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ABOUT IMPROVEMENT OF THE UNION OF THE ORTHOPEDIST AND PRODUCERS OF CORRECTIVE MEANS FOR REDUCTION OF PATHOLOGICAL DEVIATIONS OF FEET AT CHILDREN (MESSAGE 2)

Abstract: *in the article, the authors have developed recommendations for the orthopedist and manufacturers of orthopedic shoes on its correct selection, taking into account pathological abnormalities, to ensure the formation of a healthy foot for the child, excluding the formation of pathological abnormalities. At the same time, the authors substantiate their concern about the reduction of social protection of families in Russia, whose children have pathological abnormalities, to provide them with free service from an orthopedic doctor in regional centers with mandatory payment by social bodies of municipal, regional and Federal branches of government of the costs of manufacturing medical, preventive shoes and corrective products that create comfortable conditions for the child's foot.*

Key words: *valgus, varus, clubfoot, hard side, pronator, oblique, cork, arch layout, beveled heel, lacing, hard heel, hard toe, special soft, hard and metal corrective parts, range of shoes, pathological abnormalities, anthropometry, demand, implementation, competitiveness, demand, financial stability, plantography, rengenography, plaster casts, prosthetics, rehabilitation.*

Language: *English*

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Introduction

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the beginning (the first part)

Walking - is an automated motor act, carried out as a result of extremely difficult to coordinate the activities of the skeletal muscles of the trunk, lower limbs. Human Walking composed of individual steps which are easy locomotory cycle where two phases are distinguished: the transfer and support. when the diseaseICP delayed and disrupted the formation of all motor functions. In this case, movement disorders can vary widely. In the design of orthopedic shoes with high effect for the rehabilitation of children with cerebral palsy is important to take into account the

specifics of the static, locomotor functions and movement disorders.

Human movement and the proper functioning of muscles as a whole is only possible with the normal innervation. All the nerves entering and passing through the muscles should not be damaged and have breaks.

When flaccid paralysis or paresis of the affected muscle tone sharply lowered, active movements are absent or weak, there is no tendon reflexes. Is either wasting (decrease in the amount of muscle that can function normally) or atrophy (complete absence of movement) of muscles, so when walking in patients with flaccid paralysis or paresis of the lower extremities, there is a wobble in the joints. For flaccid paralysis or paresis of the lower limbs is characterized by equinus foot (ie, the foot is in plantar flexion or, in other words, sag foot). With this foot position, so as not to touch the supporting surface during walking, the patient has much to bend the leg at the hip and knee joints.

Several distinct types of walk: normal, with additional support and pathological, which can occur in violation of joint mobility, loss or violation of muscle function, as well as in violation of the masses - the inertial characteristics of the lower extremities. Biomechanical structure walk usually considered, highlighting the following elements: the spatial structure of walking;temporal structure walk; kinematics walk; dynamics walk; innervation structure of walking.

The basic biomechanical features walk: reducing the duration of a portable phase flexion setting the lower limbs, the restriction of motion in joints, and reduction of the deformation curves constituting the reference reaction[1].

A detailed comparison of the kinematics of the joints when walking in normal and cerebral palsy is presented in Figure 1.

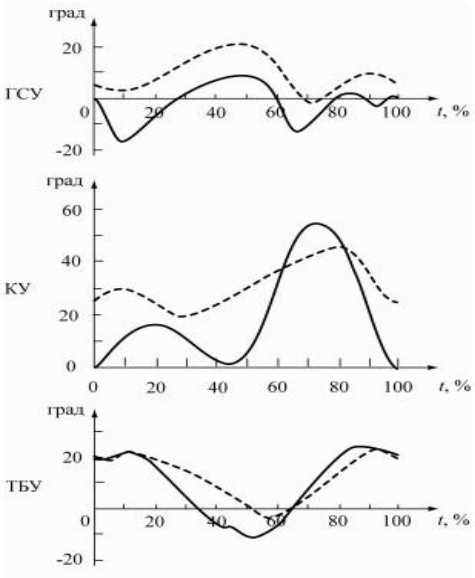


Figure 1 - graph of angular displacement of the joints of lower extremities during walking normal (solid line) and cerebral palsy (dotted line).
GUS - ankle angle CG - knee angle TBU - hip angle

The graph of angular displacement of the ankle angle (GUS) that the first plantar flexion is reduced due to the short-term rolling through the heel. Dorsiflexion at support phase increases due to the pretilt tibia forward second plantar flexion is reduced, indicating an insufficient repulsion from the support foot; dorsiflexion in its transport phase has a small amplitude, that is the possibility of snagging the toe support surface.

From an analysis of the angular displacement of the knee joint (CS) can conclude that the patient is not straightening full leg in the joint, for carrying phase puts on a support bent limb, then it slightly unbend and as soon begins roll stack through the front part, again flexes. When analyzing the angular displacement of the hip joint (TBU), there is only a reduction of the angle of extension, while maintaining the basic elements of the curve.

Research phase traffic stop and the state of the ankle showed that the time of the foot support and the footprint associated with the design of the shoe. Thus, the biomechanics of the movements of children with this disease determines the choice of constructive and technological solutions making shoes. Thus, in the case of maximum support for the toe portion of the foot, the shoe design operate with increased stiffness

in the frame parts nosochno beam portion. When a longer phase of support to the heel - reinforce the frame parts in the heel-gelenochnoy part.

In this connection, for the creation of designs of orthopedic shoes, important analysis of locomotor disorders.

Main part

Harusheniya musculoskeletal system in children with cerebral palsy are associated with developmental disorders or damage to motor mechanisms of the central nervous system (CNS).Muscle imbalance child with cerebral palsy, is manifested in the inability to perform voluntary movements. In this case violated the acts of standing and walking, movement coordination. There is a predominance of flexor tone, leading, proniruyuschey muscles. Develop flexion (flexion-pronation) installation and contractions of the limbs, kyphoscoliosis, kyphosis, scoliosis of the vertebral column. When spasticity is no phase relaxation of muscles, which leads to a slowing of its growth and development, "short muscle syndrome", resulting in contractures appear. In further developing malnutrition tissue and replacing it with the loss of connective tissue contraction.Motor motion for cerebral palsy are often accompanied by sensitivity defects, changes in cognitive and communicative functions, disorders of perception, behavior, and seizures.

When ICP observed violation of muscle tone, which plays a leading role in migration movements and their resistance, stability and flexibility. There is a dysfunction of the "kinetic melodies" movement[2]: From smooth it becomes a jerky, dezavtomatizirovannoe consisting of individual, unrelated to each other elements. When postcentral Abuse cortical afferent observed apraxia and failure analysis of cortical kinesthetic pulses expressed in difficulties select the desired combination of movements.

