

QUANTITATIVE ESTIMATION OF THE STATE OF VAULT FEET GYMNASTS ON THE DIFFERENT STAGES OF THE LONG-TERM TRAINING

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Annotation. The analysis of the vaults given about the state is conducted feet gymnasts on the different stages of the long-term training. 93 sportswomen of different qualification took part in research. The system of Big foot was used. It is set that on the early stages of the long-term training for gymnasts observed flattening heights of unevenness of navicular bone above the floor. With growth of qualification of sportswomen to avoid development of pathological changes of vaults feet actually not possibly. It is conditioned the rules of competitions to complication of competition compositions and technique of execution of elements of calisthenics. It is marked that appearance of flattening feet requires: corrections in the system of training; introduction of the specially developed methods on the removal of existent deformations; prophylaxis of flat-footedness; strengthening of the musculoskeletal system feet.

Keywords: vault, foot, functions, height, qualification, artistic gymnasts.

Introduction

In connection with the fact that modern rules on calisthenics include requirements to demonstration of ultra-difficult elements with objects and without them, it is necessary to review all system of sportswomen's training on all stages of many years training in order to maximally facilitate effective realization of feet's functions and prevention from traumatism, ensuring health and workability of female gymnasts [2, 5]. Realization of ultra-difficult elements with an object is impossible without high level of feet's manipulation function – ability to control of object by foot or by its separate parts [7].

In effectiveness of female gymnasts' competition activity great role is played by ability to resist tiredness in conditions of long physical loads, stress situations, non-compliance of physical abilities' development, disbalance in strength and flexibility indicators of symmetric halves of body and in realization of calisthenics' techniques [1]. Considering the fact that foot is a key link in the process of calisthenics movements' fulfillment, for sportswomen it is of critical importance – training of feet muscles, joints' mobility, elasticity of ligaments, ability to manipulate objects and realize effectively main and specific feet's functions for long time in order to eliminate risk factors, to prevent traumatism and disorders in gymnasts' supporting motor system (SMS) [3, 8].

Considering the scale of feet's participation in calisthenics' exercises, their work is regarded as significant, requiring constant perfection [4, 6, 9]. In this connection we consider research, devoted to state of female gymnasts' feet arches on different stages of many years training to be an urgent one for grounding of systemic approach to perfection of feet's techniques in calisthenics' exercises.

Purpose, tasks of the work, material and methods

The purpose of the research is to study the state of feet's arches of female gymnasts on different stages of many years training.

The methods of the research: video-computer analysis of feet arches' state, with the help of special computer software – program "Big foot" with involving of female gymnasts of different qualification: 3rd degree (27 persons), 2nd degree (6 persons), 1st degree (9 persons) candidate masters of sports of Ukraine (11 persons), masters of sports of Ukraine (29 persons), masters of sports of Ukraine (international class) (11 persons); methods of mathematical statistics for processing of the obtained data.

Results of the researches

With the help of «Big foot» system we obtained geometry data of bone components of different qualification gymnasts' feet. With it we registered linear dimensions of feet, angle α (ALFA) (mesopodial) – which characterize foot's spring abilities, connected with keeping of arches by active components of muscles and angle β (BETA) (calcaneal) – which characterize foot's spring abilities, connected with passive components, conditioned by peculiarities of bones' articulation and foot's ligament system. The obtained data were analyzed with statistical methods of data processing. The researches were carried out on the base of Scientific & Research Institute of National university of physical education and sports of Ukraine. In the course of the researches we obtained indicators of maximal height of medial part of longitudinal foot arch (foot incline) and of tuberosity height of navicular bone over floor on the base of previous researches' results [10], in which there were determined standards of all anthropometric feet's indicators for different age groups (see table 1).

