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BIOMETRIC FOUNDATIONS FOR DEVELOPMENT OF WOMEN'S HIGH HEADLINES WITH INCREASED COMFORTABILITY

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Abstract:

On the basis of the analysis, the question of the problems of the musculoskeletal system arising from the use of shoes with a high elevation of the heel is revealed. The reasons for the negative impact of this shoe on the body have been established.It was determined that the height of the heel elevation for high-heeled shoes, from which the negative effect of the shoes on the musculoskeletal system begins, is after the 50 mm mark.For people who do not use shoes with a high elevation of the heel for health reasons or age, the principles of using the illusions of visual perception in the artistic modeling of shoes have been developed. The possibility of correcting the external features of the legs with the help of shoes created using the illusions of visual perception is shown.

Keywords: Foot, disease, women, high-heeled shoes, musculoskeletal system, organism, posture, block, plaster casts, heel elevation

INTRODUCTION

At present, much attention is paid to human health throughout the civilized world. At the turn of the 21st century, many countries are faced not only with a demographic problem, but also with the physical weakness of their working population. A modern person should have large reserves of health, which allow not to reduce the quality of professional activity. Unfortunately, the main issue of our time is the dysfunction of the foot, namely, the appearance of foot deformities in more and more people. According to statistical studies, deviation from the norm occurs in more than 3/4 of the population.

In adults, static diseases are more common, which are associated with excessive stress on the legs. This is, first of all, overweight and the regular use of high-heeled shoes by women. Therefore, along with the tasks of orthopedics, the problem of creating high-heeled footwear (VKO) of increased comfort is urgent.

Many scientists have been studying the issue of the influence of VKO on the state and health of a person, but only recently, thanks to the creation of new research complexes, it is possible to expand the study of the problem and touch on the issue of the effect of regular use of high-heeled shoes on the musculoskeletal system and the body as a whole [1].

The article is based on a systematic approach to the study of the influence of high-heeled footwear on the disputable motor apparatus and the search for a constructive-technological solution to ensure the increased comfort of high-heeled footwear.

Due to the shift in the center of gravity, the load on the forefoot increases. As a result, there is a transverse flatfoot, accompanied by the spreading of the forefoot and the deviation of the first toe outward. The natural distribution of the load on the leg muscles is disrupted.

The natural distribution of the load on the leg muscles is disrupted. The result is a contraction of the gastrocnemius muscle and a shortening of the Achilles tendon. In addition, the redistribution in the work of the calf muscles leads to an increase in the load on the knee joint, which over time leads to the onset of arthritis. Constant overstrain of the calf muscles is fraught with the appearance of edema, spider veins and thrombophlebitis.

In order for the body to maintain balance in high-heeled shoes, the spine has to bend unnaturally in the lumbar region all the time. This, in turn, leads to uneven stress on the anterior and posterior edges of the intervertebral discs, which causes pain.

With regular use of high-heeled shoes, the position of the internal organs changes. Physiologically change in the curves of the spine, in combination with flat feet, leads to permanent microtrauma of the brain, impaired memory and attention, migraines.

The foot and the spine are links of the same system, therefore, disruption of one of the links leads to dysfunction of the entire structure. So the flattening of the foot affects the position of the pelvis and spine, which leads to poor posture. Poor posture will lead to diseases of the spine and spinal roots. This, in turn, adversely affects the functions of the cardiovascular and respiratory systems, leads to a decrease in physiological reserves.

The direction of ensuring the comfort of high-heeled shoes is very relevant, but little researched. The options for providing increased comfort are considered for shoes with different heel elevation heights. The main part of the work is devoted to supporting comfort - the transformation of the insole, sole, heel, heels. Such aspects of increased comfort are being solved as: the construction of the footprint, the stability of the heel, shock absorption in the heel of the shoe [2].

