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*Description of valgity angle of the hallux burdened
with its weight on the basis of male population
at the age between 4 and 18 in the light of projection moiré*

**Deskrypcja kąta koślowości palucha stop w warunkach obciążenia masą
własną, populacji męskiej, w wieku od 4 do 18 lat,
w świetle mory projekcyjnej**

Current developmental needs are described among others by: assessment of proportionality of development of particular features of organism's construction and manifestations of physical efficiency and overall orthopedic examination as prophylaxis of posture defects. The aim of such an action is to determine „the weakest link” as regards structures and functions of organism's activity, so to search for the element whose development should be stimulated in the nearest future, making it easy for the organism to achieve the dynamic balance in accord with kinetics and dynamics of the organism, which means the increase in health potential. Such a primary link could be a foot from which some defects may start, and with time posture defects. The efficiency of feet may influence a body posture and quality of walking, and any deviations from the foot optimal arch may be reflected in pathogenesis of chronic illnesses in other parts of body.

Various deformations of toes are a common phenomenon, and frequency of occurrence of hallux valgity is so common that it has become a standard – Piątkowski (1974), Dziak (1987). There are different reasons for the deformities. However, many authors maintain that wearing non-physiological shoes is the main cause of frequent occurrence of deformities (too narrow a tip of shoe and high heels), Karski (1970), Knapik, Lizis, Żak (1995). Initially, only few authors observed the hallux valgity at the adolescent age (Piaggot 1960), others suggested an earlier period- childhood (Borkowski, Ożga and Normant 1976, Karski and Warda 1970). Piątkowski (1983) proved the absence of pathological changes as regards feet in the youngest children, and explained that that was caused by not wearing non-physiological shoes that constrained the function of toes.

The research carried out by Knapik (1983) proved that the essential hallux valgity process takes place in the period from the 6th to 15th year of life. This fact clearly shows that to a considerable extent this is caused by wearing shoes that are too short with narrow tips, and not, as many would think, by high-heeled shoes. Shoes with sizes corresponding to children at the pre-school age are not manufactured with heels more than 20 mm high. In the case of shoes for boys at the school age the heels do not exceed 25 mm in height.

The research carried out by Niewiadomska (2007a) showed the longest hallux in 80% of boys, the adjacent toe in 20%. She also noted (2007b) miscellaneous contractures of toes measuring for both sexes from 4-5 mm to 37 mm. The difference for boys was on average 14 mm.

The research carried out by Makarczuk and Henrykowska (2007) showed the hallux valgity amongst males at the age of 22-23 in 3% of the subjects.

The research aims at the determination of the course of changes in the hallux valgity angle on the basis of male population at the age between 4 and 18 of the Warmińsko-Mazurski region.

SUBJECTS AND RESEARCH METHODOLOGY

The research covered the population of 8699 males at the age between 4 and 18 from randomly selected nursery and other schools in the Warmińsko - Mazurski region, table 1. The statistical analysis covered only these research results where the doctor did not diagnose considerable posture defects.

The research methodology covered the measurement of the valgity angle in the foot hallux (Alpha). For the purpose of the assessment, the attitude towards a computer assessment of posture, with the application of projection moire technique - Posturometer M, was used. The research methodology and technique were in agreement with generally adopted rules (Mrozkowiak 2008). The measuring position consisted of a computer, card, programme, monitor and printer, projection and receiving device for measuring backs and feet. Procuring a dimensional image is possible only thanks to projecting a line with precisely specified parameters on a child's back. The lines falling on the back become subject to distortions depending on the surface configuration. Thanks to the application of object glass, the image of the person subject to research can be received through a special optical system, and then transmitted to the computer monitor. The distortions of the line image are entered in the computer memory, and then they are processed by a numerical algorithm into a layered map of the researched surface (Świerc 2006).

The obtained results in the form of dimensional, graphic image allowed describing in numbers the parameters subject to research. The obtained research results were prepared statistically, determining the average value, standard deviation, variability coefficient, minimum and maximum value. The distribution of variables was normal.

ACHIEVED RESULTS

The research results have been presented graphically. Diagram 1 presents the course of changes in the hallux valgity angle of the left and right foot for respective sex. To compare, diagram 2 presents the course of changes in the hallux valgity angle for both sexes. However, Alpha p+ denotes the hallux valgity angle for the right foot, and Alpha p- denotes the hallux varus deformity angle for the right foot, for the left foot respectively: Alpha l+ and Alpha l-.