Table 1

Standards for evaluation of the height of longitudinal foot arch of 5-20 years old sportswomen (mm) [10]

Age	Very low	Low	Lower than middle	Middle	Higher than middle	High	Very high
5	< 19.02	19.03 - 23.87	22.57 - 23.14	23.15 - 28.95	28.96 - 33.03	32.74 - 37.70	> 37.70
6	< 19.65	19.66 - 24.22	24.12 - 25.91	25.92 - 30.12	30.13 - 33.44	33.05 - 38.02	> 38.02
7	< 19.80	19.81 - 24.40	24.41 - 26.70	26.71 - 31.30	31.31 - 33.60	33.61 - 38.20	> 38.20
8	< 20.00	20.01 - 25.00	25.01 - 27.50	27.51 - 32.50	32.51 - 35.00	35.01 - 40.00	> 40.00
9	< 21.80	21.81 - 26.90	26.91 - 29.45	29.46 - 34.55	34.56 - 37.10	37.11 - 42.20	> 42.20
10	< 23.40	23.41 - 28.70	28.71 - 31.35	31.36 - 36.65	36.66 - 39.30	39.31 - 44.60	> 44.60
11	< 23.55	23.56 - 28.90	29.03 - 31.48	31.49 - 36.95	36.96 - 39.47	39.51 - 44.73	> 44.73
12	< 23.77	23.78 - 29.10	29.47 - 31.74	31.75 - 37.15	37.16 - 39.66	39.70 - 44.89	> 44.89
13	< 24.09	24.10 - 29.18	29.98 - 31.91	31.91 - 37.21	37.22 - 39.89	39.92 - 45.04	> 45.04
14	< 24.28	24.29 - 29.32	30.16 - 32.11	32.12 - 37.92	37.93 - 40.10	40.05 - 45.19	> 45.19
15	< 24.73	24.74 - 29.55	30.74 - 32.32	32.33 - 38.13	38.14 - 40.28	40.15 - 45.30	> 45.30
16	< 24.96	24.97 - 29.78	30.99 - 32.68	32.69 - 38.29	38.30 - 40.45	40.22 - 45.49	> 45.49
17	< 25.12	25.13 - 29.90	31.17 - 33.14	33.15 - 38.35	38.36 - 40.63	40.39 - 45.71	> 45.71
18	< 25.28	25.29 - 30.24	31.32 - 33.44	33.45 - 38.55	38.56 - 40.93	40.57 - 45.88	> 45.88
19	< 25.60	25.61 - 30.55	31.59 - 33.78	33.79 - 38.89	38.90 - 41.14	40.80 - 46.04	> 46.04
20	< 25.89	25.90 - 30.97	32.07 - 34.23	34.24 - 39.24	39.25 - 41.56	41.03 - 46.21	> 46.21

As a results of researches, indicators of tuberosity height of navicular bone over floor of NUPESU girl students (17-20 years old age, masters of sports of Ukraine) witness that only 25% of the tested have normal indicators of right foot and 40% - of left one. One gymnast had indicators of foot arch exceeding norm – 41.49 mm. 8 girls-gymnasts had indicators lower than middle – 31.17 – 32 mm and 6 sportswomen - low indicators – 21.7 – 30.50 mm. 4 gymnasts of combined team of Ukraine (16-20 years old, masters of sports of Ukraine of international class) had these indicators higher than middle -42.44 – 48.07 mm; 5 gymnasts – within norm – 32.54 – 37.08 mm; 1 girl-gymnast had indicator lower than middle – 31.68 mm and 6 – very low – 22.78 – 30.62 mm. Analysis of the obtained data showed that tuberosity height of navicular bone over floor of members of combined team of Ukraine in average is 34.71 mm that is higher than the same indicators of NUPESU girl students – 32.08 mm.

For sportswomen of 16-20 years old age normal tuberosity height of navicular bone over floor shall be in the range of 32.69 – 39.24 mm. The obtained data witness about reduction of height of longitudinal arch. These changes are prived by angle characteristics of bone system of sportswomen’s feet (see fig.1).