By the phenomena of underdevelopment are synkineses: involuntary movements that are not related in the sense of arbitrary motions. Table 1 shows the data movement disorders, depending on the form of cerebral palsy [2].

Table 1 - Movement disorders with cerebral palsy [2]

form of cerebral palsy	movement disorders
spastic diplegia	Impaired function of muscles on both sides. Ranging from those expressed paresis to mild embarrassment. Delay straightening trunk reflexes.
double hemiplegia	Always dominated by muscle rigidity, reinforced under the influence of surviving over time tonic reflexes.
hyperkinetic	Paralysis and paresis, manifested in the form of slow, gummy worm-like movements and seizures with muscle contraction. Latency reduction of tonic and righting reflex. Muscle stiffness in the neck, torso and legs. Involuntary muscle movements.
Atonic-astatic	Low muscle tone in the presence of abnormal tonic reflexes. Absence or hypoplasia of the righting reflex. High tendon reflex and periostanalny. Trunk ataxia. Incoordination.
hemiparetic	Trophic disorders, bone growth retardation. Struck by one of the sides of the body.

Symptomatology of the disease can somewhat reduced by the background of the conservative treatment (medication, the use of botulinum toxin drugs, physical therapy, etc.), but this is only possible at an early age (usually up to 5-6 years) and often to a small extent. Subsequently patients having a background persistent high muscle tone sets them irreversible degeneration and shortening, which leads to limitations in range of motion joints (contracture) curving bones and the development of subluxation and dislocation.

Common functional activity of the patient in a familiar environment for it can be estimated on the international scale classification of motor functions GMFCS patient (Global Motor Function Classification System). It is important that it is estimated the daily activity level, rather than the maximum possible, demonstrated only during the study. The scale is divided into 5 levels, each of which has different movement possibilities and different ages. On a scale established by the child's ability to move, including the use of assistive technologies. The levels of motor function on a scale GMFCS presented in Figure 2.

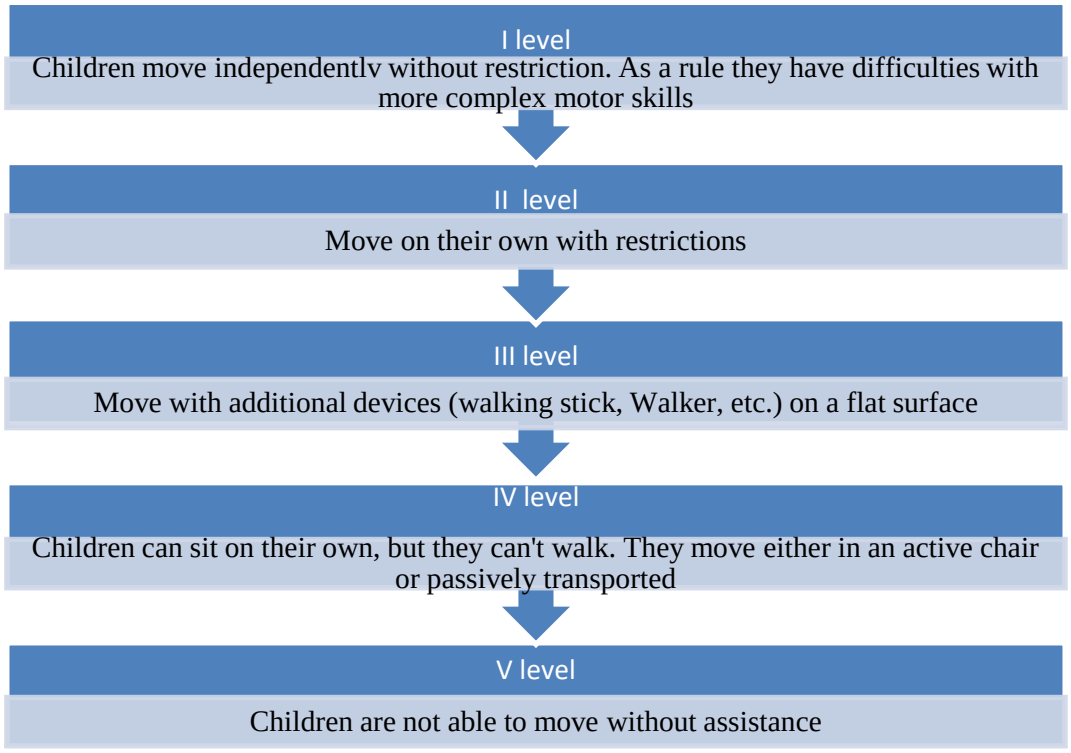


Figure 2 - The levels of motor functions GMFCS scale [83, 84]

Figure 2 shows that consumers are patients orthopedic shoes first, second and third levels of motor functions GMFCS scale. In this case, the first level of the patients in most cases, use orthopedic shoes, supplemented by individual orthopedic insole. Patients of the second and third levels increasingly used exclusively individual shoes. Important interrelation of accuracy of movements with a form of cerebral palsy. Thus, in the form of ataxic cerebral palsy observed imbalance associated with a defect regulation of the distribution of muscle tone in the group of muscles that maintain posture and precision of movement.