The pack is devoted to the study of the musculoskeletal system with different heights of the heel. To establish the optimal height of the EKR heel, at which the negative effect on the musculoskeletal system was minimal, anthropometric data and the results of monitoring the spine were obtained and processed at different heel elevations (h_k).

To study the posture at different hk and to design the last of high-heeled shoes of increased comfort, the following studies were carried out.

The survey made it possible to select a group of people to monitor the dorsal surface of the back. Students and staff of the institute were interviewed. As a result of the analysis of questionnaires, 32 out of 45 respondents were selected for further research. The objects of the study were young women from 18 to 30 years old. In the questionnaire, data about the subject were recorded: age, height, weight, what sports he did, or what musical instruments he played, the presence of visible abnormalities in the spine was also visually determined. When selecting subjects, in addition to the results of visual examination, the parameters of measurements on equipment for monitoring the dorsal surface of the back of objects were taken into account: the height of the object, weight, the presence of large dark pigment spots on the skin.

For further research by the method of anthropometric measurements, a foot was chosen in terms of parameters close to the average-average, anthropometric studies were carried out for it, plaster models of the foot were obtained for the heel elevation height of 0, 30, 50, 70 and 90 mm (vk). The main dimensional features of the foot and lower leg were determined with a measuring tape at the main anthropometric points. For the design of the last and shoe models, further verification of the last, the girth parameters of the foot were measured in standard sections [3].

To determine the state of the longitudinal arch of the foot and to construct the insole, the method of plantography was applied. To assess the state of the vault, indices and indicators were calculated that characterize the state of the longitudinal and transverse vaults. The processing of the plantogram showed that the selected foot was healthy, without deformities.

The average values of the parameters SAl, ST, C, I, L, K, SP, SI were calculated for the sample, statistical processing was carried out for them - the reliability and error of the experiment were determined. Generalized graphs were constructed, characterizing the dependence of each of the parameters on the height of the heel elevation.

With an increase in the heel elevation, the SA1 pelvic tilt angle (the concept of an overloaded pelvis) increases, which indicates an increase in lumbar lordosis in size and length.

The angle of inclination of the body ST (practically does not change, which is quite logical, so when bending forward, in order to achieve a state of balance, the body has to redistribute the load, namely, deviate posteriorly.

With an increase in the height of the heel, the degree of violation of the shape of the body (parameter C) is unchanged up to hk = 50 mm, starting from this height the value of the index increases. In addition, it can be said that the average value of the degree of trunk deformity in the sagittal plane in the group varies within the first degree [4].

The level of displacement of the border "lordosis-kyphosis" (index I) takes the optimal value at a heel height of 50 mm. This suggests that at a height of elevation of the heel of 50 mm, the value of the length of lordosis and kyphosis is closest to the norm.

People with different types of posture will differently transfer to the load on the spine in the position of elevation on the heel, therefore, when interpreting the results, we divided the study group according to the types of posture.

Also, this division allows you to order the results in order to avoid large variations in values. The entire group of subjects was divided into five groups depending on the type of posture. 1st group (5 people) KB - increased kyphosis (round or stooped back); 2nd group (20 pers.) LB increased lordosis (flat-concave or lordosis back, hyperlordosis); 3rd group (5 people) LKB - simultaneous intensification of lordosis and kyphosis (round-curved back); 4th group (Ipers.) LCNo - balanced lordosis and kyphosis are normal; 5th group (Ipers.) Hon - deformity not attributed to a specific type of posture. In a team of 32 people, a group of people with increased lordosis (62%) predominates, groups with an increase in kyphosis and a simultaneous increase in lordosis and kyphosis (16%), balanced kyphosis and lordosis, and deformity that is not attributed to a specific type of posture occurs in 3 % of subjects. For each group, individual and average graphs were plotted according to the parameters: ST-torso angle, SA

1-pelvic inclination angle, I - index of displacement of the lordosis-kyphosis border, C - index of body shape disturbance in the sagittal plane [5].

