ($P < 0.05$). In addition, the children with 'growing pains' were more likely than those in the control group to be reported by their parents as 'tends to be on his own, rather solitary' ($P < 0.05$), 'Irritable, quick to fly of handle' ($P < 0.01$), and 'often miserable, unhappy, tearful, distressed' ($P < 0.05$). However, teachers noticed differences only on the Anxious/Fearful subscales ($P < 0.05$). Twenty-five percent of the children with 'growing pains' were awakened from sleep by their leg discomfort. Oberklaid did not attempt to separate the patients into those who had primarily leg and night pain when these associations were determined. Although this study had a control group, it is not clear that patients had a physical examination in this study and thus articular pain may not have been properly ruled out.

3. Studies on the relationship between 'Growing Pains' and Restless Legs/Periodic Limb Movements in Sleep

To our knowledge, here are only three studies in the literature directly looking at a possible relationship between 'growing pains' and RLS [3,20,21].

In 1975 Ekbom reported a single case of a patient who had 'Growing Pains' persisting into adulthood and subsequent RLS. The character of the discomfort of the childhood 'growing pains' was different from the subsequent character of the RLS discomfort [20]. This and the fact that 'growing pains' disappeared after childhood in other family members led Ekbom to conclude that 'growing pains' and RLS were distinct entities. However, Ekbom did say that he had seen patients with childhood onset RLS who had been misdiagnosed as having growing pains [20].

A much more extensive study was done by Brenning, who was a contemporary of Ekbom [21]. He looked at the relationship of 'growing pains' to adult *Molimina Crurum Nocurna* (MCN) including 'Restless Legs'. MCN was described as a broader category including 'Restless Legs', but the definition of MCN has much in common with our modern definition of RLS. Brenning defined MCN as leg discomfort that is precipitated by 'sitting still, especially in

the evening, and/or nightly horizontal position'. Of 112 growing pain children studied with leg discomfort, only 12 had exclusively daytime symptoms. One hundred had 'leg troubles during the night and/or while sitting still in the evening'. Seventeen percent of cases had discomfort that was exclusively non-painful. Some growing pain children had creeping sensations reminiscent of RLS, and some had a sensation of cramps sometimes seen in RLS. 'Growing pains' had been experienced by one or both parents in 51% of 'growing pain' children as opposed to 12.5% of children without 'growing pains'. MCN symptoms experienced as an adult were present in one or both parents in 47% of 'growing pain' children as opposed to 19.7% of children without 'growing pains'. Furthermore, the prevalence of adult MCN was 39.7% in parents who had experienced 'growing pains' as a child as opposed to only 12% in parents who had not experienced 'growing pains' as a child. Leg discomfort was found in a full 45.4% of children who had parents with adult MCN as opposed to only 16.7% of children who had parents without adult MCM.

Our previous work has shown that in adult RLS patients with age of onset before 20 years, seven of 60 patients retrospectively remembered that their RLS symptoms were misdiagnosed as 'growing pains' [3]. This point was also previously made by Ekbom [20].

4. Discussion

Symptoms of RLS can begin in childhood and persist into adulthood [3,20]. To our knowledge, no one has done a systematic review of the literature to determine if the descriptions of 'growing pains' are consistent with the diagnosis of childhood RLS. We therefore reviewed the work of seven groups of authors that addressed 'growing pains' as an isolated phenomenon in order to determine whether the descriptions of 'growing pains' were consistent with the clinical features of RLS. We found no consistent pattern in the descriptions even when articular pain was excluded [9–19]. Thus, it is unlikely that all patients with 'growing pains' have RLS and it is likely that 'growing pains' is a heterogeneous disorder. It must be stated that the epidemiological studies of 'growing pains' [8–19] were not designed to compare the features of 'growing pains' with those of RLS and these studies were mostly completed before the modern definition of RLS was published [1]. Thus this literature, by and large, only allows us to compare singular features of RLS with those of 'growing pains' rather than the entire symptom complex. A notable exception is the work of Naish and Apley which indicates that those pains occurring only at night were almost exclusively confined to the lower limbs [14] and that of Brenning who found similar results [21]. Further complicating the data are problems with methodology, e.g. in some studies small children and their parents were asked to retrospectively recall remote and infrequent events, and in other studies, articular pain was

not adequately ruled out. These deficiencies have been pointed out in detail earlier [9–19]. Even the work of Brenning which directly compares the features of RLS with those of ‘growing pains’ suffers from the inclusion of MCN which is indicative of a broader category including RLS [21].

So, having rejected the idea that all of ‘growing pains’ are due to RLS, the question now becomes one of determining whether there is a *subset* of children with ‘growing pains’ who experience symptoms compatible with the diagnosis of RLS. There is some evidence that this might be the case.

4.1. Character of the leg discomfort

Overall the character of the sensations in ‘growing pains’ is similar to that seen in RLS with the pain felt ‘deep within the musculature’ and occurrence of painful but also non-painful sensory symptoms such as ‘just sore’, dull, stabbing or sharp, tight, burning, throbbing, creeping, tingling, and cramps [1,18,19,21]. In the study by Brenning 17% of the children with leg discomfort had no pain, but sensations of another type [21]. One obvious concern is that non-painful leg discomfort seems to be uncommon in ‘growing pains’ [19,21], but common in RLS [1–3,20,21]. However, this could represent selection bias as studies of ‘growing pains’ would tend to concentrate on painful more than non-painful sensations.

