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PREVENTION OF SPRING FUNCTION OF THE FOOT, TAKING INTO ACCOUNT THE ANATOMICAL FEATURES OF ITS STRUCTURE

Andriy Sak

Raisa Antipova

Kharkiv State Academy of Physical Culture,

Kharkiv, Ukraine

Purpose: to study the possibilities of expanding conservative methods for correcting the arches of the foot, taking into account the anatomical features of their structure, since in the early stages of acquired deformities of the foot, its pathological setting is usually caused by changes in soft tissues: skin, ligaments and muscles.

Material and methods: 48 male students of KhSAPC, aged 18 to 20, participated in the experimental survey. A survey of representatives of 4 sports specializations was carried out, 12 athletes in each group: Football, Weightlifting, Basketball, Volleyball, Judo, Sambo, Taekwondo. The estimation of the standing height of the longitudinal arch based on the calculation of the "podometric index" (Friedland index). The assessment of the condition of the longitudinal and transverse arches of the foot was carried out by the method of plantometry. The assessment of the metric parameters of the foot was carried out at the beginning of the examination and after teaching the students the methods of manual foot correction: according to the method of muscules relaxation of the feet according to K. Lewit and according to G. Ivanichev. At the same time, autorelaxation of the spasmodic foot and lower leg muscules was carried out using the method of "finger exercises" of impact on the points of painful muscle compaction (BMU) of the plantar and dorsal surfaces of the foot.

Results: there was a change in the arches of the foot of two types (sharp and moderate flat feet) in athletes of the specialization "Football", "Basketball, volleyball", "Judo, sambo, taekwondo", and moderate flat feet in athletes of the "Weightlifting" specialization. Recommendations are given regarding conservative methods for correcting disorders of the foot structure.

Conclusions: the data obtained indicate that with conservative methods of correction of the foot arches, there are positive subjective changes. However, this influence is not enough to maintain the structure of the foot with constant overload. Since athletes have a developed musculo-ligamentous apparatus, which firmly holds the arches of the foot and ensures a tight fit of the foot bones to each other, it is especially important to use conservative methods of correcting the foot arches until the age of 20-25, that is, until the bone growth stops.

Keywords: arches of the foot, spring structures of the foot, flat feet.

Introduction

The study of the anatomical and functional state of the foot is one of the urgent problems of theoretical and practical medicine, as minor structural changes in the foot disrupt the coordinated activity of muscles, bones and joints [1, 4, 12, 13, 17]. In this regard, morphofunctional diagnosis of the condition of the feet and its correction is an essential element in the prevention of a number of disorders of the musculoskeletal system [1, 9]. The complexity of pathological changes is largely due to the anatomical and physiological features of the foot and the variety of its functions.

The ability of the arches of the foot to 80% to dampen the impact energy that occurs at the time of dynamic contact of the foot with the support during walking, as well as especially during jumping and running, determines its spring function. The spring function of the foot protects the joints and bones of the entire human body, including the vertebrae, intervertebral discs and skull bones, from shock overload, and thus from injury. If the spring function of the foot is impaired, it inevitably leads to the rapid development of irreversible diseases of the ankle, knee, hip and intervertebral joints [5, 6, 7].

No less important is the functional action of the foot when pushing off the support (pushing function). The kinetic energy generated by walking, running or jumping is transmitted to the foot at the time of contact of the heel with the support, stored in it during rolling on the sock and again transmitted to the body at the time of separation of the foot from the support. This allows a person to make further translational movement in any direction. In this case, due to the ability of the joints of the foot to move in all planes, a person can maintain a given body posture during movement or in a standing position with any unevenness of support, which allows you to maintain balance (balancing function).

However, abundant innervation and the relationship of the nerve endings of the reflexogenic zones of the foot with various internal organs of the whole body, can affect the entire human body through massage, acupuncture and thermal effects on the feet (reflexogenic function of the feet).

The lifestyle of modern man changes the conditions of functioning of the foot and musculoskeletal system in general. Tolerant attitude to physical activity, which causes obesity and weakening of skeletal muscles, or, conversely, overload of static or dynamic nature can lead to a decrease in the spring capacity of the foot [3, 5].

The foot is the distal part of the lower extremity and can withstand heavy static and dynamic loads throughout life. Individual differences in the structure of the foot are associated with the large number of bones of the foot and the complexity of the joints formed by them, as well as the architecture of the ligament which, in combination with muscles, provides stability and endurance to the foot [6].

