Development of rational approaches to the selection of initial data for the design of clothing for people with statodynamic function disorders

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Abstract:

Currently, there are several ways to create clothing for people with disabilities. These methods are aimed at creating modern ergonomic clothing that allows ensuring a comfortable state in everyday life. In the course of the research, several tasks are identified: ensuring the possibility of taking off and putting on clothes; ensuring the convenience of staying in the "sitting" position; ensuring the possibility of making clothes in a non-fitting way.

To solve these problems, the features of the biomechanics of the motor system of people with various types of diseases were considered. According to the results of the research, trial samples of dress up and dress down were made, which in the test showed a high degree of compliance with the requirements.

Keywords: people with dexterity impairment, disorders of the statodynamic function of the musculoskeletal system, taking off, putting on, biomechanics of the motor system, the "sitting" position.

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1. Introduction

By In 2006, the United Nations Convention on the Rights of People with Disabilities was adopted, and is the first legally binding international UN instrument on disability that sets out the minimum standards that governments must meet to ensure that people with disabilities can effectively enjoy their civil, political, economic and social rights. The Convention specifically recognizes disability as a human rights issue. This Convention does not create new rights, it

clearly prohibits discrimination against people with disabilities in all areas of life, including civil rights, access to justice and the right to education, health services and access to transport [1]. The measures developed by the Government of the Russian Federation for a comfortable stay of a person with dexterity impairment (DI) in the environment and the conditions created in this regard for staying in society [2], highlight the task of purposefully improving the range and quality of clothing for people with limited mobility, which occupies a special place in the complex of measures to ensure the successful and safe activities of people with DI.

Providing various contingents of disabled people with special ergonomic clothing, comfortable and convenient for everyday use, will significantly increase their level of self-service and thereby reduce life restrictions. The creation of special clothing that can compensate for the lost motor functions or create comfort and illusorily hide the affected parts of the body is quite an urgent task both in the medical and social aspects.

2. Objects and methods of research

The object of the study is clothing for people with statodynamic function disorders. The general methodology of a systematic approach to the design of clothing, methods and means of ergonomic biomechanics was used in the study.

The aim of this study is to form the initial information of the process of designing clothing for people with statodynamic function disorders.

3. Results and discussions

There are four degrees of the statodynamic function (SDF) disorders - mild, moderate, pronounced and significantly pronounced. The dependence of disabled people (partial, moderate or complete) on physical assistance is determined by the level of their motor activity when performing household activities, social and professional employment, the need for technical means of rehabilitation, the need for additional help or care [3, 4].To achieve the aim of the study, the following tasks were identified:

- ensuring the convenience of taking off and putting on clothes by a person with the statodynamic function (SDF) disorder of the musculoskeletal system;
- comfortable stay in the "sitting" position for a long time;
- search for the possibility of making clothes in a non-fitting way.

Currently, there are several ways to create clothing for people with SDF disorders. All these methods are united by the common task of creating comfortable, inclusive clothing that helps the wearer to fully feel in society. To solve these problems, the following methods of creating special ergonomic clothing for people with SDF disorders are proposed: development of original

design and technical solutions based on the generalized experience of designing and operating products for the appropriate purpose (the principle of "design invention"); purposeful development of a rational (optimal) design solution based on deep penetration into the structure of the studied system "person-clothing-environment".

Clothing used by disabled people for functional purposes can be divided into clothing for self-service (buttons, hooks, loops, Velcro closure, loose zipper tape, bearers); to facilitate the actions of service personnel; for the convenience of using prostheses (availability of balancing fasteners-Velcro closure, loose zipper tape in the places of articulation); as well as for the illusory concealment of morphological defects (the use of a special cut, decoration of prostheses, etc.). When performing self-service, the main role is played by the safety of movements in the upper extremities. Most of the actions that make up the self-service of I, as well as II degree can be compensated with the help of auxiliary technical means and adaptive devices. More severe self-service restrictions (partially II degree and fully III degree) require assistance or care provided by another person.

