Bone strength in children with growing pains: long-term follow-up

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Abstract

Objective

To examine the changes in bone strength in a cohort of children with "growing pains" (GP) after 5 years follow-up and the correlation with pain outcome.

Methods

Bone strength was measured by quantitative ultrasound. Subjects were 39 children with GP previously studied. Controls were normograms based on the measurement of bone speed of sound in 1085 healthy children. Current GP status was assessed by parental questionnaires. Bone strength was compared with pain outcome.

Results

We examined 30/39 (77%) patients after 5 years. Bone strength was significantly increased when compared to the first study (Z score 0.65±1.77 vs. -0.62±0.90, p<0.001). While overall there was no significant difference in the bone strength between the 16 (53%) patients whose GP resolved and the 14 (47%) who continued to have GP episodes (p=0.71), all 6 (20%) patients with a speed of sound Z-score <-1 continued to have GP (p=0.003).

Conclusion

Our findings that pain improves in most patients parallel to the increase in bone strength may support the hypothesis of GP representing in some patients a local overuse syndrome.

Key words

children, growing pains, bone strength

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Introduction

"Growing Pains" (GP) is the term used to describe the most common cause of recurrent childhood musculoskeletal pain with a prevalence between 3 and 37 percent of children mainly those between 3 to 12 years of age (1-2).

The prognosis of childhood GP is considered to be "good" but only few studies have prospectively examined this notion in well-defined cohort. In a recently published study of such a cohort we showed that GP resolved or decreased in intensity in most patients after 5 years of follow-up (3).

The etiology of GP is unknown. We proposed several hypotheses including that GP represent a non-inflammatory pain syndrome (3) and/or a local overuse syndrome (4).

To support the latter hypothesis we found that patients with GP had decreased bone strength measured by ultrasound speed of sound compared to normal values in age and sex of matched children (4).

Our aim in this study was to re-examine the bone strength in a group of previously examined GP subjects and to assess the correlation between the bone strength and pain symptoms.

Methods

Patients

Our original cohort included 39 children with GP recruited from paediatric rheumatology clinics and participating child community health centres (4). The initial diagnosis of GP was confirmed by a paediatric rheumatologist based on the typical clinical characteristics outlined by us in previous work and after other causes of the pain were excluded (5). We were able to locate and consent 30 (77%) of these children for this study. Four patients were lost to follow-up, 3 refused consent and 2 did not show up for evaluation. There were no significant demographic and clinical differences between the patients from the first study lost to follow-up and the patients included in the current study. The control was normograms based on the measurement of bone speed of sound in 1085 healthy children (6). Demographic data included age, gender and ethnicity. Patient/parents questionnaires contained data on the clinical characteristics of growing pains, including duration, frequency of attacks, location of pain, sleep quality (parental and self-report questions on the general quality of sleep), days of school missed, development of other pain syndromes, and the use of various analgesic measures (including complementary medicine).

Bone Strength

Bone speed of sound (SOS) quantitative ultrasound (QUS) was measured by Sunlight Omnisense™ (Omnisense-Tel Aviv) according to a validated protocol (7). The measurement site was the midpoint between the apex of the medial malleolus and the distal patellar apex. The probe searched for the site with maximal reading. The non-dominant extremity was measured unless a previous fracture was reported in that extremity. Means of three measurements performed by the same physician (GC) were analysed. Our measured coefficient of variance was 0.2–0.35, similar to the instrumental precision in the reference study for the tibia and fibula, 0.25–0.47. Results were compared to normograms based on SOS values of 595 female and 490 male healthy children who were born and lived throughout Israel (6). The mean SOS Z-score was the actual SOS – mean SOS for age / standard deviation.

Paired Student's *t*-test and Mann-Whitney Rank Sum Test was used to compare the z-score between the first and second studies. Spearman's rank correlation was used to correlate the bone SOS with the GP status of the patients. Chi-square was used to compare the status of GP of those with Z score <-1 with those ≥-1.

Results

The 30 patients we studied included 17 (57%) males and 13 (43%) females with a mean age of 13.6±2.8 years. Patients were examined 5.1±0.3 (median 5) years after the first study.

Bone strength

The SOS Z-score of the 30 examined children increased significantly when compared to the previous study