With an increase in the heel elevation for all types of posture, an increase in the SA1 pelvic inclination angle is observed. The torso angle (ST) remains largely unchanged. The index characterizing the displacement of the border of lordosis-knphosis (I) with an increase in the height of the heel elevation increases for all types of posture, except for the LB and LCP. This suggests that for people with an increased length and height of the arch of lordosis of the spinal column, shoes or high heels do not have a significant effect on the spine.Which explains the fact that some people who constantly use VKO cannot wear shoes with a low or medium heel elevation. The index of disturbance in the shape of the trunk in the sagittal plane (C) decreases with an increase in the height of the heel elevation for posture types LKNo and Hon, changes insignificantly for LCP and LB, does not change for - KB. According to the graphs, we can conclude that for all types of posture at a height of 50 mm, the angle of inclination of the pelvis SA1, the index of displacement of the lordosis-kyphosis border I, the index of disturbance of the shape of the trunk in the sagittal plane C reach optimal values (the values of the parameters before or after which there is spinal deformities).

According to the graphs, we can conclude that for all types of posture at a height of 50 mm, the angle of inclination of the pelvis SA1, the index of displacement of the lordosis-kyphosis border I, the index of disturbance of the shape of the trunk in the sagittal plane C reach optimal values (the values of the parameters before or after which there is spinal deformities) [5].

In addition, a study of the characteristics of the foot was carried out at different heel elevation heights, an insole assembly was built using modern materials[6].

The method of plaster casts. A plaster cast of the foot was obtained with uniform support on both feet. In contrast to the traditional technique, which assumes support on a flat base, the case of uniform support is considered, when a person's foot rested on a material. At the first stage, negatives were obtained - gypsum substrates for various elevations of the heel, on which a layer of material was laid. According to the marks made in advance on the pedilin surface, the foot was placed on a plaster base. Upper foot casts were obtained for each elevation (0, 30, 50, 70 and 90 mm). Further, the casts were oriented in the Cartesian coordinate system. On each impression, the cross-sections passing through the anatomical points of the foot were marked using a height-gauge: 0.07D, 0.18D, 0, ZD, 0.41D, 0.5D, 0.62D, 0.68D, 0.73D, 0, 8D, 0.9D.

Change in the height of the inner (BH) and outer dimensions (NAR) of the foot with different Hk in standard sections relative to the dimensions with uniform support on both feet with hk = 0 mm.From table 1 it follows that with an increase in the height of the heel portion, the change in the height of the inner dimension for standard sections is generally the same: so, up to a heel height of 30 mm, the size of the dimension increases, from the 50 mm mark, a decline begins. It shows LTO.

With the growth of the heel, starting from a height of 50 mm, the lowering of the inner vault is observed. It was determined that with an increase in the height of the heel, the outer arch rises, which indicates an increase in the degree of bending of the foot with an increase in the heel. In the region of the web, the width of the gauge becomes narrower, which is especially noticeable at a height of 50 mm, the width of the gauge in the bundles does not decrease significantly.

Table – 1

The nature of the foot support and the height of the heel elevation, hk, mm	Cross section									
	0,3 D		0,41 D		0,5 D		0,62 D		0,68 D	
Uniform support on both feet	VN	NAR	VN	NAR	VN	NAR	VN	NAR	VN	NAR
h_k=30 mm	10	22,1	-4,6	15,4	8,5	10,7	5	-5,3	2,3	5,2
h_k=50 mm	8,3	10	6,4	27	6,4	15,4	3,8	2,3	4,6	4,1
h_k=70 mm	3,7	41,3	-14,1	26,5	2,3	18,3	5,3	1,1	2,3	4,2
h_k=90 mm	3,5	73,8	-16,5	67,3	-5,5	17,7	-7,5	3,9	-3,9	1,5
Full support on one foot h_k = 0 mm	-1	-1	-4	1	-	-	-2	0	-5	-5

Based on the fact that the nature of the change in the inner and outer arches with different elevation of the heel corresponds to the change in the inner and outer lines of the dimension, it can be concluded that with the growth of the heel, the inner arch as a whole drops, and the outer one rises [7].

