

## Parameters of the Foot of the Children

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**Annotation.** This article presents data where the parameters of the foot in children with scoliosis are studied. The study involved 200 children with scoliosis. Using the method of 3D computer photometry with graphoanalytic interpretation of the image and system analysis, anatomical parameters such as length, width, angle of the 1st and 5th fingers, heel angle were obtained. An automated complex for screening and express di-agnostics of flat feet in children with scoliosis has been developed.

**Keywords:** childrens, flat feet, computer plantography, digital photometry.

Scoliosis is called a biological tragedy of humanity. With scoliosis, there are viola-tions not only of the functions of the musculoskeletal system [1, 2]. The problem of functional diagnosis of foot injury and disease is relevant in the choice of tactics and methods of treatment and evaluation of its effectiveness. Among the various deformities of the lower extremities, the most common is flat feet, characterized by flattening of the longitudinal and transverse arches of the foot in combination with rotation around the longitudinal axis, as well as its withdrawal [3, 4, 5]. The predominance of flat feet in the structure of foot pathology indicates the need to improve the methods of diagnosing this condition. Early diagnosis of flat feet is very important when conducting dispensary examinations of children in preschool and school educational institutions, in sports medicine, for the timely prediction of athletes health disorders. From the available literature sources, it is known that the longitudinal arch of the foot and its spring function in children are formed by the end of the 4th year of life [6,7,8]. However, we assume that the longitudinal arch of the foot continues to form in subse-quent age periods,

Diagnosis of foot pathology is traditionally based on several non-automated methods: visual, podometric, X-ray, plantographic, etc. In recent years, automated diagnostic methods have been increasingly used to assess the height of the arch of the foot and the degree of its flatness. In particular, there is a technique that allows you to assess the na-ture of foot deformity using strain-gauge platforms[9, 10]. However, the latter method requires the manufacture of a special device containing a matrix of load cells, which complicates the design of the diagnostic device. Another technique uses a foot image obtained using a flatbed scanner with a CCD sensor. However, this technique does not allow us to assess the nature of changes occurring in different parts of the foot [11,12,13].

The aim of the study. The goal of the study was to develop an automated system for screening and rapid diagnosis of flat feet in children with scoliosis.

Materials and research methods. In this work, a new method for diagnosing flat feet has been successfully tested, based on the analysis of foot images obtained using an up-graded software and hardware complex (PAC) for assessing the morphofunctional state of the human body (digital 3D photometrograph).

The image of the foot was obtained using a computer photoplantograph using the technology of projection transposition photometry, the body of which is reinforced and able to withstand the weight

of the human body. The method presented above for determining the state of the foot, identifying and evaluating possible manifestations of transverse and longitudinal flat feet was the basis for the computer diagnostic method used in this work. Figure 1 shows the program window for calculating the morphofunctional state of the foot.

Analyzing the print obtained on the monitor screen, it becomes clearly noticeable that the surface of the foot adjacent to the scanner surface looks lighter in the image. Thus, there is enough information in the image of the foot to get the area of the surface of the foot adjacent to the scanner. To determine the area, the program uses the definition of the foot contour and counting the points lying inside the contour [9, 10, 11]. The analysis of the dynamic (time) series was reduced to the calculation of the following indicators: absolute growth (or decrease); growth rate (or decrease); growth rate. The absolute increase is the difference between the next level and the previous level. The growth rate is the ratio of the next level to the previous one, multiplied by 100%. The growth rate is the ratio of the absolute increase (decrease) to the previous level, multiplied by 100%.

According to the above method, a morphofunctional study of the feet was performed in 200 children with scoliosis. 110 girls and 90 boys aged from 3 to 12 years were examined.

The results of the study

In male rats of 90 days of age in the control group, the body weight varied between  $95,6 + 120,3$  g and in average  $106,8 + 1,53$  g. Testes are oval and are mainly found in the scrotum, less often in the inguinal-scrotal canal. The mass of the testes varies individually from 0.62 g to 0.88 g, on average  $0.78 + 0.016$  g. The relative weight of testes was 1,46%. The length of the testes is 1.23 - 1.78 cm, on average  $1.42 + 0.034$  cm. The width of the testes ranges from 0.9 to 1.3 cm, an average of  $1.11 + 0.025$  cm. The volume of testes individually ranges from 0.61 to 0.83 cm<sup>3</sup>, an average of  $0.69 + 0.014$  cm<sup>3</sup>. Microscopic examination of testicular tissue sections showed that, at this age, the diameter of the convoluted seminiferous tubules increases, a free lumen appears to promote mature sperm, so the density of the testis tissue decreases sharply.

