



METHODS FOR ASSESSING INTERACTING FORCES BETWEEN SHOE AND FOOT

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<https://doi.org/10.5281/zenodo.7450643>

ARTICLE INFO

Received: 08th December 2022

Accepted: 15th December 2022

Online: 17th December 2022

KEY WORDS

Anthropometric parameters of the foot, design of impressions, shape of the heel surface, heel pressure, specificity of the base surface.

ABSTRACT

The article proposes a method for assessing the forces of interaction between shoes and the foot (relative distance, relative stiffness, stiffness), statics and dynamics of the foot in order to ensure high comfort in shoes.

Both the general condition of a person and his performance depend on the comfort of shoes. Creating comfortable shoes of a certain type and purpose is a complex task and depends on the solution of problems in the field of technology and design of shoes and leather. However, reliable anthropometric parameters of the foot, which are taken into account when designing shoe molds, play a key role.

Karagezyan Yu.A., Fukin V.A., Zybin Yu.P. et al. have established in their scientific works that the improvement of the ergonomic properties of footwear and its comfort can be achieved by using the internal holes of the footwear in the surface of the profile made of polymeric materials. Matching the footprint to the shoe reduces the pressure of the heel on the base surface, reducing the fatigue of the calf muscles of the spine.

The analysis of most scientific papers has made it possible to raise the forms of the heel surface to a higher level with the

help of graphic imaging methods. But at the same time, the problem of creating comfortable shoes remains relevant, since it is not possible to objectively assess the comfort of shoes due to the lack of scientifically based selection criteria for reasonable material sets.

So far, the properties of shoe materials are based on their individual characteristics, which almost do not characterize the comfort of shoes, since they evaluate their quality and upper materials, regardless of the static and dynamic position of the foot. In addition, no sets of materials have been identified that determine the rationality of the shoe design in terms of the forces of interaction between the upper and the boot. It is known that during the day the foot changes its original size and the size of the base surface. Therefore, due to the specifics of the base surface of each foot, the profile insole, made according to the arithmetic mean plantogram, is not fully applicable to all types of feet, even in the

same sizes. One of the main criteria for walking in comfortable shoes is that these shoes are evaluated by the fact that the materials withstand the allowable pressure. Using information about the interaction of the foot and shoes allows you to carry out calculation work in two directions in comfortable shoes:

1. Creation of mathematical models of footwear surfaces;
2. Selection of materials with optimal physical and mechanical properties.

It is known that when a person moves, the foot performs work related to overcoming not only the forces of inertia, but also the forces of deformation of the shoe materials. For this, the theory of shells was used, which makes it possible to relate the geometric parameters of the object under study with the deformation properties of these materials and the force factors acting on the object.



When solving the problem, the upper part of the base is presented as a shell, as it has a thin-walled structure consisting of a combination of materials subjected to various influences (static and dynamic force and heat), such as a geometric shell.

The methodology for assessing the comfort of footwear in terms of its physical and mechanical properties consists of the following sequence of recommendations.

- ❖ determine the physical and mechanical properties of the material in terms of stiffness and elongation of the tested foot skin;
- ❖ determine the amount of pressure on the heel relative to the boot using the optimization equation. The obtained pressure values are compared with the permissible limits and a conclusion is made about the acceptability of this shell;
- ❖ the right choice of the optimal material for indicators.

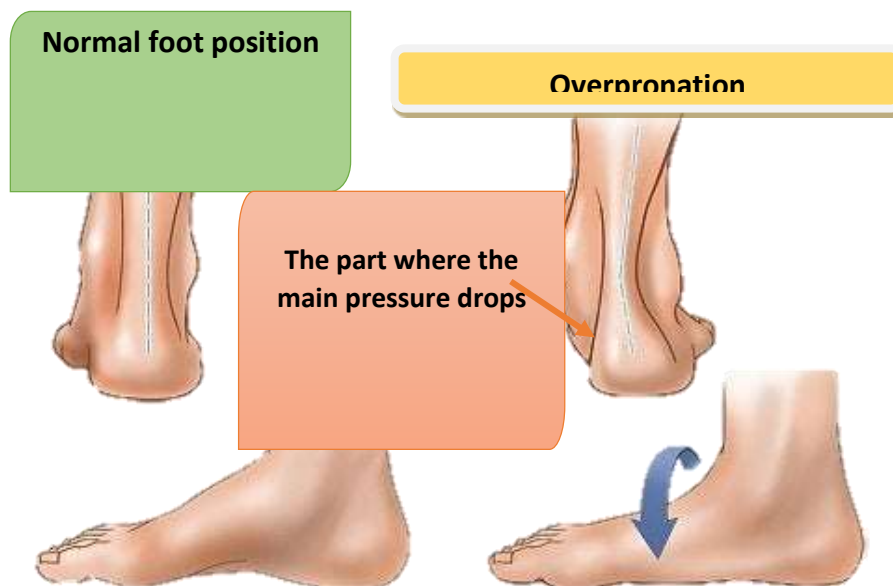


Fig.1. Parts subjected to pressure in the static and dynamic position of the foot.

As a result, we compare the material parameters (to create a shoe design) with the recommended optimal values.

Consequently, the developed technique allows drawing conclusions about the rationality of the design of shoes at the



design stage based on a set of indicators, which means that it can improve the comfort of shoes in two ways:

1. Selection of a set of materials, assessment of its suitability based on its physical and mechanical properties;
2. Calculation of deformation properties of materials for certain structures.

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