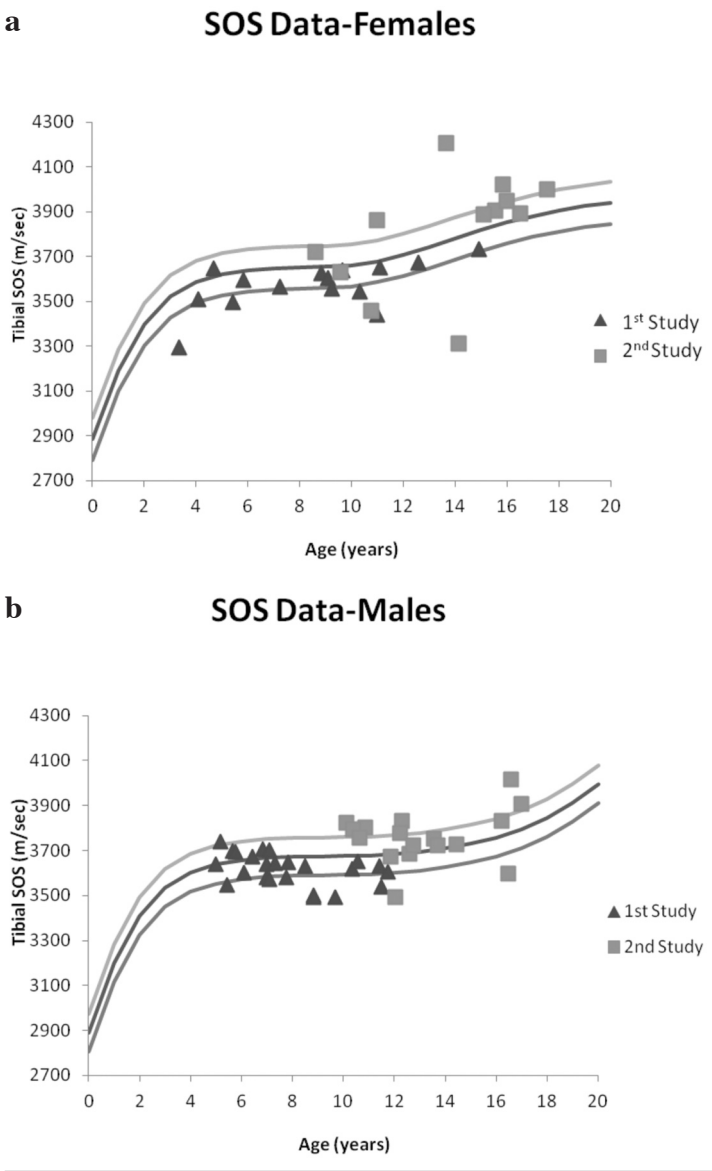

Fig. 1. Comparison of the Z-score of the speed of sound measured by quantitative ultrasound between the current and previous studies of the growing pain cohort (**a** for females and **b** for males). Mean ± SD.

Table I. Speed of Sound Z score.

	1st Study (4) Mean±SD	Current Study Mean±SD	*p*-value
Males (n=17)	-0.43 ± 0.94	0.74 ± 1.26	0.004
Females) n=13)	-0.87 ± 0.81	0.65 ± 1.77	0.008
Growing pain resolved (n=16)	-0.52 ± 0.71	0.49 ± 1.75	0.01
Growing pain continued (n=14)	-0.74 ± 1.1	0.82 ± 1.84	0.02
Total (n=30)	-0.62 ± 0.9	0.65 ± 1.77	0.001

(0.65±1.77 *vs*. -0.62±0.90, $p<0.001$). This improvement occurred in both genders (Fig. 1a-b, Table I). There was no significant difference in bone SOS between the 14 (47%) of children with continued GP (in 80% episodes were less frequent and milder) and the 16 (53%) children with resolved GP (Table I, *p*-value=0.71). There was no significant correlation between the frequency of GP episodes and the SOS Z-score (correlation coefficient -0.2, $p=0.3$). Although the SD (and thus the scatter) of females was greater than males there were no significant differences in the SOS between the genders ($p=0.63$). There were no significant correlations between the presence of joint hypermobility (12/30-40% of the patients were hypermobile by the Beighton criteria) and the current status of GP. However, hypermobile patients had a significantly higher SOS Z-score than non hypermobile patients (1.49±1.02 *vs*. 0.02±1.17, $p=0.01$). This was seen only among males ($p=0.03$) but not females ($p=0.19$).

Four (13%) children, 2 male and 2 female, had a Z-score less than one standard deviation of the population mean (compared to 28% in the previous study-(4)) and 2 (7%) had a Z-score less than 2 standard deviations. All these children continued to have GP and need analgesics ($p=0.003$).

Discussion

We found a significant increase in bone strength that paralleled a decrease in pain symptoms in our 5-year follow-up study of a cohort of patients with GP (3). While the increase in bone strength occurred both in patients with and without continued GP and the difference between the groups was not significant (as well as lack of significant correlation between bone SOS and pain status), it was interesting to observe that the 20% of those patients in our cohort with the lowest bone strength (less than 1 SD below the population norm) continued to have GP symptoms (highly significant). It is possible that the correlation between bone strength and GP symptoms occurs only in those with significantly lower values than the population norm with no correlation once bone strength increases reaches this threshold ("threshold effect"). While hypermobility was associated with bone strength (mainly among males) there was no correlation with the continuance or resolution of GP. We did not investigate the potential causes of increase in bone strength over these 5 years (dietary changes, pubertal status, laboratory tests of bone turnover). It was interesting to note in a recent cross-sectional study that the vast majority of patients with GP had low vitamin D25 levels (8). While not proof of a cause-effect (and there are other potential reasons why low vitamin D levels may be associated with pain), this may indirectly support our findings of potential association between low bone strength and GP. Other limitations are

related to the lack of data collected during follow-up on factors that could affect musculoskeletal pain, such as physical activity and detailed sleep and psychosocial information.

While relative overuse can help explain late day pains, this theory cannot explain all features of GP such as the abrupt nocturnal episodes of pain or pain in the upper extremity in some patients. Indeed a recent study seemed to indicate there are various types of GP, perhaps with different pathogenesis (9).

In summary, these findings add to our hypothesis that GP may represent in a subset of patients a local overuse syndrome that improves in most patients parallel with an increase in bone strength.

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