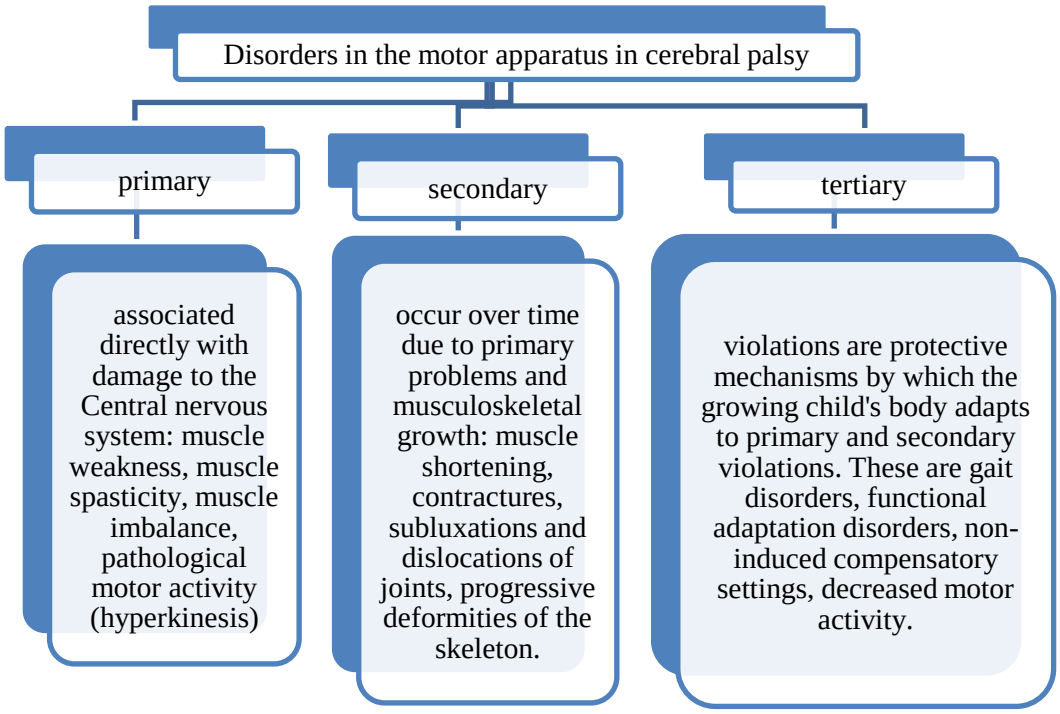


Figure 3 - Types of disturbances in motor apparatus with cerebral palsy [3]

When spastic form broken biomechanical component retention posture stability, while dyskinetic form - extrapyramidal postural control. Disturbances in the motor unit can be either primary, directly related to the CNS, and arise from the underlying causes. A more detailed description of types of violations in the motor unit at disease ICP is shown in Figure 3.

An important characteristic of static and motion as a healthy person, and the person with the disease cerebral palsy, is to find the total center of gravity (center of mass) and its projection on the bearing area. Distinguish the common center of gravity (bct) of the human body and the centers of gravity of its parts.

The common center of gravity of the whole body - is an imaginary point to which is attached the resultant force of gravity of all parts of the body [3]. Bct consists of the centers of gravity of the individual parts of the body and affects the balance of the body and its degree of stability.

If you change the posture of the body OCM shifts, and in some cases, particularly when bending forward and back, may be outside the human body. The center of gravity of the foot located on the straight line connecting the calcaneal tuberosity of the calcaneus to the end of the second finger at a distance of 0.44 from the first.

Analytical method for determining based on addition bct moments of gravity on Pierre Varignon theorem: "The sum of moments of forces, with respect to each center point is equal to the sum of these forces (or resultant) relative to the same center."

Any body can be regarded as a set of point, which serve, for example, molecules. Newton's laws for the material point with almost no changes are applicable to the real body, if we introduce the concept - the center of mass (CM).

Body weight and weight of the individual segments are important to the various aspects of biomechanics. For the analysis of body movements using the method of segmentation of the body: it is cut to certain segments. For each segment is determined by its mass and center of gravity.

Thus, compensation balance disorders in structures is achieved due to balance all parts of products used by humans. Extrapolating the foregoing in relation to the construction of orthopedic shoes.

In the development of orthopedic footwear is necessary to focus on her weight. Control of the masses of shoes is essential for maintaining or changing the body center of mass.

As shown above, the weight of the human body depends on the mass center of mass points from which it is composed. In calculating the center of mass of the weight to be considered a technical means of the rehabilitation (TCP), in particular orthopedic shoe, the weight of which will also affect the change in center of mass. Of the guidelines, "Hygienic requirements for children's shoes," [4] stations 46429990-010-2015 "Children footwear with uppers of leather" [90] and technical regulations customs union TR CU 007/2011 "On the safety of products intended for children and teens "it follows that the weight of shoes for small children should not exceed 300 g .; preschool - 380gr. and relate to the everyday mass-produced footwear. In

the GOST R 54407-2011 "Orthopedic footwear. General technical conditions "[1] pointed out that the mass of orthopedic footwear to individual manufacturing parameters not regulated.

However, there are cases in which the weight poluparah shoe is different. This may be due to the different composition of elements corrective insole; weight parts shoe upper materials caused by design features in whole or features frame parts; Weight accessories defined design features; weight soles associated with the presence of corrective elements (compensation due to shortening of the sole, to bear heels, etc.). Figure 4 shows a sample shoe, one polupar which carcass part fixed to the foot of the metal buckle.

Figure 4 - The sample shoes with different weight polupar

The difference in weight of the right and left polupar is 86 grams. Thus, wearing shoes with different weight polupar manifested in a difference of weights of the segments (lower limb) and leads to a shift in the total center of gravity, the position of which impact on the biomechanics of the motion.

Introduction weighting for rehabilitation described in detail in [5]. The author considers a healthy baby's body as a system of material points with a known center of mass (CM), and claims that its weight is evenly distributed relative to the axis of symmetry. Thus, the child maintains equilibrium by equalizing the internal forces of the body. In that case, if the figure of a man has any morphological disturbances, balance preservation condition remains the same, but in this situation, the child is forced to compensate for the displacement of one of the segments of the body changes in the position of others, thereby making up for the lack of weight and equalizing torque. When you add the goods to one of the segments of the body there is a change of torque CM. Thus, knowing the coordinates of the CM system author [5] suggests that by moving the center of mass of one of the body segments, thereby changing the torque, the child's body will tend to return point CM whole body in a starting position. Presented in [5] indicates that maintaining the balance of the equilibrium conditions is a key factor in the design of products for ICP. The main objective in the design of footwear design is to find locations of latches parts to ensure low amplitude vibrational movements and enhance their own body sensations.

Based on the foregoing, we propose a technique of working designs of orthopedic shoes, providing balanced equilibrium. It includes:

- analysis of morphological features of a figure and lower limb deformities of the child;
- acquiring a digital image figure of the child;
- the construction of a balanced geometric spatial and conventional mechanical child body model;
- determining locations of the items for latches weighting;
- body balance testing of the child.

Under the definition of "part-locks" we mean their configuration details, pockets ankle boots shoes, which are designed to contain the weighting.

According to the results of the child's body balance test with cerebral palsy, depending on the morphological characteristics, we proposed the topography of the location-clamps parts for weighting shoe designs (Table 2).

In the design must take into account that the maximum mass of the weighting in the latch detail stationed at polupare shoe must not exceed 1.5% of body weight.

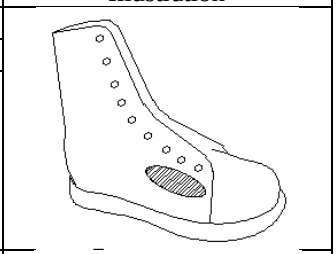
Table 2 - Location-pieces in clamps shoe designs depending on the morphological features of a child with cerebral palsy.