The article also discusses the issue of building blocks for high-heeled shoes of increased comfort. The basic conditions for designing a block for aerospace defense with a rational footprint are given:
- the longitudinal profile of the shoe in the area of the track in the heel part should be close in shape to the corresponding profile of the foot resting on a soft base, raised to a height (50, 70, 90 mm);
- the shape of the lateral side in the area of the web (outer arch) should be displayed in the footprint of the block;
- the shape and size of the shoe track correspond to the foot.

In the elevated position of the heel, the longitudinal arch of the foot is bent and unloaded due to the transfer of load to the toe-beam part of the track - this is how the outer arch rises and the inner one falls. Therefore, there is a need to provide a clearance in the under-pivot area to prevent disturbance of the spring function [8].

The data obtained using the method of plaster casts during the design were converted into parameters for the rational inner shape of the shoe. The inner surface of the footprint was designed using the plaster cast method to ensure a comfortable and correct position of the foot in the shoe. Also, when constructing the inner surface of the shoe track, changes in the size and shape of the foot under the influence of the weight of the body, and changes associated with the elevation of the heel were taken into account [9].

When building the shape of the toes, the main thing is to ensure the necessary height of the inner shape of the shoe so as not to injure the big toe. To ensure normal functional mobility of the toes along the length and width, it was decided to design the toe part of the shoe in accordance with the toe arch. In accordance with GOST 2927-88, the height of the block in the section 0.3 Ds-should be equal to 0.11 Oo <8.

Based on the data of the method of plaster casts, obtain the shape of the outer arch in the position of the foot support on a soft base and the shape of the inner arch, corresponding to the position of uniform support on one foot.

In the heel and in the area of the outer arch of the section, the pads were modified along the contours of the sections of the foot in the position of support on a soft base. In this case, the contour of the modified shoe track occupies an intermediate position - closer to the centerline it coincides with the contour of the foot, and diverges closer to the edges, becoming more flattened. In the fascicular region, the trace remained standard; it cannot be changed due to the great variability of the feet along the length of the metatarsal bones [10].

According to the obtained control templates, dummy blocks were made with a heel height of 50, 70, and 90 mm. An insole knot has been developed for women's high-heeled footwear of increased comfort with a heel height of 50, 70, and 90 mm. The insole was formed on the basis of the trace of the pads obtained.

Its goals are: to unload as much as possible the plantar surface of the foot in the area of the beams and heels; to increase stability in a standing position and when walking; improve blood circulation in the feet; to prevent fatigue of the lower extremities when walking on high heels; to prevent the development of pathological conditions of the musculoskeletal system; reduce the load on the spine, hip, knee and ankle joints.

Fulfillment of these requirements can be achieved through the use of materials with appropriate elastic-elastic properties, as well as the technology of manufacturing insoles. When choosing a brand of foam for the manufacture of insoles, one should take into account the weight of the wearer: the greater the weight, the more compressive stress is experienced by the insole material, therefore, the greater is its deformation. Based on a study of the foam market, materials from Otto Bock, a leading company in the production of orthopedic materials and devices, were selected. To increase stability and increase comfort, the materials of the insole assembly should be elastic and soft, and quickly molded to the foot [11].

In addition, she is devoted to the use of visual perception illusions (IVI) in the artistic modeling of shoes to correct the external features of the legs.

Taking into account the negative impact of regular use of air defense systems on a person, we are sure that not everyone will be able to use air defense systems of increased comfort. For adults with foot deformities, accompanied by pain, the use of high-heeled shoes, even with a rational footprint, becomes impossible. For the adolescent organism, EKO is not health-saving and contributes to the disruption of the foot and the entire musculoskeletal system.