The medial part of the forefoot in all children aged 3-4 years was within the normal range. At the same time, there was a deviation of 5 toes, exceeding the normal values. Among children aged 3-4 years, 10 (32.3 %) people had a deviation of the 5th toe over 12°, which indicated a flattening of the lateral part of the forefoot. More pronounced changes were observed in the middle part of the foot. The K coefficient indicated a decrease in the arch of both feet in 7 (22.6 %) people. Unilateral reduction of the foot was observed in 15 (48.4 %) people. The first degree of flat feet on both sides was not detected in any person. In 9 people, the first degree of this pathology was unilateral. Only 1 person in this age group was found to have grade III flat feet on one side. The condition of the posterior part of almost all children was assessed as normal, only in 1 child the angle of the HC'C was less than 5°, which indicated valgation of the calcaneus.

In 5-6-year-old children, the following changes were detected in the anterior part of the foot: deviation of 1 finger above the norm was observed in 1 person, while the QBR angle (deviation of 5 finger) was more than 12° in 6 (30 %) people, and only in 1 – on both sides. Pathological changes in the middle part of the foot were more pronounced: a decrease in the arch of the foot was observed in 9 people (one of them on both sides), I degree of flat feet on one side in 3, 11 degree – in 4 (one of them on both sides) and III degree of deformity on one side was detected in 1 child. 3 children had a deviation of 5 toes, and 1 of them had a bilateral deviation. These changes indicated a transverse flattening of the forefoot. Changes in the middle department were observed in 13 people, only in 1 case 1 the process was two-sided. In 11 children, there was a decrease in the longitudinal arch of the foot, in 2 children, flat feet of the I degree and in I-II degree. Valgization of the calcaneal angle was detected in 3 children, only in 1 person – on both sides.

In 9-10-year-old children, deviations of the medial part of the foot were not detected. In the lateral part of this part of the foot, only 1 child had changes indicating the first degree of transverse flatfoot. No

changes were detected in the middle and posterior parts of the foot.

In 11-year-old children, there were pronounced changes in the anterior part of the foot: in its medial part: flat feet of the first degree were detected in 5 (25 %) people, of them on both sides – in 2, II degree – in 2 (10 %) people, and only one on both sides. In the lateral part of this part of the foot, I degree of flat feet was detected in 11 (55 %) people, 5 of them on both sides, II degree of flat feet – in 11 (55 %), 4 of them had bilateral pathology. In the middle part of the foot, a slight decrease in its arch occurred in 9 (45 %) people, in 3 the process was bilateral. Valgation of the calcaneal angle was observed on one side in 2 people.

Among 12 – year – olds, in the medial part of the anterior part of the foot, 9 (27.3 %) people had grade I flat feet, of which only 1 had two sides, and grade II on one side – in 3. In the lateral part of the anterior part, grade I flat feet were detected in 17 (51.5 %) people, of which 6 had two sides. Grade II flat feet in this part of the foot occurred in 23 (69.7 %) people, and 14 (42.4 %) of them had pathology on both sides. In 18 children of this age, there was a decrease in the arch of the foot in the middle part, and in 6 people the process was localized on both sides. Reducing the NS angle'K less than 5° was observed in 7 children, and in 2 people on both sides.

In children aged 3 to 12 years, there is a gradual increase in the length of the foot. The rate of increase in foot height in children with scoliosis is noted from 3 to 6 years, then up to 11 years, the height of the foot remains unchanged and only at 12 years there is a further increase in foot height.

#### Discussion and Conclusion

In children aged 3 to 12 years, there is a gradual increase in the length of the foot. The rate of increase in the height of the foot in children with scoliosis is noted from 3 to 6 years, then up to 11 years, the height of the foot remains without dynamics and only at 12 years there is a further increase in it. The growth dynamics of the anterior part of the left foot in children aged 3 to 12 years slightly outstrips the growth rates of the same part of the foot of the opposite limb. The largest deviation of 1 finger was observed on the left in children aged 7-8 years, and 5 fingers on the right-in children aged 12 years. In children with scoliosis, during their growth, there is a decrease in the K coefficient, which indicates an increase in the longitudinal arch of the foot. In the course of age in children with scoliosis, there is a decrease in the angle of the NS'K, which indicates a tendency to valgization of the calcaneus.

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