The morphological characteristics of the patient	Directional effect of the weighting agent	Location weighting element
Contracture of the lower limbs flexor	It is necessary to impact on the muscle groups with lower tone.	Clamps are placed in the lower parts of the tibia anteriorly offset.
foot supination	It is necessary to impact on the foot on the inside of the turn in the correct position.	Spacers are placed at the bottom of the inner side of tibia.
foot pronation	It is necessary to impact on the foot on the outside of a turn in the correct position.	Spacers are placed at the bottom of the outer side of tibia.
Atonic-astatic form of cerebral palsy	It should weighting effects to reduce the amplitude of oscillatory motion.	It is advisable to combine the suit with the weighting. The design of the shoe to place the clips on the tibia at the ankle.

As the weighting is recommended to use a steel or lead shot, specific weight of 7.8 and 11,3g / cm3, respectively.

Depending on the location of their configuration details for weighting-pockets that ensure the balance equilibrium, products can be classified into 9 groups (Table 2).

Table 3 - Classification of shoes depending on the location of pockets for weighting, providing the balance equilibrium.

The location of their configuration details, pockets for weighting	Illustration
in the lower parts of the tibia on both sides of anteversion	
the bottom of the tibia on the outside with an offset anteriorly	
the bottom of the tibia on the inside with an offset anteriorly	
the bottom part of the tibia on both sides	
the bottom of the tibia on the outside	
the bottom of the tibia on the inside	
on the tibia on both sides in the ankles	
bertsami on the outer side in the region of the ankles	
on the inside of the tibia in the ankles	

For the development of health-designs of orthopedic shoes for children with cerebral palsy need to know the parameters of their feet and tooling park, which is used for the manufacture of such shoes.

In the practice of orthopedic companies for children with cerebral palsy disease, as a rule, is made difficult orthopedic shoes, which is divided into two groups: correcting, to correct more amenable to remedial and compensatory deformations, the purpose of which is to compensate for various incurable strains [6]. In GOST P 55638-2013 "services of manufacturing an orthopedic shoe" [6] shows the classification of services for manufacturing the orthopedic shoe according to methods which comprise the individual manufacturing orthopedic shoes and selection orthopedic shoes. Service Composition for the manufacture of these types of shoes are different.

When individual services instead of manufacture "Selection finished orthopedic shoes in accordance with the GOST P 54407-2011" introduced a number of services (for the definition of parameters of special orthopedic items and the choice of materials for their production, characterization or obtaining initial data for the mathematical model (scanning) of the foot and lower leg user, selection and adjustment or individual manufacturing tooling, manufacturing of orthopedic footwear, including fitting), which significantly increase labor and material nye costs, thereby increasing the cost of the product. Therefore, cost-effective is to increase the services on selection orthopedic shoes, followed by supplementary equipment orthopedic insole and additional corrective elements.

When transferring from the status of an individual shoe manufacturing in the status of "the selection" is necessary to meet the needs of the customer, developing a design with a set of corrective elements for various lower limb deformities. From the analysis section of the study, the following description of features of the disease cerebral palsy and possibilities of improving the designs of products for people with cerebral palsy, it can be concluded that the range of orthopedic footwear includes design, providing different levels of rehabilitation effect. This allows us to approach the classification of these types of shoes from the standpoint of customization. In this article, this campaign is attractive primarily for ethical reasons: the customer feels that the product (in this case - shoes) and is personally satisfying his personal need for it. In general, the "customization" (fromEng.to customize - to set up, change something, making it more suitable to the needs of a specific consumer) is treated as individualisation products under the orders of specific customers by introducing structural or design changes (usually - in the final stages of the production cycle). Considerthe life cycle model orthopedic footwear in terms of customization. At its core, the model is phased with the iterative repetition of some of them (Fig. 5). Figure 5 shows that the first stage is formed by a general idea about the product, its main functions and solved with the help tasks. To develop structuresorthopedic shoesit is important to get the maximum information and to fix it in the source documents. However, be aware that not all wishes of the customer can be displayed in the terms of reference (TOR), particularly through an integrated approach to the solution to create a product, which is the orthopedic shoes:some items may contradict each other, or simply be untenable for various reasons (eg, organizational and technical). However, this can not justify their exclusion. At the second stage, the product design, which are designed sketches, drawings, technological and instructional card data and other documents necessary for manufacturing the product sample. Thus, the steps covered shoes at all life-cycle analysis of the market (search for product ideas) - Preliminary design - design - creation of experimental models - production, which determine the important moments of formation of quality footwear.

Figure 5 - The life cycle of product development process in terms of customization[]

Actually the production is the key to the life cycle of orthopedic products: manufactured shoes that are being tested at the fitting. In this case, a discrepancy is allowed in the prototype of elements (e.g., additional or other fastening fittings, which determine the degree of fixing of the shoe on the foot), which according to previous decisions are secondary. The obtained data make it possible to evaluate not

only the technical but also the price of the product characteristics and decide whether its further development[7].

If it is decided to continue the customization process, product development moves to the next stage - the introduction of changes and bug fixes. In all design - technological documents should be amended accordingly. Stages of the design and subsequent changes can be repeated several times, until you reach a result that satisfies all the requirements of the Customer. Experience in manufacturing orthopedic footwear shows that the number of iterations is typically one or two, and almost never more than three.

Various levels of individualization in the range of orthopedic shoes all from the standpoint of design customization can, In our opinion, divided by the mass or ultra-customized [8]. By definition mass a customized orthopedic shoes we understand - shoes, which has developed a design based on typical features of the medium uniform in the diagnosis of patients. Customization is done at the expense of supplementary adjustments corrective elements, design features of models that regulate the amount of vnutriobuvnogo space and framework components that provide rehabilitative effect. Ultra-a customized shoes are models designed to meet individual anatomical features of the foot of the individual patient based on model designs a customized shoe mass.

Wearing orthopedic shoes stereotype forms a right foot, suppresses giperkinezy eliminates contracture, prevents the development of foot deformities, develops motor skills. Orthopedic shoe rehabilitation effect depends on the shape and size vnutriobuvnogo space, which in turn is determined by the shape and size of shoe lasts.

The issue of establishing shoe pad described in sufficient detail so this article does not discuss [9]. In the development of new designs of orthopedic shoes, according to the hypothesis put forward by the working contact, should focus on creating mass and ultra-a customized product.

Having studied the range of shoes orthopedic companies, compiled by us classification of footwear in the degree of compliance with its internal shape of the patient stop:

- aboutrtopedicheskaya shoes made on the pad according to GOST or TU;
- orthopedic shoes, custom-made shoes, size is communicated to the individual parameters of the stop;
- orthopedic shoes, made individually by a plaster cast of the foot, or on the basis of it on 3D-scans.

Within this article the refinement of shoe lasts settings to create a customized mass footwear Orthopedic Enterprise regions of the SFD and North Caucasus Federal District.