The human foot consists of 26 bones, tightly interconnected mainly by immobile joints. The movements of the foot and its parts are carried out by the muscles of the lower leg, the tendons of which pass to the foot, as well as numerous own muscles of the foot. In addition to the muscles in the function of the foot are involved plantar aponeurosis, firmly connected with the skin: - so the skin of the sole is almost motionless. Plantar aponeurosis plays an important role in maintaining the arches of the foot [6].

It is well known that the condition of the arches and feet in general depends on the condition of the ligaments and muscles, as well as on the specific living conditions, work and exercise in which a person is. The evolutionary adaptation of the human foot to the locomotor function affected the uniqueness of its shape, which provided the foot with special properties necessary for upright walking. Biologically, the human foot is designed to walk barefoot on elastic-viscous, uneven natural surfaces: earth, stones, sand. When walking barefoot, the natural soil fills the anatomical depressions of the feet. This supports the receptor and spring function of the foot, which provides stability and steadiness of the lower extremities and the body as a whole on the abutment.

The main feature of the human foot is an arched structure, which forms the arches of the foot, which have a certain shape and relative position of the bones. There are longitudinal and transverse arches in the foot.

Longitudinal arches are formed by arcs extending from the heel hump to the heads of the metatarsal bones.

The most pronounced of them are the lateral vault formed by arcs running along the IV and V metatarsal bones, and the medial vault, the arcs of which run along the I - III metatarsal bones.

The lateral vault carries the bulk of the body and serves as a support when standing, walking or running, and therefore is a bearing, and the medial - spring, because it performs a buffer role.

Transverse vaults:

- the proximal arch is formed by the connection of the metatarsal bones in the form of an arch, and forms an angle of up to 40 ° with the support.

- the distal vault is formed by the heads of the metatarsal bones, and forms an angle of up to 10 ° with the support.

Due to the arches of the foot, the body weight is evenly distributed, and the shock loads from the abutment, while walking or running, are significantly reduced [5, 6].

The shape and size of the arches of the foot in humans can change even during one day under the influence of various static and dynamic loads. When standing, due to some stretching of the ligaments, the foot may be slightly flattened, as evidenced by its elongation by a few millimeters and a slight expansion. A normal foot is one, in which the area of abutment occupies 35-54% of the total area of the foot.

Violation of the anatomical structures of the foot causes flattening of the longitudinal and transverse arches of the foot, which leads to flat feet. There are three degrees of flat feet (Fig. 1):

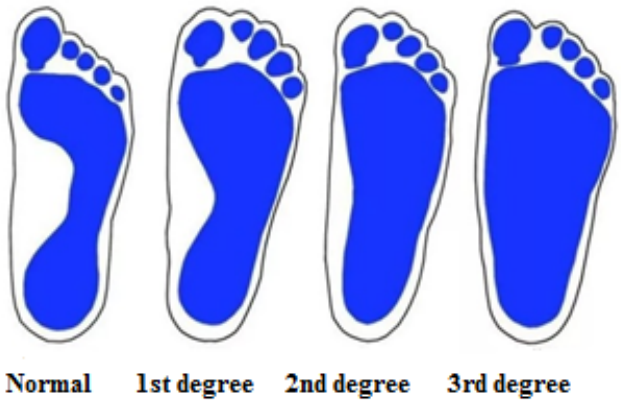

Fig. 1 Degrees of flat feet:

1st degree - the arches are slightly reduced, but there is no deformation of the foot yet.

2nd degree - the arches are sharply reduced, there is expansion and flattening of the foot.

3rd degree flat feet- no arches, pronounced deformities of the foot.

In contrast to flat feet, an empty foot or a foot with a high rise has deformations in which the distance between the heel hump and the heads of the metatarsals decreases. Thus, the height of the longitudinal arch increases with a simultaneous increase in the curvature of the foot.

It should be noted that with static or dynamic overloads, which are inherent in athletes, the body does not have time to adapt to statokinetic changes in the foot and lower extremities. As a result, the development of flat feet is accompanied by rapid fatigue by the end of the day, pain in various parts of the foot, heel bone, as well as in

the lower leg, thigh and even the lumbar region. Also, one of the common causes of flat feet is the wearing of irrational shoes, because it violates the normal biomechanical conditions of the foot arches.

Purpose of the study: to study the possibility of expanding conservative methods of correction of the arches of the foot, taking into account the anatomical features of their structure.