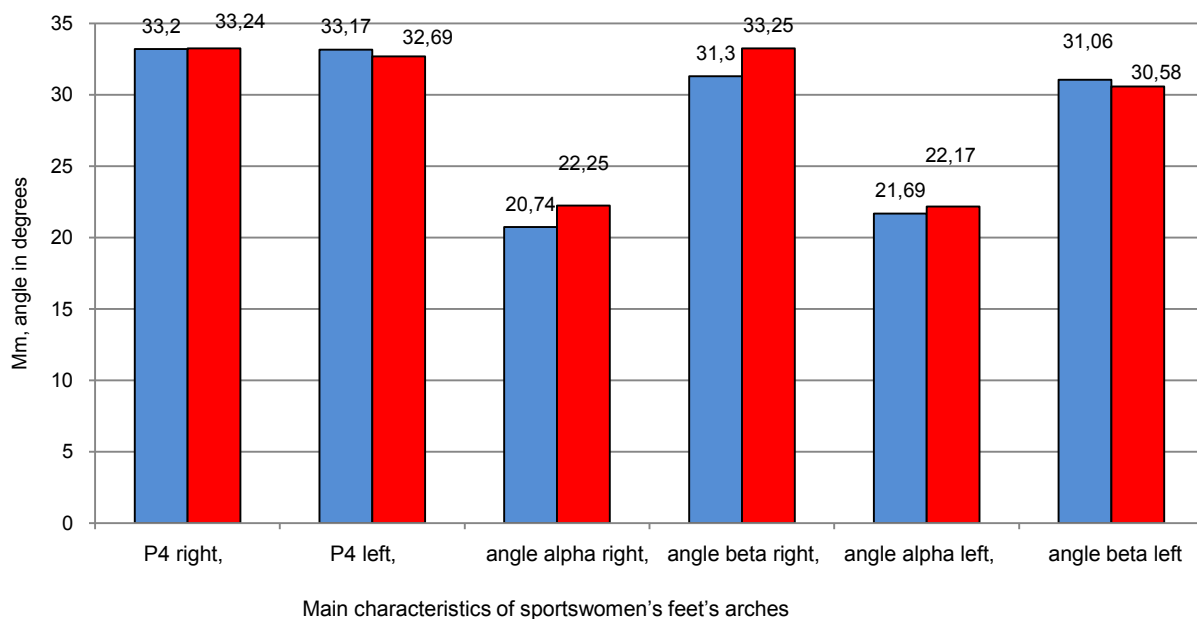


Fig.1. Correlation of main indicators of feet arches of highly qualified female gymnasts:

- gymnasts of combined team of Ukraine;
- NUPESU girl students;

So, angle ALPHA, which characterizes student feet's spring abilities, was 22.21 degrees and angle BETA 31,91 degrees. The members of calisthenics combined team of Ukraine these indicators were as follows: ALPHA – 21.21 degrees and BETA – 31.18 degrees.

Analysis of feet's medial arches of female gymnasts of lower grades showed that tuberosity height of navicular bone over floor of candidate masters of sports (12-15 years old age) was in average 31.83 mm and foot incline was 48.74 mm. Gymnasts of 1st and 2nd grades (9-11) years old age had these indicators equal to 28.07 mm and 41.57 mm accordingly, Gymnasts of 3rd grade (8-7 years old age) and gymnasts participating in program "junior gymnast" (6-5 years old age) these indicators corresponded to 24,71 mm and 52.09 mm.

Concerning existing norms of feet arches' height (see table 1) female gymnasts of all studied qualifications had flattening of feet's arches. In every age group it is within 0.24 mm to 2.69 mm from lower boundary. In some cases there is flattening only of one foot. Even the youngest group has deviations from standard and they are in average 1.35 mm ($S = 0.26$, $V=11.9\%$). In our opinion it is explained by specificity of this kind of sports. In calisthenics exercises, feet are always in strained state and often together with supporting actions they fulfill different manipulations with objects. In connection with specificity of this kind of sports coach together with gymnast choose "leading" side and, accordingly, supporting foot, which, in most of movements, will be loaded more than opposite one. Thus, overloads can influence on state of feet arches.

