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Age alterations in foot mobility during the puberty

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The foot mobility has been measured using goniometric traits expressed in angle degrees. Special instruments were used constructed by one of the authors. The subject were 800 children (11-14 years old boys and girls). Age and sex differences were established concerning the foot mobility.

Key words: foot, mobility, goniometry, age and sex alterations.

Introduction

The exact and precise characteristics of foot made by the use of a large number of functional traits is of great importance not only to the theory, but to the medical practice and technology as well.

Investigations of the metric characteristics of foot have been made for a Bulgarian population (25 000 men and women of defferent age) during the period 1960-62. These results laid on the base of the foot standards of Bulgarian population [4, 5, 6, 7, 8]. The knowledge of the functional possibilities of foot and especially of the tibiotarsal articulation movings are of a great importance to the theory and practice. Мутафов et al. [9, 12] using an unique apparatus made functional and dynamic measurements of the head, arm and foot of grown-up Bulgarians [10]. On this base the authors made an analysis of 7 dynamic traits of foot in the tibiotarsal articulation [1, 11]. Similar investigations were carried out in Czechoslovakia and Japan [2, 3].

Studies of children foot concerning their functional and dynamic possibilities are not sufficient, so that was the purpose of our investigation.

Table 1. Biostatistic characteristics of the goniometric parameters of foot (angle degrees)

Characteristic	Abduction max				Adduction max				Extension max				Flexion max				Supination				Pronation			
	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14
Boys																								
$\bar{x}$	46,5	45,3	45,2	45,7	43,9	41,9	42,3	38,8	38,0	40,4	37,3	41,3	42,8	43,1	44,8	42,4	39,1	36,8	35,2	37,1	27,2	28,0	28,1	24,6
σ	8,8	7,7	8,4	8,4	9,5	8,4	10,7	9,1	11,0	11,7	14,3	11,0	12,3	11,6	11,8	12,6	13,9	14,6	12,4	13,5	12,6	13,4	9,7	9,4
m	0,88	0,78	0,85	0,89	0,96	0,85	0,91	0,96	1,07	1,18	1,44	1,11	1,25	1,17	1,19	1,18	1,40	1,33	1,25	1,42	1,12	1,35	0,99	0,99
V_σ	22,6	17,5	19,2	18,1	22,2	20,0	24,2	23,1	28,6	28,6	38,0	26,7	28,8	27,7	29,3	29,1	35,9	39,0	35,0	35,5	46,6	48,0	35,0	37,8
min	27	25	29	24	13	21	15	17	15	11	10	13	18	14	18	18	14	10	10	13	6	6	5	8
max	70	62	65	64	70	66	71	57	65	65	96	62	75	83	73	85	80	85	67	75	89	85	52	55
Girls																								
$\bar{x}$	47,3	47,9	48,6	49,8	45,0	44,1	44,5	41,3	44,2	39,7	40,9	43,2	41,3	43,7	44,2	41,7	39,1	39,7	40,7	39,9	32,9	38,1	32,0	29,5
σ	8,9	8,4	9,3	8,7	9,9	9,3	9,3	8,4	13,5	11,5	11,4	10,5	13,7	13,3	10,9	10,3	12,5	14,5	13,2	13,2	10,7	20,2	12,1	10,6
m	0,89	0,93	0,93	0,86	1,00	0,93	0,93	0,83	0,93	1,31	1,15	1,05	1,35	1,48	1,05	1,02	1,26	1,38	1,33	1,30	1,08	1,23	1,21	1,05
V_σ	19,8	18,2	19,2	18,1	22,3	21,2	21,5	20,7	31,3	30,0	28,5	24,6	33,4	31,0	25,1	25,4	32,4	37,2	33,1	33,2	31,9	35,6	38,2	36,0
min	22	32	22	27	20	18	15	18	20	12	15	18	16	21	18	20	12	10	15	10	10	7	6	6
max	80	78	7,0	76	72	70	67	65	91	80	64	65	84	77	75	68	75	80	84	70	55	99	60	56

Material and methods

The subject were 800 children aged from 11 to 14 years (100 boys and 100 girls in every age group). We took 7 goniometric traits by the use of special instruments constructed by Moutafov and co-workers (Institute of Cell Biology and Morphology, Sofia) – pelmatoangulometer, sedentariometer, and angulometer. The foot mobility in tibiotarsal articulation was analysed by the use of the following goniometric traits: maximum of abduction and adduction, of flexion and extension, and of pronation and supination.

Results and discussion

The data in Table 1 show that the maximum of abduction and adduction is 2°8′ and 2° greater respectively for girls in comparison to the boys. The abduction possibilities of foot for the boys are not changed during the investigated age period, while for girls they increase with age.