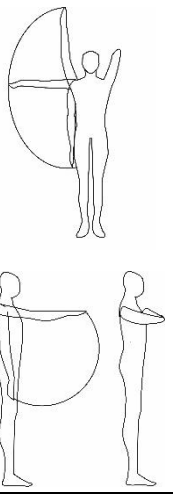
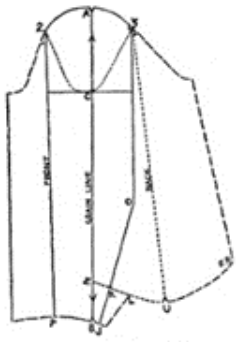
The performance of such elements as putting on and taking off, as well as performing physiological functions, in addition to auxiliary devices, can be compensated by providing special clothing designed so that it can be used with defects in both hands or one hand, if the defect affects the proximal parts of the hand. The performance of putting on and taking off dress up requires the preservation of movements in both hands, almost the maximum amplitude of movements in the shoulder and elbow joints, and the preservation of the functions of grasping and holding the hand. So, putting on and taking off clothes from the upper torso (shirts without fasteners, sweaters, etc.) require the ability to raise the arms in the shoulder joint above the horizontal level, i.e. the participation of not only the shoulder joints, but also the shoulder girdle, flexion and extension of the arms in the elbow joint and the preservation of at least several types of grip in one hand. Putting on and taking off clothes from the upper part of the torso that have a cut in the front (coat, raincoat, jacket, etc.) requires the possibility of at least an end grip (with the participation of I finger) of one hand. Putting on-taking off dress down (skirts, trousers) requires flexing the arms in the shoulder joints, flexing and extending in the elbow, wrist joints, gripping at least one hand with the participation of I finger. When performing physiological functions, manipulations are carried out with the clothing of the lower part of the trunk (trousers, skirt, underpants) and they are carried out with the help of specific movements that require lowering (but not taking off) trousers, underpants, fixing them and exposing certain parts of the perineum. In men's clothing, for urination, the lowering of trousers and underpants is not required, but the preservation of the manipulative functions of the hand is necessary. When using a skirt in the exercise of physiological functions, lifting and fixing the hem of the skirt, lowering and fixing the panties is required.

Thus, the development of clothing requires preliminary biomechanical studies, in which the nature of movements is determined by the amplitude of movement of the upper and lower extremities. Table 1 shows a fragment of the choice of the design and technical solution of the product to ensure the process of putting on and taking off the dress up (the possibility of solving the first problem).

To implement the second task, an ergonomic analysis of the biomechanics of the injured person' s posture and movements caused by the specifics of person' s position in the wheelchair was carried out.

Optimization of the "low-mobility person – clothing – wheelchair" system requires accurate information about biomechanical parameters. The conjugacy of the elements of the "person – clothing" system is primarily determined by the anthropometric correspondence of the product to the size and shape of the human body when performing various types of movements. Therefore, when studying the biomechanics of motor processes for design purposes, it is necessary to establish quantitative values of changes in linear parameters (dimensional features) with changes in angular parameters (the amplitude of movement in the main joints).

Table 1. The choice of a constructive and technical solution of the sleeve for various degrees of self-service

Degree of dependence on physical assistance	Part of the body	Movement scheme	Design solution	Design drawing
Partial degree of dependence	Hand		Designing an asymmetric sleeve cut	

Describing the position of the body of a person in a wheelchair from a geometric point of view, Dr. Herman D. Kamenets states: in this position, only the ankles are located at an angle of 90

degrees, the legs are raised by 15 degrees, so that the angle of flexion in the knee joint X1 forms an angle of 105 degrees, and the back is tilted back 10 degrees, due to which the back and the angle of flexion in the hip joint X2 are at an angle of 100 degrees (Figure 1) [4].

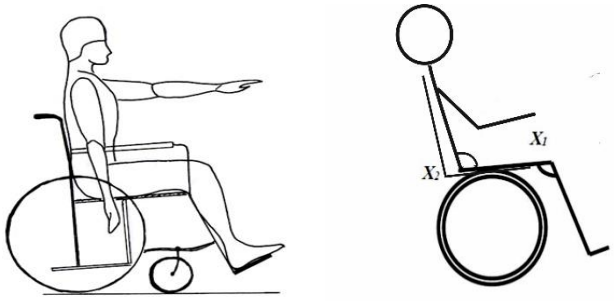


Figure 1. Correspondence of the image of a person with SDF disorder and the bio-kinematic pose

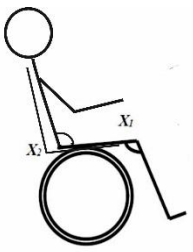
In the structure of the ergonomic provision of clothing for the "sitting" position, the following components should be noted, formulated earlier in the author's research:

- dynamic effects of the main and additional dimensional features (absolute and relative values);
- mathematical models of the dependence of relative dynamic effects on angular biomechanical parameters of movements;

- developments of ergonomically rational design solutions that ensure the convenience of the "sitting" position for a long time [5].