To this end, we conducted anthropometric studies feet of children with cerebral palsy disease, as well as measurements of parameters of orthopedic shoe pads of Russian production, which are used in the prosthetic - orthopedic enterprises regions of the Southern Federal District and the North Caucasian Federal District for the manufacture of orthopedic shoes.

According to statistics, in the regions of the Southern Federal District and the North Caucasian Federal District, there are about 2,000 children with cerebral palsy disease. We take this number for the general population sample. Then, for the confidence probability of 85% and 5% confidence interval required sample size is 390.

In the cities of Rostov-on-Don and Krasnodar, we have carried out measurements of the stop390children aged 2 -17 years with various forms and severity of cerebral palsy disease. In the experiment, the children took part, growing up in families and in institutions.

According to the research we found that for more boats rated, the stop lengths obtained in the study are in the range from 145 to 200 mm. According to GOST 54407-2011 [1] This corresponds to the size of small children and pre-school groups footwear, which includes girls and boys from 3 to 7 years. The article presents data distribution number of disabled people with cerebral palsy by age. The share of children aged 4-7 years is 18.1%. Consequently, the general sample population for a given age and gender group is 267 people.With a confidence level of 95% and 5% confidence interval required sample size is 217. The number of measurements in a given sex and age group of 220 people, which allows further investigations.

Measurements were performed on a thin stop sock. Measurement was carried out on the foot length stopomere. The scheme for obtaining parameters obhvatnyh stop. For the selection of shoes at a shoe manufacturing are needed: setting №1 - the girth of the foot in bundles; option №2 - the girth of the foot forward vzome; parameter № 3 - girth foot oblique; 4 - lower leg above the ankle circumference.

Measurements of latitude parameters feet are made only in the case of the manufacture of the individual pads.

In the manufacture of shoes for children with cerebral palsy disease in most cases used shin pad as construction cover the ankle and have frame parts to maintain and normalize the biomechanics of the foot. The magnitude of the tibia pad tube parameters depends on the length of the track. From the statistical data, it follows that the height of the tibia part when the length of the foot 140 should be -150 mm to 140 mm, at a length of 150 - 180 mm - 150 mm and at 180 - 190 mm - 160 mm.

The height of the shoes is regulated GOST P 54407-2011 "Orthopedic footwear. General technical conditions "[1] but it may be a change on prescription

- orthopedist. Recommended GOST R 54407-2011 height parameters tibia orthopedic shoes, manufactured for selection are given in Table 4.

Table 4 - Recommended height bertsami orthopedic shoes, manufactured on selection

sex and age group	Shoe size	The height of the shoe, mm, not less than		
		recommended	0.3L + 59	0.3L + 63
small children	135	100	99.5	
	145	105	102.5	
	155	110	105.5	
	165	110	108.5	
Preschool	155	110		109.5
	160	115		111.0
	165	115		112.5
	170	115		114.0
	175	120		115.5
	185	120		118.5
	190	125		120
	195	125		121.5
	200	125		123

For further investigations we have carried out measurements of the three lines of shoe lasts, for the manufacture of orthopedic shoe for patients with orthopedic DTsP.Obuv must comply not only a complex technology, but also the medical requirements. When measuring the stop patients recorded medical appointments doctor orthopedic insoles.

For example, the product with a supplementary orthopedic insole must conform to the anatomy of the foot and ensure its normal functioning. Free shoes does not contribute the necessary pathology correction functions due to sliding of the foot inside the shoe may be formed abrasions, calluses. Overly Tight shoes violates the physiology of the foot, causing her injury and the progression of deformation.

Thus, the manufacture of mass a customized orthopedic shoes must be provided an additional space for volume vnutriobuvnogo orthopedic insole.

Removable, orthopedic insole made of leather, thermoplastic et al. Materials 3 mm thick. On corrective insole elements, such as the instep, pronator, the calculation set etc. use foam or thermoplastic materials. The size and position of the correcting elements assigned orthopedic doctor, depending on the nature and extent of deformity. For further study, we have drawn up a classification (Fig. 6) corrective elements (FE) at the position in vnutriobuvnom space.

Based on the analysis of medical appointments for patients with cerebral palsy, conducted in enterprises and SFD NCFD contact frequency distribution chart composed of corrective elements (FE) in the shoe for children with cerebral palsy (Fig. 7).

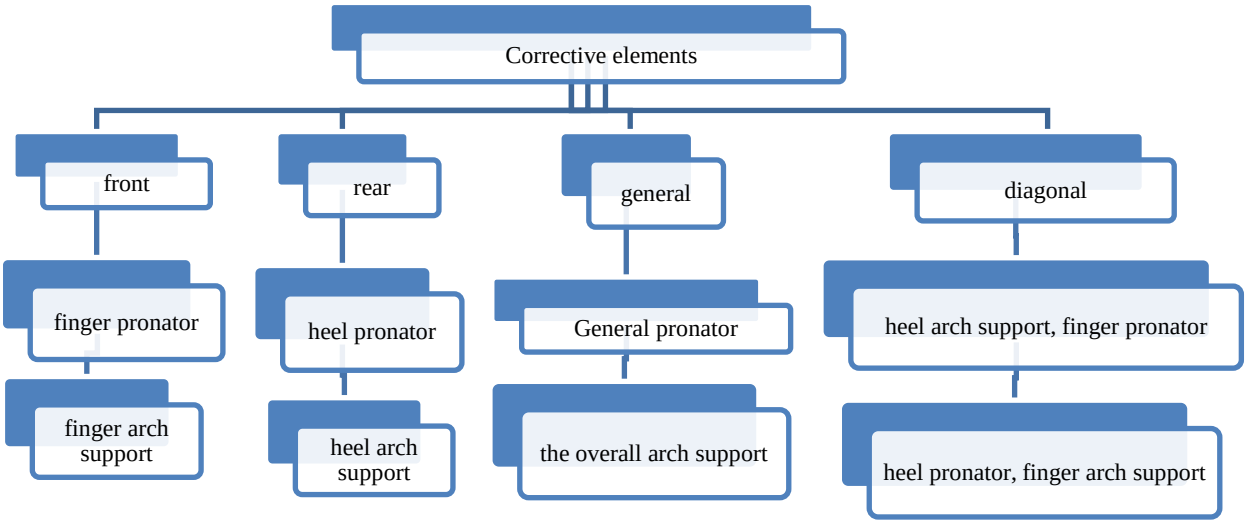


Figure 6 - Classification of corrective elements in the place position in space vnutriobuvnom

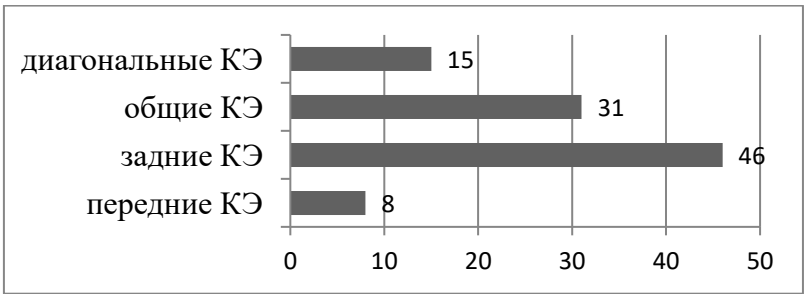


Figure - 7 Frequency distribution of the use of diagram elements corrective shoes for children with cerebral palsy

The analysis of the data revealed two cases of mismatch parameters pad mass a customized shoe parameters stop patients with disease ICP (Fig. 8).

