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Scientific and Theoretical Research on the Development of Requirements for the Design of Rational Shoes with Patients with Diabetes Mellitus

**UZAKOVA LAYLO POLVONOVNA, ABDURAKHMANOVA FIRUZA ABDUFARMANOVNA,
JURAEVA MUHABBAT IBODULLAEVNA**

Candidate of pedagogical sciences, associate professor of the department “Technology and design of leather, fur”,
Bukhara Engineering Technological Institute of the Republic of Uzbekistan
Senior Lecturer, Department of Technology and Design of Leather, Fur Products, Bukhara Engineering Technological
Institute of the Republic of Uzbekistan
Assistant at the Department of Technology and Design of Leather, Fur Products, Bukhara Engineering Technological
Institute of the Republic of Uzbekistan

ABSTRACT: This article presents the materials of scientific and theoretical research on the development of requirements for the design of rational shoes for patients with diabetes mellitus, as well as a number of important advantages compared to orthopedic shoes with ordinary shoes. The design of the top blank for special orthopedic shoes is proposed, that is, the elimination of traumatic seams, folds of any thickness, thickenings that can provide the patient with the most comfortable mode, eliminate any abrasions, and ensure an even distribution of pressure on the loaded sections of the foot, which are a threat to the development of trophic ulcers.

KEYWORDS: diabetic foot, heel with bevel, removable shock-absorbing insole, deformation of joints, optimal design of orthopedic shoes, rational redistribution of load on the plantar surface of the foot;

I. INTRODUCTION

Orthopedic shoes for a diabetic foot are an important means of preventing the formation of ulcerative defects. For the third part of patients suffering from this disease, wearing such shoes is mandatory.

Orthopedic shoes for diabetics help reduce the risk of the appearance of a diabetic foot several times, sometimes wearing it has a more pronounced effect than long-term drug treatment. The main purpose of orthopedic shoes for diabetes is to protect the feet from the process of formation of diabetic ulcers.

Orthopedic shoes for diabetes have a number of important advantages compared to regular shoes:

- ❖ does not have a compressive effect on the feet suffering from severe edema;
- ❖ has a minimum of seams that prevent skin trauma;
- ❖ has an easily extensible top;
- ❖ has a wide nose made of soft material, due to which the toes fit freely in the shoes and do not rub when walking;
- ❖ has a flexible not rigid sole, which absorbs mechanical impacts on the foot;
- ❖ has a tight backdrop, softened with a special gasket, which prevents the formation of corns and at the same time fixes the foot well;
- ❖ the internal volume of the shoe is regulated by laces or special velcro fasteners;
- ❖ the sole of such shoes does not have a heel or has a special heel with a bevel facing the front, which reduces the risk of injury;
- ❖ the presence of a removable shock-absorbing insole without arch support;
- ❖ high esthetics.



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Shoes for diabetic foot can be summer, winter and demi-season, in addition, it can be classified by age range and severity of foot pathology.

The main indications for wearing special shoes for diabetes are:

- diabetic polyneuropathy or angiopathy;
- operations associated with amputation of the lower limb;
- chronic osteoarthropathy, which is accompanied by deformation of the feet;
- the presence of diabetic foot syndrome (in the absence of ulcers and other defects);
- circulatory disorders in the toes;
- joint deformation (in order to compensate for this defect).

II. SIGNIFICANCE OF THE SYSTEM

The decision to wear orthopedic shoes in patients with diabetes is made by the doctor. It determines how effective the wearing of the product will be, selects the optimal shoe design.

When choosing orthopedic shoes, it is important to pay attention to how it looks, whether it has a platform or a heel. With a diabetic foot, they are not recommended. It is best to choose shoes with a closed upper, so the skin will be minimally affected by the external environment.

Every hour in the world there are 55 amputations of the lower extremities in patients with diabetes mellitus.

Despite significant world achievements in the study of the pathogenesis of diabetes mellitus and its complications, the number of leg amputations in diabetes is growing.

III. LITERATURE SURVEY

According to international statistics, the main risk factors for the formation of plantar recurrent ulcerative defects in diabetes mellitus is a combination of neuropathy with deformations, while the main risk of amputation belongs to ischemia.

The most important factor contributing to the development of diabetic foot ulcers is high plantar pressure. This factor affects only in combination with neuropathy. That is why any treatment must necessarily take into account the need for partial or complete unloading of certain zones or the entire foot.

There are a number of factors that can cause an increase in peak plantar pressures. These are such as internal factors, external and behavioral. Internal factors include foot changes in various deformations. Among the external factors for increasing plantar pressure, the use of inadequate shoes is most often observed, as well as the treatment of feet with sharp objects.

The lack of measures for unloading the foot, high plantar pressures can cause the formation of ulcers on the foot, which has lost sensitivity. There are three ways of damage. The first is the effect of the load on a very small area, for example on the fingers, even insignificant in time.

The second is constant squeezing with narrow shoes for several hours with the development of ischemic necrosis. The third way is the repeated effect of pressure on the affected area leads to the appearance and spread of infection into the deep tissues of the foot. The areas of protrusion of the bone structures of the foot are particularly susceptible to compression by footwear.

