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Growth of children with physiolysis of the hip

Growth during adolescence was analyzed in 40 children with slipped capital femoral epiphysis using the Infancy Childhood Puberty growth model. The advantage of this model is that reference values for height can be adjusted for the individual age at pubertal maturation.

In both sexes an above average height was found before the onset of the pubertal growth spurt. However, the pubertal gain in height was less than normal, and at maturity the heights were only slightly above the reference mean values. Most of the children had their first hip symptoms during the period of increasing gain in height at the initial stage of the pubertal growth spurt. Both boys and girls were overweight before puberty and remained so during puberty and at maturity.

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Introduction

A few studies on physiolysis of the hip (or slipped capital femoral epiphysis) have focused on the body constitution of these patients. Most investigations have demonstrated a preponderance of overweight children (Ferguson & Howorth 1931, Burrows 1957, Wilson et al. 1965, Bianco 1966, Sörensen 1968, Kelsey et al. 1972); in addition, a few of these studies have reported a group of tall, often thin, children (Ferguson & Howorth 1931, Bianco 1966). Contrary to this, Sörensen (1968) did not find any abnormality in height. So far, there is no report on longitudinal growth covering the entire period from before onset of slipping to maturity.

The Infancy Childhood Puberty (ICP) growth model (Karlberg et al. 1986) has improved reference values for height during adolescence. We have applied this model in a growth analysis of 40 children with physiolysis of the hip.

Patients and methods

The ICP growth model breaks down the growth curve into three additive components, consistent with current knowledge of the regulation of growth (Karlberg 1987). The Infancy component represents the postnatal continuation of fetal growth, appears to be independent of growth hormones, and acts during the first years of life. The Childhood component, representing the effect of growth hormone (GH), has its onset at 6–12 months of age, and shows a decelerating pattern during childhood and adolescence (Figure 1). The Puberty component, the size of which is independent of its timing, describes the part of longitudinal growth stimulated by sexual hormones. By recording the individual age at maximum growth during puberty (peak height velocity), the puberty component can be determined (Figure 1). Predicted height in a normal population is, in the ICP model, adjusted for the individual variations in pubertal maturation (peak height velocity).

The investigation was done in 40 children who had been operated on for physiolysis of the hip by pinning (Table 1). The mean age at onset of hip symptoms was 13 (10–16) years for the 24 boys and 12 (9–15) years for the 16 girls. None of the children had any known hormonal or metabolic disorder. To be included in the study, longitudinal records of body measurements had to be available during the period before age at onset of slipping to maturity. This information was missing for 12 probands (7 boys, 5 girls) and led to their exclusion from the primary sample of 52 children.

Information on attained weight and height during childhood and adolescence was obtained in all the remaining patients from their individual school growth charts. These measurements were generally recorded once a year by the school nurse. After the operation, weight and height were recorded annually at the hospital until the subcapital growth plate had closed in both hips. Final height was recorded after at least another 3 years. From a questionnaire, current parental weight and height were obtained in 33 of the 40 families.

Age at peak height velocity was individually determined by observing the individual velocity curve for height, which had been smoothed by a spline function. Age at peak height velocity could be converted into standard deviation scores (i.e, deviation from the reference mean expressed in units of standard deviation of

the normal population) according to reference values given by Karlberg et al. (1987). Attained weight and height at 2 years before age at peak height velocity, attained weight and height at maturity and the total gain of weight and height during the pubertal period was recorded. The reference values were individually adjusted for the age at peak height velocity and could then be expressed in standard deviation scores.

The statistical evaluations were carried out using the Student's *t*-test.