Design mass a customized shoe for children with cerebral palsy have intermediate frame parts to fix the ankle joint. This shoe element can be made of skins of increased thickness or thermoplastic materials. To avoid injury, the child's foot to form calluses and abrasions during use shoe designs feature otblokovkoy in the ankle that gives extra space between the frame parts and the patient's leg. Thus otblokovanny portion in the manufacturing process of footwear recommended duplicate soft rubber-like material.

The height of the pads must be above the tube blank uppers not less than 10 mm. It provides the convenience of molding frame parts of footwear in the tibia. Subject to the requirements and the results of measurement stop patients, a table 3.10, which indicates the altitude and obhvatnye parameters tubes orthopedic pad for making a customized shoe mass [10].

To test the results obtained by us were taken pads Rostov orthopedic factory, the parameters of which have been brought to set by the results of the research (Figure 8).

For these blocks we made line of shoes that have been offered to patients as a finished or fitting shoes. The design of orthopedic shoes with high tibia part is shown in Figure 9.

a b

Figure 8 - Pads: a - the original form, b - brought to the set parameters

Footwear is a two-way hard Berecz and supplementary orthopedic insole, which can complement the necessary corrective elements, if necessary.

Here are the basic principles of the concept of development of this design:

- parameters for initial pad adopt minimum girth of the foot, produced in the course of the study;
- to adjust the parameter "girth bundles" offered a set of wedges, increasing girth in 5 mm increments. Increasing girths stop can be caused by a large fullness deformation of the fingers, the spreading of the forefoot. Therefore we need both vertical and horizontal wedges;
- girth shin above the ankle is measured in increments of 5mm. Therefore wedges value should increase the volume of the tube blocks at the same pitch;
- in some cases the increase otblokovok under the ankle. For this design pads must be provided to install the process opening otblokovochnogo web.

Figure 9 schematically presents the structure with vertical flat and wedge-shaped inserts.

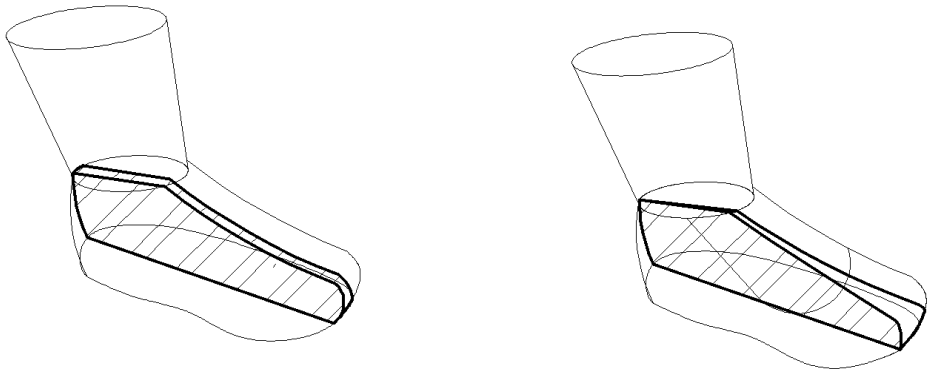


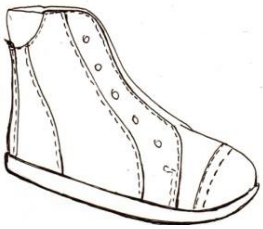
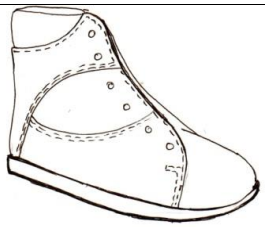
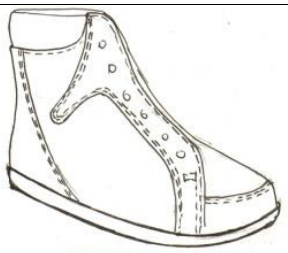
Figure 9 - Schemes structures vertical flat and wedge-shaped inserts

In addition to the internal shape of the shoe on the degree of rehabilitation effect influences product design. Therefore, the next section of the article is devoted to the analysis of the range of children's orthopedic shoe for patients with cerebral palsy disease.

Range of children's orthopedic footwear is wide, requiring its classification and identification of the basic models. To solve this problem we analyze the designs of shoes manufactured by enterprises of Russia specializing in the manufacture of orthopedic shoes. Thus, the construction of the "envelope" is made orthopedic Company Rostov-on-Don, Stavropol, Krasnodar, Sochi, Kirov and Lipetsk, Kaliningrad, Rostov, Syktyvkar [11].

Table 5 presents the photographs of models with insulated footwear, made from industrial catalogs orthopedic companies. For clarity, the structure transformed into a technical drawing in the description of their structural elements.

Table 5 - Construction of shoes with their configuration bertsami

illustration products	technical drawing	Structural and decorative elements
1	2	3
		Lace boots with soft edging. As a decorative use decorative stitches
		Shoes with laces. As used their configuration decor decorative elements contrasting color
		Lace boots with soft edging. In used as a decoration: the division of parts, parts contrasting in color saturation
		Lace boots with soft edging. In used as a decoration: the combination of colors, stitching in a contrasting color
		Lace boots with soft edging. As used decor division parts, parts of neutral colors
		Boots on the tapes "Velcro" with soft edging. As decor used: partitioning parts, parts related colors.

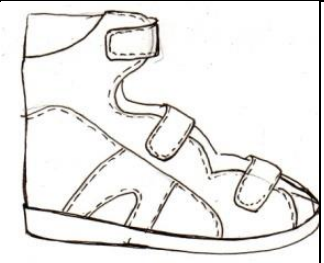
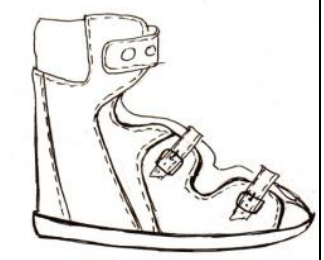
The most popular design is the type of "envelope" with bertsami boots, ankle closing for frame details. The shoe good detection is required, which is achieved by lengthening the tibia to the V baseline for or entering it. Methods pattern fixing different, they are priority laces, but it is possible to use tapes "Velcro" fasteners and - buckles [12].