Extremely important is not only the treatment of foot damage in diabetes mellitus, but also the active prevention of foot damage.

In the acute and subacute stages of the process of this disease, a complete exclusion of loads on the foot is necessary.

IV. METHODOLOGY

In the chronic stage, patients need to be provided with individual orthopedic shoes.

Unloading the middle part of the foot with progressive deformity is an extremely important task since increasing biomechanical disturbances in the foot cause ulcerative necrotic processes resulting in amputation of the limb.

When choosing shoes for a patient with diabetes mellitus, first of all, one should assess the presence of risk factors that allow the patient to be classified as a risk group for diabetic foot, as well as the degree of activity of the patient, his age and social level.



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When appointing shoes, the following problems associated with the type and shape of the foot should be taken into account:

- ✓ loss of “protective” sensitivity - susceptibility to abrasions, compression of shoes, minor injury;
- ✓ development of typical deformities due to motor neuropathy;
- ✓ typical plantar localization of ulcers and risk zones due to the concentration of peak plantar pressures;
- ✓ hammer-shaped fingers and ulcerative defects located on the plantar and back surfaces of the fingers are characteristic;
- ✓ development and formation of an ulcer in the center of the foot or deformities of the back of the foot, with a violation of the biomechanics of walking.

In addition to the above features, you should also consider such additional problems that complicate the use of shoes:

- the use of a bandage in cases of damage or the occurrence of edema of the foot may lead to the need for temporary use of shoes with additional volume;
- in obese individuals, it is possible to expect a significant increase in the load on the longitudinal arch of the foot, which requires an insole with biomechanical correction;
- in patients with arthritis, it is possible to expect difficulties when using strap fasteners, in these cases Velcro fasteners should be used.

Thus, providing patients with diabetes with orthopedic shoes should help:

- restoration or compensation of the standing and walking function; rational redistribution of load along the plantar surface of the foot;
- prevention of trauma to the soft tissues of the foot and, as a result, the appearance of purulent-necrotic complications; prevention of early amputations within the foot.

Patients with "diabetic foot" syndrome need special shoes or special orthopedic devices that can provide the patient with the most comfortable mode, eliminate any scuffs, and ensure even pressure distribution on the loaded "peak" sections of the foot, which are a threat to the development of trophic ulcers.

According to the normative documentation, “diabetic” shoes are divided into individual - made strictly according to the plaster cast; and individualized - that is, shoes made on a special "diabetic" block, but with an individual insole attached.

The materials from which special orthopedic shoes are made should provide good ventilation, be hygroscopic. When designing the construction lines of shoe parts, it is necessary to take into account the biomechanics of patient walking.

Particular difficulties arise in the manufacture of shoes for patients with concomitant deformities, often accompanying “diabetic foot syndrome”. For example, patients who underwent amputation, in addition to the above requirements, are shown, if possible, compensation for the lost part of the limb, as well as the restoration of its supporting and locomotors function.

When prescribing supplementary corrective devices to patients suffering from static flatfoot, the manufacture of “semi-insoles” is unacceptable. Inserted internal parts of the shoe should be made along the contour of the draw pads, and raising the vaults must be done with extreme caution.

The shape and geometric dimensions of the pads should provide the necessary footwear for the toe, to take into account the thickness of the interstitial layer, to correspond to the optimal height of the heel of the heel of the foot.

In case of edema growing at the end of the day, it is advisable to recommend shoe designs with parts that regulate the volume parameters, while the pads should ensure the use of the maximum (possibly non-standard) volume.

It is necessary to take into account the case of the use of replaceable inset soft devices in one shoe design, which can be used as swelling increases. This option pads must be made individually and take into account the full, long and high increments depending on the deformation of the feet.

V. EXPERIMENTAL RESULTS

The design of the top blank for special orthopedic shoes for patients with diabetes mellitus should be devoid of traumatic seams, folds of any thickness, thickenings. When designing designs for special shoes for patients with diabetes, it is advisable to consider the following:

- the design of the shoe has an allowance that takes into account the thickness of the insert orthopedic insoles;



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- have a minimum number of cutting parts in the area of obliquely beam part;
- the lining is built with a minimum number of parts and lines;
- in the designs of shoes and low shoes to use for fastening shoes on the foot (depending on the deformation of the diabetic foot) laces, belts with buckles, belts with Velcro tape;
- to design a soft tongue in the designs of boots and low shoes, which prevents rubbing during edema of the foot or bandaging;
- the design of summer shoes for holding on the foot must be secured with a lifting belt;
- limit the use of elastic braid; use it in cases minor deformations of the feet;
- high aesthetic characteristics of shoes, including designs one of the components of the psychological comfort of patients.

Frame parts provide shoe shape stability, reliable fixation on the foot, protect the foot from traumatic deformations. These include backdrop, toe cap, side panels, insole plates. The back securely fixes the heel part, a soft toe cap protects the forefoot from internal traumatic deformations. The sides give increased shape stability to the beam and gel parts of the shoe. Steel plates are recommended for patients with partial amputation of the foot to fill the empty space in the shoe. However, when designing special shoes for patients with diabetes mellitus, the frame details of the top are designed only in special designs, since they create additional rigidity in the shoes or are laid with additional softening elements.

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