The curve of the hallux valgity angle for the right foot starts with the value of 3.04 degrees in the 4th year of life, in the following year it grows to 4.98 degrees and in the next two years it falls to 3.16 degrees, and then it successively increases to 4.62 degrees in the 14th year of life. In the next two years the angle value lowers to 3.29 degrees, in the 17th year of life it grows to 4.63 degrees and in the 18th year of life it finishes with the value of

2.75 degrees. The hallux varus deformity angle of the same foot starts with 1.7 degrees in the 4th year of life. Up to the 8th year of life it does not show any statistically significant deviations; however, up to the 14th year of life there is a constant falling tendency to 1.18 degrees, and further the value constantly grows up to the 18th year of life and is 2.33 degrees.

The curve of the hallux valgity angle for the right foot starts with the value of 4.3 degrees in the 4th year of life, in the following two years it grows to 4.73 degrees and it falls to the value of 3.42 degrees in the 12th year of life. In the following two years it grows to 4.89 degrees, and further it successively lowers its level to 3.21 degrees in the 18th year of life. The hallux varus deformity angle of the same foot starts with 2.38 degrees in the 4th year of life, and then up to the 10th year of life it does not show any statistically significant deviations except for the 5th year of life. However, in the next three years up to the 13th year of life there is a constant falling tendency to 1.68 degrees, and then the value increases up to the 16th year of life and is 2.52 degrees, in the following year it lowers to 1.61, and up to the 18th year of life it increases to the level of 3.4 degrees.

DISCUSSION

The research carried out by Makarczuk and Dudkiewicz (2004) shows that the average values of the alpha angle fall within the standard range and hold steady at an approximate level from the 10th to the 18th year of life. The research carried out by Knapik (1983) shows that the alpha angle increases systematically up to the 15th year of life, and the next period of intensive increase of its value takes place after the 46th year of life. The research carried out by Knapik and Mazur (2003) shows that in the case of pre-school children no deformities as regards the alpha angle are noted. Whereas in the case of school children, a clear growing tendency of the researched angle is noted. The performed analysis of the research results showed that in the period from 1968 to 2000 there was a clear improvement of hallux valgity in the case of both pre-school children and school youth.

The research carried out by Makarczuk, Kijo (2003) in the population of 21-year-old students of physical education showed less frequent occurrence of hallux valgity among males: (3%).

The research carried out by Makarczuk (2004) showed that among 110 males at the age of 22-23 defects in the area of forefoot (hallux valgity) occur rarely: 3%.

The research carried out by Zeyland-Malawka and Nowakowski (2002) in the population of pre-school children showed that the position of toe I, in extreme cases, was 84 and 114 degrees. Most frequently (in the case of 82%) it oscilated in the range of 14 degrees i.e. from 91 to 105 degrees. Smaller angles, so the tendency towards hallux valgity, were noted in 12 degrees, whereas greater angles, pointing to its adduction, in 13 degrees. The average values in the case of boys – 99 degrees—were greater compared to the ones presented for 3-year-old children by Knapik (1983), which indicates a little more varus position of toe I.

CONCLUSIONS

1. In the first period from the 4th to the 6th year of life in the right foot and to the 7th year of life in the left foot, the hallux valgity angle of both feet increases the value, in the

second period to the 14th year of life after the drop to the 8th year of life it successively grows, and in the third period up to the 18th year of life it goes down, except for the 17th year of life in the right foot.

2. The hallux varus deformity angle of the left foot in the first period from the 5th to the 14th year of life shows a steady falling tendency, in the second period up to the 18th year of life it steadily increases. The varus deformity angle of the right foot in the first period from the 4th to the 16th year of life shows insignificant fluctuations, and in the second period up to the 17th year of life it shows a significant fall, and then grows rapidly up to the 18th year of life.
3. In the period from the 4th to the 8th year of life the valgity angle is greater in the left foot, and from the 8th to the 14th year of life values of both feet are approximate, from the 14th to 18th year of life the angles diverge.
4. In the period from the 4th to the 8th year of life the hallux varus deformity angle is at an approximate level, in the period from the 8th to 16th year of life the angles show symmetrical values; further, up to the 18th year of life the angle in the left foot is greater.