In this regard, we proposed an artistic technique, in which shoes with a medium and low heel elevation visually slim the lower leg and look like a high-heeled one. At the heart of the xydivine reception are IZV, which open up the possibility for various design solutions that allow you to correct the external features of the legs.

The use of the laws of visual perception in artistic modeling of shoes is to improve the aesthetic properties of the shoes themselves, as well as harmonize the proportions of the lower extremities [12].

Most of the changes in body proportions arising from the use of high-heeled shoes can be achieved with the help of visual illusions. We have compiled a list of the external features of the lower extremities that are most common in women:
• full (thin) lower leg;
• long (short) lower leg;
• full (thin) knees;
• o - shaped lower limbs;
• x - shaped lower limbs;
• lower limbs arched in profile.

As a result of the analysis of data on WPI, which are more often used to correct the appearance with the help of clothes, for the given list of external features of the legs, the table "Application of WPI for the correction of external features of the legs" was compiled. Working with the table is carried out according to the principle of morphological analysis. The cells are filled with information about how a certain type of illusion works to a specific external feature of the lower extremities [13].

The use of optical illusions to simulate the external influence of high-heeled shoes, the collection "Illusion of Height" was created, model shoes with heels with a heel height of 50 mm were presented. The main idea of the collection is to create the illusion of slenderness in the lower limbs, similar to the effect achieved with high-heeled shoes.

Using various artistic and constructive solutions, we managed to:

- reduce the fullness of the lower leg
- increase the length of the lower leg
- create a beautiful profile of the gastrocnemius muscle
- give a graceful bend to the foot, thereby reducing its size
- visually increase the height of the heel

Based on the results obtained, the paper proposes a list of optical illusions used in artistic shoe modeling. The above principles of visual correction of legs by means of constructive and artistic design of shoes contribute to the harmonization of the proportions of the foot, lower leg and body as a whole, which will help in the development of shoes with medium heels for people who, according to health reasons, do not use high-heeled shoes (adolescents, adults).

CONCLUSION

On the basis of the analysis, the question of the problems of the musculoskeletal system arising from the use of shoes with a high elevation of the heel is revealed. The reasons for the negative impact of this shoe on the body have been established.

The effect on the spinal column of different heel elevation (0, 30, 50, 70 and 90 mm) was revealed. It was found that an improvement in the state of posture occurs with elevations of the heel of 30 and 50 mm, with a further increase in the height of the heel, a sharp deterioration in the parameters SA i (angle of inclination of the pelvis), I (index of displacement of the border of lordosis-kyphosis), C (index of disturbance of the shape of the trunk in sagittal plane). It was determined that the height of the heel elevation for high-heeled shoes, from which the negative effect of the shoes on the musculoskeletal system begins, is after the 50 mm mark.

The plantar surface of the foot was investigated by the methods of plaster casts; the obtained data were used to construct a rational track of the EKR of increased comfort. The values of the lowering of the inner arch of the foot were determined for the selected elevations of the heel, which are recommended for use in the design of pads for high-comfort aerospace defense.

On the basis of the parameters of the feet obtained from plaster casts, the sections of the pads were designed and their prototypes were made for high-comfort air defense with heel elevations of 50, 70 and 90 mm.

On the basis of a prototype of a shoe with a heel elevation height of 90 mm, an insole assembly was designed and manufactured, which differs from analogues in the design and use of modern orthopedic materials, which provides a reduction in the load in the area of the heel and toe-bundle parts, contributing to the correct position of the foot in shoes with a high heel elevation ...

For people who do not use shoes with a high elevation of the heel for health reasons or age, the principles of using the illusions of visual perception in the artistic modeling of shoes have been developed. The possibility of correcting the external features of the legs with the help of shoes created using the illusions of visual perception is shown.

With the use of IZV, a collection of model shoes "Illusion of Height" has been developed, imitating the external harmony of the lower extremities.

An artistic technique for modeling shoes has been developed, which creates the effect of a slender lower leg.

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