Material and Methods of research

The experimental survey involved 48 students of KhSAPC aged 18 to 20 years (male). A survey of athletes of 4 sports specializations "Football", "Weightlifting", "Basketball, volleyball", "Judo, sambo, taekwondo" was conducted for 12 athletes in each group.

An estimate of the height of the longitudinal vault based on the calculation of the "podometric index" (Friedland Index). To determine the degree of flat feet, direct podometric features were determined: the height of the arch and the length of the foot, after which the Friedland index was calculated taking into account its gradations proposed by T.A. Globa.

The condition of the longitudinal and transverse arches of the foot was assessed by plantometry. When analyzing the footprint (plantogram), both absolute indicators (foot length, arch height, lifting height, etc.) and relative ones (the value of the foot arch angle, calculated indices) were evaluated. Marking of the plantogram was performed according to the method of Stritter and Chizhin.

Evaluation of metric indicators of the foot was performed at the beginning of the survey and after teaching students the methods of manual correction of the foot.

According to the method of relaxation of the foot muscles according to K. Lewit [11] and G. Ivanichev [2], autorelaxation of the spasmed foot and leg muscles was performed. At the same time, local hypertonia of the leg and foot muscles was determined and their deep massage was performed until relaxation. Direction of movements: on the front surface of the shin and the back of the foot - from top to bottom, on the plantar surface of the foot and the back of the shin - from bottom to top.

The technique of "finger exercises" of influence on painful muscular consolidations of points of a sole and back surface of foot, and multipoint influence on a number of biologically active points of meridians of a body was also used. Additionally, according to the method of V. Janda [10], relaxation of the iliopsoas muscle was performed, which in a state of hypertension maintains and deepens lumbar hyperlordosis.

Manual correction of the foot was of the same type at different degrees of flat feet and was performed every other day for one hour. The total duration of conservative methods of correction of the arches of the foot was 1 month.

Evaluation of the effectiveness of the method of manual correction of the foot in the dynamics was carried out on the most significant indicators: complaints and gait disturbances.

The results are processed using licensed Excel spreadsheet packages and a set of applications. Relative indicators were calculated - the prevalence of the trait and its error. Deviations were considered significant with a difference of relative values of at least 10 %.

Results of the research

Analysis of the results based on the calculation of the "podometric index" showed the athletes of the first group of specialization "Football" the following distribution of the arches of the foot: normal vault was recorded in 8,3 %, very high vault was determined in 41,7 %, moderately high vault – 41,7 %. Sharp flat feet were noted in 8,3 % of the surveyed students.

In athletes of the second group of specialization "Weightlifting" normal arch was recorded in 33,3 %, very high arch in 25 %, moderately high arch in 25 % of subjects. At the same time, 16,7 % of athletes had moderate flat feet, but sharp flat feet in athletes of the second group were not recorded.

Athletes of the third group of specialization "Basketball, volleyball" condition of the arches of the foot is distributed as follows: normal arch is noted in 41.7%, very high arch is defined in 33,3%. Athletes in this group had moderate flat feet in 8,3%, and 16.7% of the surveyed students had severe flat feet.

In the fourth group of athletes specializing in "Judo, sambo, taekwondo" normal arch was noted in 41,7 %, very high arch was recorded in 25 %, moderately high arch in 25% of surveyed students. Sharp flat feet were also recorded in 8,3 % of athletes.

On the basis of plantographic researches the results of a condition change of longitudinal and cross arches of foot are received. Analysis of plantograms showed that athletes of the first group of specialization "Football" have a normal arch in 83.3%, moderate flat feet have 8.3% of students, sharp flat feet are noted in 8,3 %.

Thus, the results of plantography and the conclusions made on the basis of the calculation of the "podometric index" generally coincide. Both anthropometric methods show changes in the arches of the foot in 8,3% of athletes specializing in "Football" (sharp flat feet).

Athletes of the second group of specialization "Weightlifting" have a normal arch in 83,3%, moderate flat feet have 16,7 %, sharp flat feet are not recorded, which is also confirmed by calculations of the Friedland index

The analysis of plantograms of the third group athletes of specialization "Basketball, volleyball" shows a normal arch in 75% of athletes, 25% of the surveyed students have moderate flat feet. Sharp flat feet are not recorded.

Since the results of anthropometric studies (plantometry and pedometry) complement each other and give fairly accurate data on the true state of the foot shape, we can conclude that athletes in the group "Basketball, volleyball" noted changes in the foot arches of two types: sharp flat feet and moderate flat feet.