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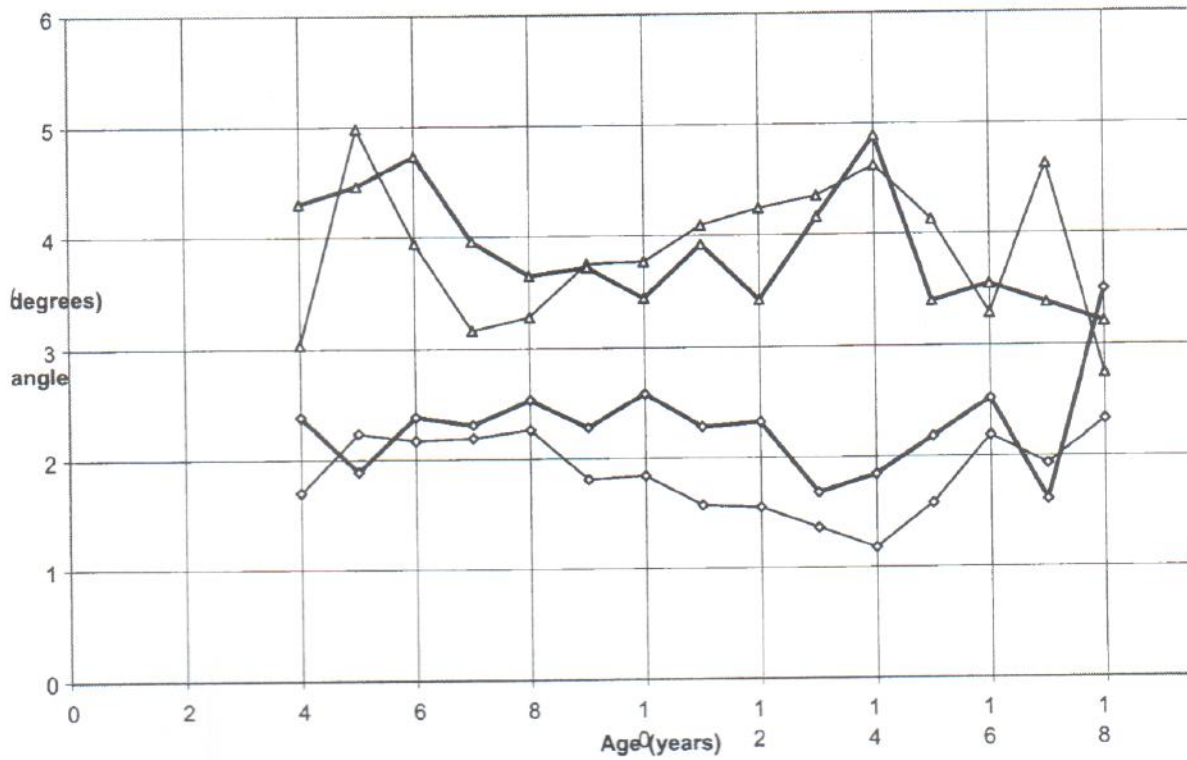
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Diag. 1 Course of changes in average values of hallux valgity angle of feet in male population at the age from 4 to 18 lat (n) 8699



Diag. 2 Course of changes in average values of hallux valgity angle of feet in population of both at the age from 4 to 18 lat (n) 18503