For female gymnasts of 1st – 2nd grade these indicators corresponded – ALPHA – 18,73 degrees, BETA – 35.2 degrees. For gymnasts of 3rd grade and sportswomen, participating in program "junior gymnast" these indicators were– 18.67 mm and 36.07 mm (see fig. 2).

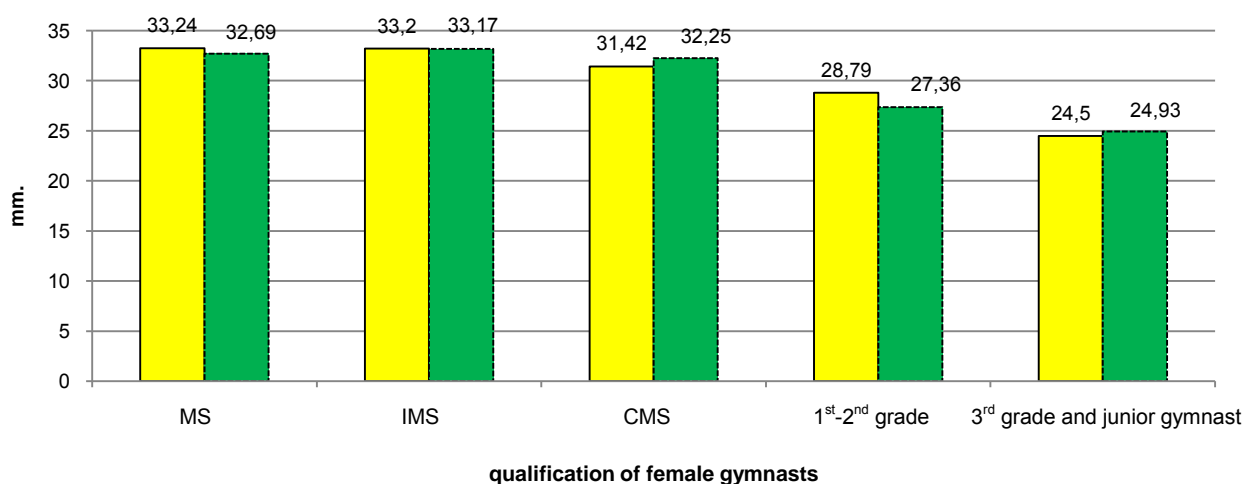


Fig.2. Correlation of indicators of feet's flattening of female gymnasts on different stages of many years training in calisthenics:

P4 of right foot;
 P4 of left foot;

Thus, the obtained data of feet arches' state of female gymnasts of different qualification witness that there is a problem of foot arch's flattening of female gymnasts on all stages of many years training.

Conclusions:

By means of analysis of feet arches' state of sportswomen on all stages of many years training with the help of special software – program «Big foot», we obtained geometry data of bone components of sportswomen's feet – angle α (ALFA) (mesopodial), angle β (BETA) (calcaneal), and tuberosity height of navicular bone over floor.

In compliance with accepted standards of foot arch height we analyzed the obtained data of female gymnasts of different qualification.

All researched groups of gymnasts had tuberosity height of navicular bone over floor at "lower than middle" level. The members of combined team of Ukraine it is 34.71 mm that is higher than the same indicators of NUPESU girl students – 32.08 mm. Candidates master of sports had average foot arch height 31.83 mm. Indicators of tuberosity height of navicular bone over floor of 1st – 2nd grade gymnasts were 28.07 mm, of 3rd grade gymnasts and gymnasts, participating in program "junior gymnast" they were – 24.71mm

The obtained data prove urgency of studying of sportswomen's feet as far as they are reliable foundation of all, without exclusions, movements in calisthenics and strategic factor of competition activity's efficiency. Foot flattening even at early stages of sportsmanship's formation requires substantial correction in training system in calisthenics and introduction in training and extra-training processes specially developed methodic for elimination of the existing deformations, for prevention of flat-footedness and strengthening of feet's bone-muscular system for prevention from traumas and disorders in gymnasts' supporting motor systems..

The prospects of further researches imply development and foundation of effectiveness of system of many

years complex perfection of feet's techniques in calisthenics' exercises.

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