The adduction decrease for both sexes and this is more clearly manifested for girls. In comparison to the establishment of Moutafov (16-20 years old boys and girls) our group investigated (11-14 years old children) have 10° greater abduction and adduction. These differences could be explained by taking into account the sample specificities, the greater mobility of foot which is typical of our age group, and a probable secular trend. As for the foot flexion and extension, there is pronounced variability in its mobility for both sexes, although a tendency exists for increasing of foot flexion with age. The extension especially for girls, shows an opposite tendency, i. e. decreases with age. Compared to the data of Moutafov the foot flexion is 2°5′ and 0°6′ lower for girls and boys respectively; the extension is also 12° and 8°6′ lower for girls and boys. The values of supination and pronation are 2°8′ and 6°2′, respectively greater for girls, compared to these for boys.

There is a tendency of increasing of supination possibilities for girls and decreasing for boys up to 13 years. The pronation is variable again. The foot motion has greater functional possibilities for children, than for young boys and girls.

Figure 1 illustrates the sex differences related to given motions and to the whole mobility using the informative opportunities of the "star system" of Maigne. The comparison shows greater mobility of foot for 13 and 14 years old girls.

Conclusions

1. The functional mobility of boy's foot is lower, compared to the girl's one, with an exception of its flexion and extension.

2. The possibilities of abduction and flexion of girl's foot increase with age, whereas the adduction and extension decrease. The abduction possibilities of boy's foot are not altered, but flexion and extension increase with age.

3. The angle dimensions of mobility in the tibiotarsal articulation are higher for 11-14 years old children in comparison to young boys and girls. A possible explanation of these results could not be growth and puberty only, but the secular trend as well.

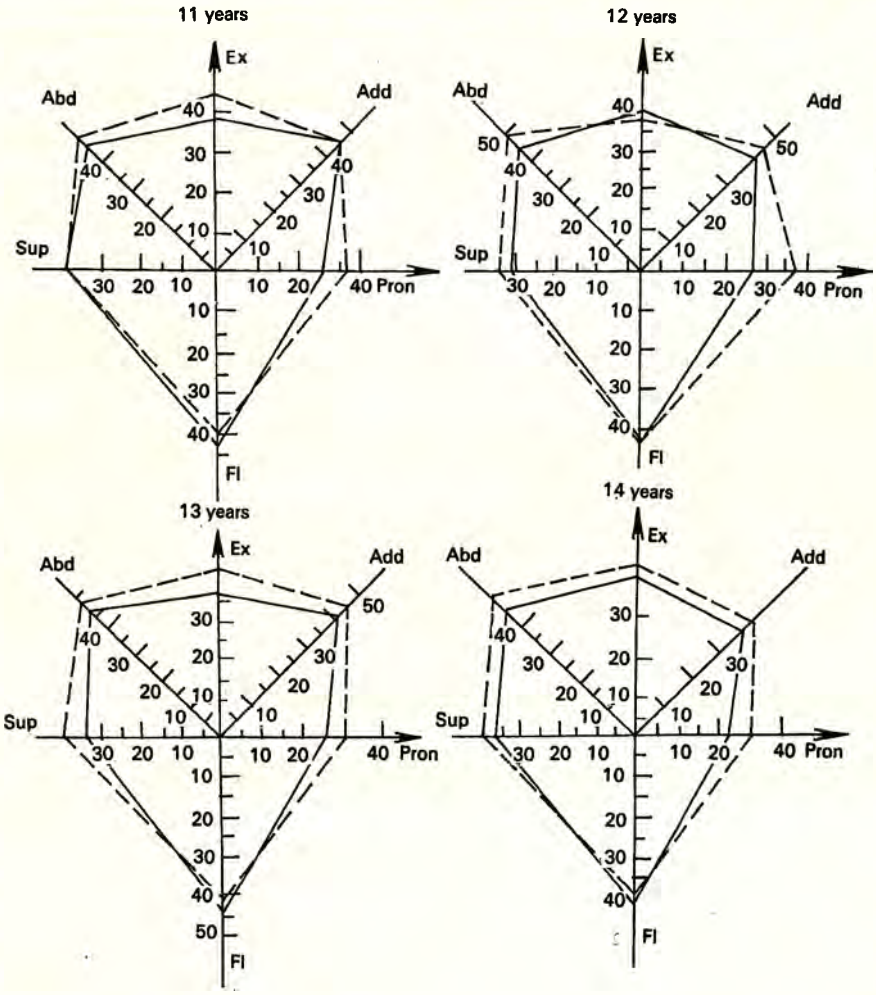

Fig. 1. Changes in the volume of mobility (angle degrees) of foot in relation to the age and sex differences
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