Table 1. Observations in 40 children with physiolysis of the hip

A	B	C	D	E	F	G	H
1	G	11.5	12	139	164	47	84
2	G	11.5	12	143	162	50	81
3	B	15.5	15	146	189	48	103
4	B	15	16	166	195	80	119
5	B	13.5	13	155	187	55	92
6	G	13.5	12	140	169	28	46
7	G	13	13	150	168	45	62
8	B	12.5	13.5	171	189	71	110
9	G	12.5	12	140	164	33	64
10	G	12	14.5	151	163	54	69
11	B	13.5	14.5	156	181	59	89
12	B	12.5	14	154	182	67	106
13	B	13	11.5	133	168	31	61
14	G	11.5	12	146	162	38	68
15	B	13	14.5	146	172	55	86
16	G	11.5	13	149	173	52	70
17	B	14	14.5	161	183	59	91
18	B	14.5	14	156	187	44	98
19	B	12.5	14.5	152	180	45	77
20	B	9.5	10.5	138	180	50	106
21	B	12	14.5	181	197	86	115
22	G	11	13	151	177	52	105
23	B	13.5	14.5	156	182	41	61
24	B	12.5	14.5	153	180	58	83
25	G	11	12	160	170	50	73
26	B	10.5	14.5	150	178	72	115
27	G	11.5	13	151	166	54	94
28	B	14	14.5	155	185	57	88
29	B	11.5	14	179	196	89	100
30	B	10.5	12.5	160	195	60	94
31	B	11.5	11	145	179	51	95
32	G	14.5	14.5	149	166	38	54
33	B	12	14	158	182	52	98
34	B	9.5	13	155	174	44	69
35	G	9	12.5	136	154	50	65
36	G	10	14.5	132	163	38	76
37	B	13.5	12.5	146	164	55	60
38	G	11	14.5	148	170	51	71
39	G	11	12	162	169	81	96
40	B	11	13	150	176	54	71

A. Case number.
B. Sex (B=boy, G=girl).
C. Age at onset of slipping (years).
D. Age at peak height velocity-PHV.
E. Height 2 years before age at PHV (cm).
F. Height at maturity.
G. Weight 2 years before age at PHV (kg).
H. Weight at maturity.

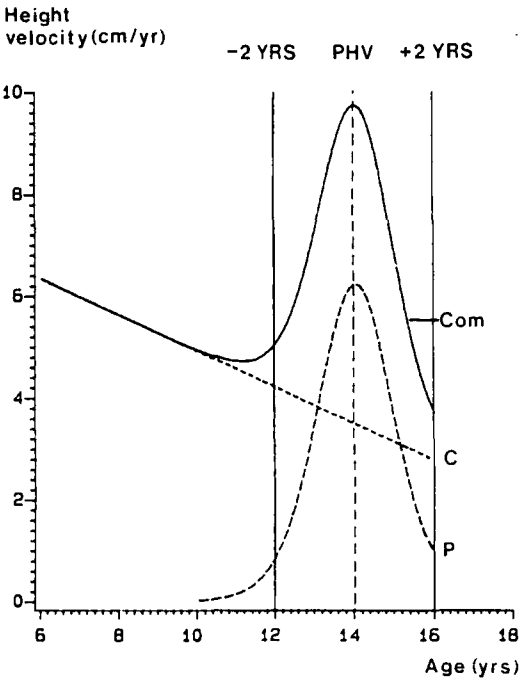

Figure 1. Average height velocity during childhood and adolescence stratified according to the Infancy Childhood Puberty growth model; mean childhood component (C), mean puberty component (P), and mean combined growth (Com), i.e., the sum of the childhood and puberty components. Reference values during adolescence are adjusted individually by timing the puberty component to the actual age at peak height velocity (PHV) for an individual.

Results

The average age at peak height velocity was 14 years in the boys and 13 years in the girls, which is 0.3 SD less than normal in boys and 1.0 SD above normal in girls (Table 2). The onset of slipping (hip symptoms) occurred on an average 1.1 years before the age at peak height velocity in both the boys and the girls, i.e., during the period of increasing height gain during adolescence (Figure 1). Five children had their onset of symptoms before the pubertal growth spurt began and 6 children after the age at peak height velocity.

Mean attained height, as observed 2 years before the age at peak height velocity, was significantly increased in both sexes, also after adjustment for the individual age at peak height velocity (Table 2). However, at maturity the heights were only slightly above normal (not significant). Mean midparental height appeared

Table 2. Growth pattern in 24 boys and 16 girls with physiolysis of the hip, expressed in standard deviation scores. Values are mean (SD)

	Boys			Girls		
Age at peak height velocity (PHV)	−0.3	(1.2)	NS	1.0	(1.1)	**
Height 2 years before PHV	1.1	(1.2)	***	0.7	(0.9)	**
2 – adjusted for age at PHV	0.9	(1.4)	**	0.9	(1.0)	**
Height at maturity	0.5	(1.2)	NS	0.1	(0.9)	NS
Pubertal gain (diff 4–3)	−1.0	(1.4)	**	−1.8	(1.7)	***
Weight for height 2 years before PHV	3.1	(1.9)	***	1.9	(1.5)	***
Weight for height at maturity	2.3	(1.3)	****	2.3	(1.8)	***

NS=not significant, **=$P<.01$, ***=$P<.001$, ****=$P<.0001$.
Two-sided *t*-test.

to be almost normal, and adjustment for midparental height thus did not affect the mean heights at maturity. Average pubertal gain was, accordingly, significantly lower than normal; −1.0 SD in the boys and −1.8 SD in the girls.