The variety of structures in this case is achieved by partitioning parts, accessories and the use of different colors.

The range of summer shoes allocated 3 basic models.

Orthopedic shoes with high tibial part and full opening for the entrance of the foot are the most popular summer models as may be appointed for different strains of the lower extremities. Illustrations articles, technical design drawing and description are given in Table 6.

Table 6 - Construction of summer shoes with open toe part

illustration products	technical drawing	Structural and decorative elements
1	2	3
		Shoes with soft edging tape fasteners. In used as decoration parts division, a combination of flowers, applique
		Shoes with Velcro tape. In used as decoration parts division, a combination of flowers, applique
		Shoes with soft edging tape "Velcro" and buckles. In used as decoration parts division, a combination of flowers, applique
		Shoes with soft edging tape "Velcro." In used as decoration parts division and combination of colors

		Shoes with soft edging tape "Velcro." As used decor articulation parts
		Shoes with soft edging tape "Velcro" and buckles. As a decorative use: the division of parts and combination of colors.

In the analysis of structures, divided into 3 main methods of fixing the shoe on the foot: laces, Velcro tape, buckles. Laces across the arc of the foot to enter differences create the greatest degree of fixation in the ankle due to the minimum possible distance between the retaining elements (threaded through eyelets and laces changes polnotnyh parameters shoe by contraction or relaxation lacing.

In the manufacture of footwear occur combined foot on fixation methods. The most popular combination of "tape" Velcro "-pryazhka". This is due to the convenience of self-donning and doffing of shoes the patient. In connection with impaired motor skills to use fasteners with buckle in most cases almost impossible.

We consider the structure of summer shoes with high bertsami and vamp with an elongated tongue booster.[13]

Due to vamp with inflated tongue in the shoe is achieved enhanced fixation of the ankle joint. Embodiments of structures of this model are shown in Table 7.

The closed part of the shoe beam creates difficulty dressing shoes for patients with severe contractures of the ankle and foot paresis. There are 2-clamp technique, the shoe on the foot: Velcro tape and buckles, as well as in the previous model can be a combination thereof.

The third model - summer shoes oversized bertsami and closed toe portion (Figure 10). The model has a number of limitations: absolutely not suitable for patients with severe contractures of the ankle joint, paresis feet, deformities of fingers, etc.

Table 7 - Construction of summer shoes with high bertsami and vamp with an elongated tongue

illustration products	technical drawing	Structural and decorative elements
1	2	3
		Summer shoes with a closed nose and the vamp-tongue. fixing method on the foot - tape "Velcro." In used as decoration parts division and combination of colors

		Summer shoes with a closed nose and the vamp-tongue. fixing method on the foot - tape "Velcro." In used as decoration parts division, a combination of flowers, applique
		Summer shoes with a closed nose and the vamp-tongue. fixing method on the foot - tape "Velcro." In used as decoration parts division, a combination of flowers, applique
		Summer shoes with a closed nose and the vamp-tongue. fixing method on the foot - belt buckles. As a decorative use unusually shaped buckle and preformation on uppers
		Summer shoes with a closed nose and the vamp-tongue. fixing method on the foot - belt buckles. As a decoration used: stitching in a contrasting color and perforations on the vamp.

Figure 10 models of shoes with summer overestimated bertsami and closed toe part

For the purpose of this design for patients with paresis of the foot or slight contractions necessary soyuzochnoy shortening of the shoe to the foot uncomplicated input in vnutriobuvnoe space. For constructive vamp length standards used Velcro tape width of 2.5 cm and more which extend soyuzochnuyu of the shoe (Fig. 11).

Figure 11 Model shoe summer with increased due to belt vamp

Thus, allocated four basic constructions of shoes for patients with cerebral palsy disease. We take them as a base. Examples of designs are shown in Figure 12, and description thereof - in Table 8.

Table 8 - Description of basic models of orthopedic footwear for patients with cerebral palsy disease.

boots	Footwear summer with high tibia part		
their configuration ankle boots	open toe part	closed toe portion (vamp with an elongated tongue)	closed toe portion (vamp without tongue)
			

Figure 12 - Models orthopedic shoe for patients with cerebral palsy disease.

Various modifications to these models can be obtained due to the partitioning parts, their configuration using decorative items, decorative items and accessories, to ensure a comfortable child stop state.

conclusion

article

- Show biomechanics movements, causes and types of musculoskeletal disorders in cerebral palsy disease. It was revealed that a violation of the musculoskeletal system in children with cerebral palsy are associated with developmental disorders or damage to the central nervous system of motor mechanisms;

-Show that orthopedic footwear is a technical means of rehabilitation, performing a number of tasks of rehabilitation. The conceptcorrecting the position of the common center of mass of orthopedic shoes to ensure equilibrium of the balance when walking and raising rehabilitation effect;

-introduced concept of footwear design methods to ensure the equilibrium of the balance, which includes:

- analysis of morphological features of a figure and lower limb deformities of the child;
- acquiring a digital image figure of the child;
- the construction of a balanced geometric spatial and conventional mechanical child body model;
- determining locations of their configuration details latches for weighting;
- Testing the baby's body balance;

-given shoe 9 groups depending on the location of their configuration details for weighting-pockets that ensure the balance balance when walking;

-formulated concept "mass and a customized ultra 'shoes under the definition of "mass a customized orthopedic footwear" refers to shoes whose design is based on a medium-typical features of a homogeneous group of patients at diagnosis. Customization is done by adjusting the supplementary corrective elements, design features of models that regulate the amount of vnutriobuvnogo space and framework components that provide rehabilitative effect. Ultra-a customized shoe model are tailored to the individual foot anatomical features of the particular patient based on standard designs mass a customized shoe;

-Swipe anthropometric studies stop children with cerebral palsy, aimed at clarifying the parameters of pad mass a customized shoe. It was revealed that in the regions of the Southern Federal District and the North Caucasian Federal District shoe lasts for children's orthopedic shoes do not meet the statistical average parameters feet of children with cerebral palsy disease. Parameters of blocks for the manufacture of mass-a customized shoe for children with cerebral palsy disease;

3. Obtained the degree of customer satisfaction of orthopedic footwear constructions made with pads on the corrected parameters;

4. The concept of creating a pad with adjustable volume for designs a customized ultra-shoe;

5. The analysis range child orthopedic shoes, of which 4 is allocated basic design mass a customized orthopedic shoes with high effect of rehabilitation for patients with disease of cerebral palsy:

- shoes with their configuration bertsami;
- summer shoes with high tibia part with open toe;
- summer shoes with high tibial portion and a vamp with an elongated tongue;
- summer shoes with high tibial part and closed toe;

-given classification orthopedic shoes, based on the rehabilitation effect, which is based on data on the rigidity, methods of fixing the shoe to the foot, corrective elements supplementary orthopedic insole;

the continuation (second part)

Introduction

The most common disorders associated with cerebral palsy lower limbs are flat, hollow foot, foot valgus deformity, paresis of the foot, shortening of the lower limb, different deformation fingers. This requires the inclusion in the design of certain add-ons shoes.