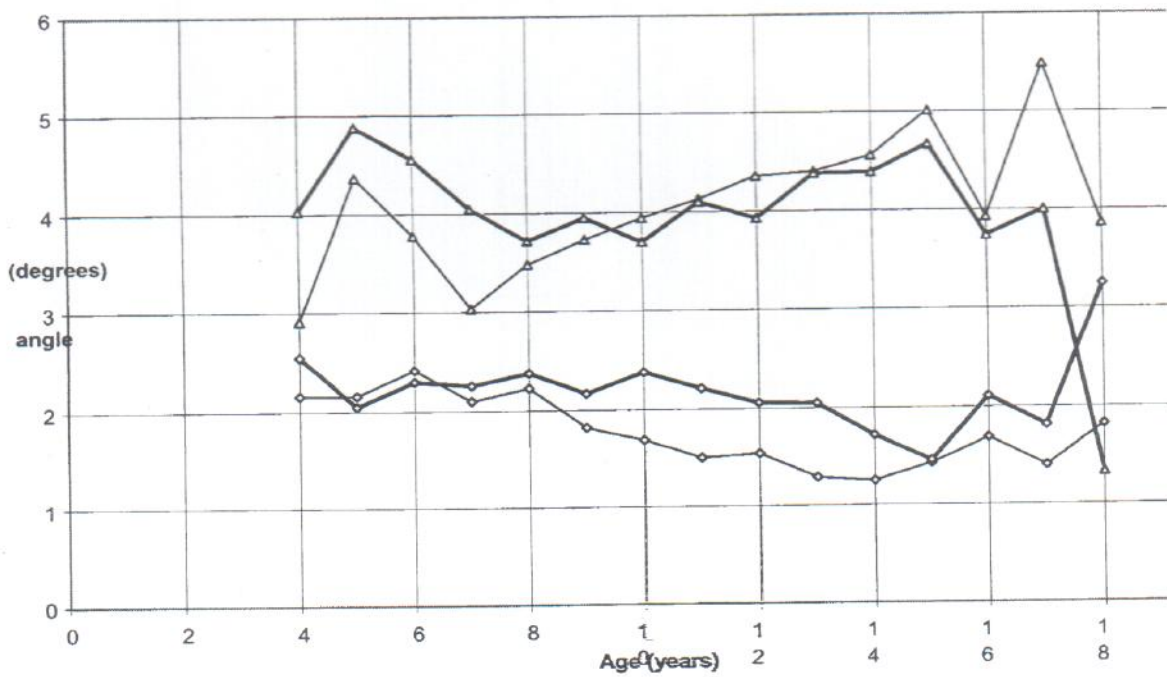


Table 1 Human material, age, body weight and height

Age	Quantity	B.W.	B.H.
4	104	19,5	109,5
5	206	20,1	113,0
6	263	21,7	118,4
7	597	23,21	127,93
8	1255	28,0	130,23
9	1677	31,34	134,47
10	1542	35,11	139,84
11	901	42,48	145,37
12	549	43,61	151,7
13	462	48,45	157,52
14	436	54,25	165,42
15	355	59,82	169,81
16	83	58,8	167,7
17	123	64,0	171,0
18	146	70,0	175,4
In total		8699	

Source: own research

Legend:

B.W. – average value of body weight; B.H. – average value of body height;

ABSTRACT

Various deformities of toes have already become a common phenomenon, and the frequency of the hallux valgity occurrence is so common that it has become a standard. The reasons for deformities are miscallenous. However, many authors claim that wearing non-physiological shoes is the main cause of frequent occurrence of deformities (too narrow a tip of shoe and high heels). Initially, only few authors observed the hallux valgity at the adolescent age, others suggested an earlier period- childhood. Determination of the course of changes in the hallux valgity angle on the basis of male population at the age between 4 and 18 of the Warmińsko-Mazurski region. The research covered the population of 8699 males at the age between 4 and 18 from randomly selected nursery and other schools in the Warmińsko - Mazurski region. The statistical analysis covered only these research results where the doctor did not diagnose considerable posture defects. The research results have been presented graphically. Diagram 1 presents the course of changes in the hallux valgity angle of the left and right foot for proper sex. To compare, diagram 2 presents the course of changes in the hallux valgity angle for both sexes. 1) In the first period between the 4th to the 6th year of life in the right foot and to the 7th year of life in the left foot, the hallux

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valgity angle of both feet increases the value, in the second period to the 14th year of life after the fall to the eighth year of life it successively grows, and in the third period up to the 18th year of life it goes down, except for the 17th year of life in the right foot. 2) The hallux varus deformity of the left foot in the first period from the 5th to the 14th year of life shows a steady falling tendency, in the second period up to the 18th year of life it steadily increases. The varus deformity of the right foot in the first period from the 4th to the 16th year of life shows insignificant fluctuations, and in the second period up to the 17th year of life it shows a significant fall, and then grows rapidly up to the 18th year of life. 3) In the period between the 4th to the 8th year of life the valgity angle is greater in the left foot, and from the 8th to the 14th year of life values of both feet are approximate, from the 14th to 18th year of life the angles diverge. 4) In the period from the 4th to the 8th year of life the hallux varus deformity angle is at an approximate level, in the period from the 8th to 16th year of life the angles show symmetrical values; further, up to the 18th year of life the angle in the left foot is greater. 5) With a great likelihood one can assume a symmetrical values distribution of the hallux valgity and varus deformity of the left foot against the right one.