The typical growth pattern found in these children with physiolysis of the hip is exemplified by 1 of the boys in Figure 2. This growth pattern, with an above average height before the onset of puberty and a reduced pubertal gain, was found in 20 of the boys and in 14 of the girls. Four boys and 2 girls had an above average pubertal gain in weight.

Weight for height, also expressed in SD, was increased 2 years before the age at peak height velocity and remained increased up to the age at maturity (Table 2). The individual differences in weight for height at these two age points were not significant.

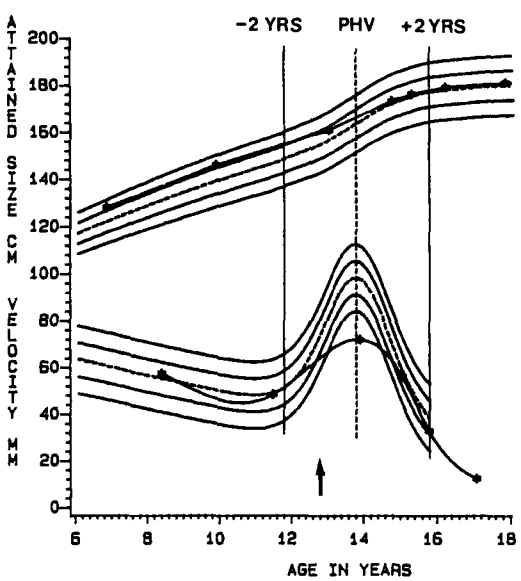

Figure 2. Case 12. A typical growth pattern for a boy with physiolysis of the hip. Reference values (---) with ±1 and 2 SD given in terms of the Infancy Childhood Puberty growth model. *Arrow denotes age at onset of symptoms.* Age at peak height velocity (PHV) ±2 years is indicated.

Discussion

The etiology of physiolysis of the hip is unclear, though a number of predisposing factors are known. Several authors have shown a familial accumulation of physiolysis (Jerre 1950, Wilson et al. 1965, Rennie 1982, Hägglund et al. 1986a), as well as racial and geographic differences in incidence (Kelsey et al. 1970, Ninomiya et al. 1976, Hägglund et al. 1984). The disease is somewhat more common in boys than in girls (Wilson et al. 1965, Kelsey et al. 1970, Hägglund et al. 1984) and occurs in general during adolescence (Kelsey et al. 1970, Hägglund et al. 1984).

Based on the body constitution of these patients, and also on animal experiments, several authors (Harris 1950, Burrows 1957, Wilson et al. 1965, Bianco 1966, Morscher 1968) have suggested an imbalance between sexual hormones and growth hormone as a causal factor of physiolysis of the hip. In addition, case reports have described physiolysis of the hip associated with growth hormone therapy (Fiddler & Brook 1974, Rennie & Mitchell 1974), hypogonadism (Sörensen 1968, Primiano & Hughston 1971), and hypothyroidism (Heyerman & Weiner 1984, Puri et al. 1985). However, hormonal analysis has not revealed any hormonal disturbance in the majority of cases (Burrows 1957, Sörensen 1968).

The growth during childhood seems to be dependent mainly on growth hormone (GH) and also, though to a lesser extent, on thyroid hormone. During puberty, these hormones are still promoting growth, but the increasing height ve-

locity is due to the contribution of sexual hormones: testosterone in males and estrogens in females (Karlberg 1986). The abnormal growth pattern before and during puberty found in our investigation could be due to a disturbed hormonal regulation of growth.

Animal experiments (Morscher 1968) have shown that the growth plate is weakened during periods of rapid growth. The time at onset of symptoms was in the majority of cases (29/40) during the period of increasing growth at puberty. As many slippings are asymptomatic (Hägglund et al. 1986a), the 5 cases with onset of symptoms after peak height velocity could have had their onset of slipping before this age. There are also indications that physiolysis of the hip is associated with a temporarily increased growth rate (Hägglund et al. 1986b).

In conclusion, this study, using the ICP growth model, shows that patients with physiolysis of the hip usually have their onset of slipping during the period of increasing growth at puberty. They also display a low pubertal gain in height and overweight persisting into maturity.

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