Analysis of plantograms of athletes of the fourth group of specialization "Judo, sambo, taekwondo" shows a normal arch in 75 % of athletes, moderate flat feet have 8,3%, sharp flat feet were noted in 16,7 % of respondents.

A comparative analysis of the results of podometry and plantometry shows that the athletes of the group "Judo, Sambo, Taekwondo" also have a change in the foot arches of two types: sharp flat feet and moderate flat feet.

It should be noted that before the survey, 83,3 % of athletes complained of fatigue and leg pain during exercise.

After the use of conservative methods of correction of the foot arches, athletes noted positive subjective changes in the muscles and joints of the foot.

Conclusions / Discussion

Analysis of the results of podometry and plantometry shows that athletes in the groups "Judo, Sambo, Taekwondo" and "Basketball, Volleyball" have the greatest deformation of the foot in the form of its flattening compared to the groups "Weightlifting" and "Football".

According to the authors of the literature, the foot accounts for up to 35 % of sports injuries, because in all cyclic, game sports and martial arts the foot plays an important role in achieving sports results [6, 9].

In such sports as basketball, volleyball, football for the effective implementation of vertical and horizontal jumps it is required purposeful development of the explosive force of the muscles of the lower extremities. Thus, the deformation of the foot in the form of its flattening is common in athletes due to high loads on the musculoskeletal and articular ligaments of the lower extremities.

According to the literature, instability of the ligaments of the joints, including the joints of the foot, is often noted during sports. The authors note that when examining fifty athletes, the most common symptoms were pain in the feet (38%), pain in the knee joint (34 %), pain in the lower leg, including chronic sprains (30%) and pain, in the ankle-foot joint (16 %). Of the detected anomalies in the structure of the foot, the most common were varus deformity of the heel bone (in 42 % of cases), displacement of the anterior foot (varus – 24 %, valgus – 14 %), varus deformity of the tibia (12%) and mismatch of leg length in 16% of respondents [15]

In our study, after the use of conservative methods of correction of the foot arches, there were positive subjective changes in the muscles and joints of the foot. Reliable objective results of normalization of the foot arches were not obtained, probably due to the short observation period.

These results coincide with the conclusions of other authors of experimental studies, who claim that conservative methods of correction of the arches of the foot

have positive subjective changes. However, this effect is not enough to preserve the structure of the foot when repeating heavy loads [14].

It should be noted that in our experimental examination of athletes specializing in "Weightlifting" there were complaints not only of fatigue and pain in the legs during exercise, but also pain in the lumbar spine.

It is known that pain in the lumbar spine may be associated with degeneration of the intervertebral discs as important elements of the spinal motor segment [8]. In turn, degenerative changes and damage to the intervertebral discs disrupt the biomechanical function of the spine and can cause pain [16].

As the flattened arches of the foot increase the vertical axial loads on the spine and all its support systems, under the influence of additional load the spine gradually loses the necessary biomechanical orientation, the depth of physiological curves changes and bends in the frontal plane occures- scoliosis.

Due to the presence of such a pathogenetic link, it is advisable to begin the correction of these changes from the foot. A rational way to correct the foot is to restore its arch and systems that strengthen these structures.

Because athletes have a well-developed musculoskeletal system of the foot, which firmly holds the arch and ensures a tight fit of the foot bones to each other, it is especially important to use conservative methods of correction of the foot arch before 20-25 years old, that is, until the cessation of bone growth.

To correct flat feet, it is recommended to avoid wearing narrow shoes, and to minimize the use of shoes with high heels (the optimal height of the heel for foot comfort is 4 cm). It is recommended to avoid regimes of hypokinesia and hyperkinesia and use the whole possible arsenal of rehabilitation effects to increase the functionality of the foot.

Prospects for further research: timely diagnosis of flattening of the foot is a condition for early rehabilitation, which prevents the spread of degenerative processes and the development of destructive changes in the musculoskeletal system. Therefore, there is a need for further scientific and experimental studies of the

anatomical and functional capabilities of the muscular and skeletal system of athletes in specific sports in order to optimally build and correct the training process.

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Information about the Authors

Andrii Sak: PhD (Biological), docent; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: http://orcid.org/0000-0002-8491-3434
E-mail: sak_andrei@i.ua

Raisa Antypova: senior lecturer; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.
ORCID: http://orcid.org/0000-0002-7172-4597
E-mail: antipowaraja@i.ua