4.2. Evidence for affection in the legs, worsening at rest or night and sleep disturbance

RLS is characterized by leg discomfort that is more prominent in the legs and the discomfort is worse at night with resultant sleep disturbance [1–3,20]. When specific percentages are given, the studies from five groups of children with ‘growing pains’ indicate that discomfort that was worse in the legs was present in 66–100% of cases and that discomfort that was worse later in the day or night was present in 25–89% of cases with resultant sleep disturbance [14,17–19,21] (Table 1). In the study by Naish and Apley, in the 27% of ‘growing pain’ patients whose symptoms were nocturnal, the discomfort was almost exclusively confined to the lower limbs [14]. In the study by Brenning which did specifically compare ‘growing pains’ with RLS, leg discomfort was found in 112 children and in 100 of these cases the leg

discomfort occurred ‘during the night and/or while sitting still in the evening’ (89%) [21]. Seham and Hilbert calculated that of all children with adequate sleep 15% suffered from ‘growing pains’ whereas 34% of those with inadequate sleep had ‘growing pains’ [10]. In the study by Oberklaid and coworkers 25% of the children with ‘growing pains’ were awakened from sleep by their leg discomfort [19].

4.3. Relief of the discomfort

Patients with ‘growing pains’ typically rub their legs or obtain relief by analgesics as is true of RLS [1,14,18]. In the series by Oberklaid, more than 50% of the patients with ‘growing pains’ also had restlessness, a key feature of RLS [1,19]. On the other hand Brenning noted that the majority of children with ‘growing pains’ do not get up to pace the floor to get rid of their leg discomfort as is true of RLS [21].

4.4. Family relationships

The work of Brenning suggests that the prevalence of RLS is higher in parents of ‘growing pain’ children than in the parents of control children and that those same parents more frequently have had ‘growing pains’ themselves as a child [21]. If a subset of children with ‘growing pains’ truly have RLS rather than ‘growing pains’ then these familial associations may represent autosomal dominant RLS.

4.5. Misdiagnosis of RLS as ‘growing pains’

We have noted that some adult RLS patients with symptom onset in childhood were misdiagnosed as having ‘growing pains’ when they were children [3], a point also made by Ekblom [20]. From our previous study we feel fairly confident that our patients did not have ‘growing pains’ plus RLS since their leg discomfort was present on a fairly consistent basis between childhood and adulthood [3]. In this study most adults with RLS and a previous history of ‘growing pains’ as a child certainly recognized their ‘growing pains’ as the start of their RLS symptoms [3] in contrast to the single patient reported by Ekblom [20].

4.6. Psychiatric features

It is tempting to suggest that ‘growing pain’ patients are more likely to have Attention-Deficit-Hyperactivity Disorder (ADHD) since Oberklaid and coworkers found that patients with ‘growing pains’ are more likely to be hyperactive ($P < 0.05$) [19] and we have previously suggested that there may be a relationship between ADHD and RLS/PLMS (periodic limb movements in sleep) [4,5]. On the other hand, Naish and Apley found that emotional instability was much less frequently present in those with nocturnal limb pain as opposed to those with diurnal limb pain (21.05 versus 42.2%) [14].

Table 1
Percentage of total patients with ‘growing pains’ who have symptoms predominantly in the legs, who are worse later in the day or in the evening or both

	Legs (%)	Night (%)	Legs and night (%)
Naish and Apley, 1951 [14]	67	27	27
Brenning, 1960 [21]	89	89	89
Oster and Nielsen, 1972 [17]	87	25	–
Abu-Arafeh and Russell, 1996 [18]	100	29	29
Oberklaid et al., 1997 [19]	Usually	39	–

4.7. Abdominal pains and migraine headaches

There are associations between abdominal pain, migraine headache, and 'growing pains' [16–18]. Such relationships are yet to be explored in RLS.

4.8. Why do 'growing pains' stop?

It has been assumed that 'growing pains' stop after childhood and, if 'growing pains' represent childhood RLS, one has to wonder why the symptoms stop. However, in many children 'growing pains' are intermittent in nature as is often true of RLS when it first begins [3].

4.9. Improbable relationships

Inconsistent, largely disproven relationships or those more relevant to patients with 'diurnal' growing pains or 'growing pains' not associated with the legs include growth, rheumatic fever, dark hair and dark eyes, damp housing, respiratory infections, and postural deformities [11–19].

4.10. Future studies

A prospective study needs to be done to see how many children with 'growing pains' progress to have symptoms of RLS. Growing pain children should be examined to see how many meet the modern definition of RLS and polysomnographic studies should be completed to look for accompanying PLMS. The search for genetic markers imposes a very accurate description of the discomfort (or pain), the duration of the event, the associated local and general problems etc. This type of information is generally lacking in the studies reviewed in this article. Once the gene(s) for RLS are identified, genetic testing may be helpful to determine if a percentage of children with 'growing pains' have RLS.

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