Table 2 shows a fragment of the variant of the design and technical solution of trousers that provide a comfortable stay in the "sitting" position.

Table 2. Fragment of the database of the choice of the design solution of trousers when designing clothes for people with SDF disorder

Anthropometric scheme	Design solutions	Design drawing
	1) Increasing the front-back balance on the back of the trousers in the waist area to provide a backup area when increasing the distance from the waist line to the subcutaneous shir; 2) Use of pintucks and shirs in the knee area on	

	the front of the trousers to provide a reserve area while increasing the distance from the waist line to the knee point; 3) Using bearers and elastic bands to attach the shoulder to the torso; 4) The presence of a zipper on the loose zipper tape in the middle of the front of the trousers and along the side seam of the front of the trousers to the bottom or knee level to ensure convenience when putting on and taking off the product.	

This solution option involves the coordination of art-design and ergonomic solutions. In the conditions of a given preliminary design, the designer needs to offer a rational transformation of the templates of the details of the original model structure in accordance with the parameters of human movements in the main joints.

The complexity of designing clothes for individual orders for people with SDF disorder is the presence of a problem, and sometimes the impossibility of fitting. In addition, today this category of citizens is not provided with comfortable clothing in sufficient quantities, and the clothing itself does not fully meet their anthropometric characteristics (possible ways to solve the third problem).

Providing the design of dress down (trousers) in a non-fitting way for people moving with the help of a wheelchair, it is possible to count the use of special patterns, according to which it is possible to pre-calculate the size of the reserve sections of trousers to ensure dynamic compliance with figures of various sizes.

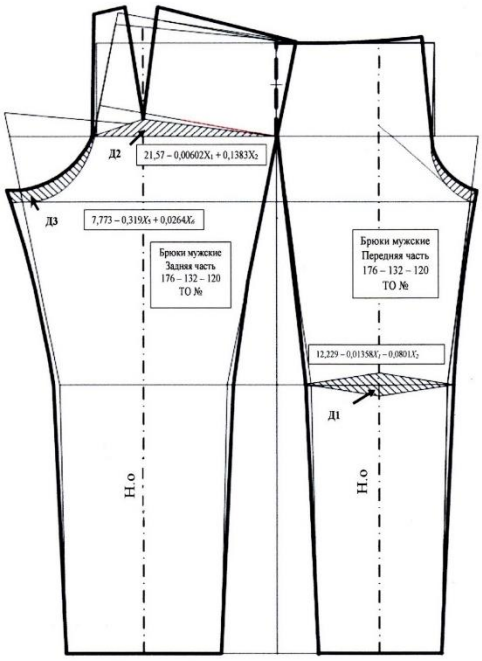


Figure 2. Patterns for adjusting the size of the details of trousers

For the manufacture of dress up in a non-fitting way, a special women's vest is proposed, the novelty of which is confirmed by obtaining a patent, which makes it possible to develop a design for a contingent with limited motor capabilities, moving with the help of a wheelchair, whose physical capabilities are limited only by the "sitting" and "lying" pose [6]. The women's vest is designed to determine the deviation of the measurements of an individual figure from a typical one, followed by changes in the design of a specific figure. The use of a vest allows reducing or eliminating the process of fitting the product on the figure, creates comfortable psychological conditions for the customer when making clothes.

4. Conclusions

Clothing specially designed in accordance with the needs of a person with statodynamic function disorder will allow them to provide a comfortable physical and emotional state, and ultimately, will improve the quality of their stay in society.

The proposed methods of designing clothing for people with SDF disorders were tested in the manufacture of dress up and dress down for individual figures and received positive feedback from consumers.

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