Shoes for children with cerebral palsy should be made of high quality materials. Distinguishing features include a specially designed shoes that have a wide forefoot to provide a natural position of the toes and the foot of the child is not deformed and took a comfortable position. The shoe sole is recommended to use with sufficient resilience and flexibility. Some models have a preventive outsole with a special heel having an elongated krokul to support and unloading of the foot. This heel, extended from the inner side of the sole. This strengthens the sole under the middle part of the foot and prevents it from heaping up inside. Using the heel helps in the prevention and treatment of foot defects.

Orthopedic patients with droops software stack defined active mobility in the ankle and foot by the presence of lateral deviation. In cases where the dorsiflexion in the ankle kept and no lateral deviations of the foot, is assigned to shoes, combined with cuff and rubber rods. If the non-fixed sagging and there is very little lateral deviations of the foot, it is recommended to use orthopedic shoes in combination with the rubber cuff and rods, as well as shoes with double lacing.

Expressed lateral deviations droops feet require destination orthopedic shoe with rigid sided Burpee and removal of the heel, and mezhstelechny layer must be supplemented pronator or instep.

For fixed sagging or excessive mobility in the ankle boots are recommended with bilateral or circular rigid Burpee. Circular hard Berecz along with more reliable fixation creates some front stop required for rolling. The species range of products is limited. Constructs recommended for children with CP D are high boots and sandals. The height of the shoe is designed based on the doctor's prescriptions and are

presented in Table. 1 in accordance with the GOST P 54407-2011.

Table 1 Calculation of parameters of individual producing orthopedic footwear

Sex and age group footwear	The height of the shoe, mm, not less than
	boot
For toddlers	0.3 / + 53

main part

When constructing an orthopedic shoe, besides vnutriobuvnogo space and parameters orthopedic insole, considerable rehabilitation effect is achieved by frame parts [1].

The degree of the topography and product stiffness determined taking into account all complex foot deformities.The special carcass parts of orthopedic shoes for children with cerebral palsy are hard heel, ankle boots tough, hard toe, vamp tough, hard flank, etc. Hard flank in most cases combined with a rigid corset bertsami or backdrop.

Usage statistics of frame parts to fix the ankle joint according to Rostov orthopedic factory of the Ministry of Labor and Social Protection of the Russian Federation is shown in Figure 1.

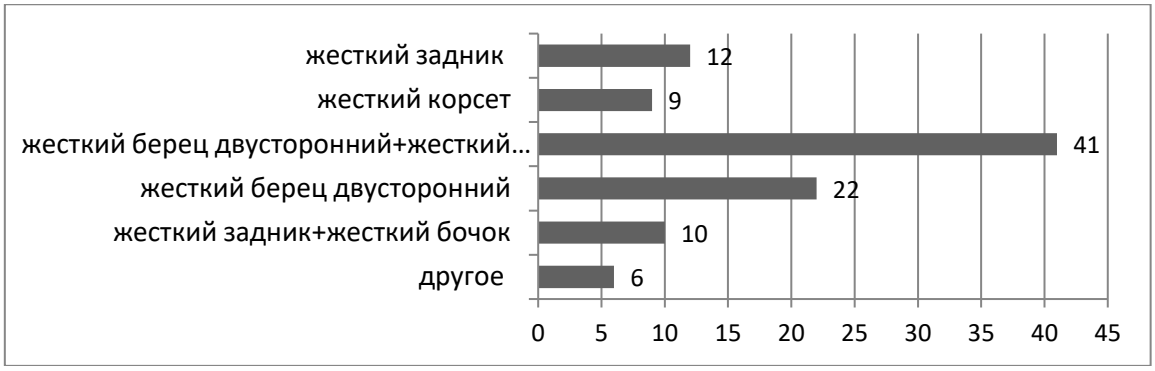


Figure 1 - Frequency of frame parts for fixing the ankle

The dominant frequency of use are hard Berecz in combination with a rigid edging (41%) and without (22%).

Shoes with rigid bilateral bertsami in conjunction with a hard edged recommended in the mass a customized shoes for people with cerebral palsy disease. The degree of fixation of the foot in space vnutriobuvnom influence fixation methods footwear on the foot. Typical methods of fixation are shown in Figure 2.

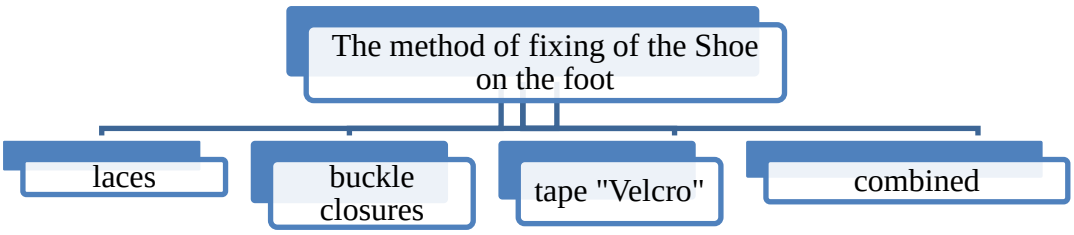


Figure 2 - Methods for fixing the shoe to the foot

The traditional methods of fastening the shoe to the foot, providing reliable fixation of the foot in space vnutriobuvnom are laces. In this case, the amount can vary vnutriobuvnogo space with high accuracy, thus increasing the effect of the rehabilitation orthopedic shoes.

With advances in technology and changes in fashion trends in children's shoes in the orthopedic shoe fixation method used on the foot with tape "Velcro", which is used by fashion designers in

various kinds of shoes. In the construction of shoes, on average, from 2 to 4 ribbons "Velcro", arranged uniformly at a distance of 2-3 cm from the edge of the tibia. To fix on a healthy foot baby that's enough. But when it comes to fixing the maximum by means of frame parts, the use of tapes "Velcro" can not create a sufficient fixation of the foot in vnutriobuvnom space. The leg does not take a fixed position, therefore, therapeutic and prophylactic significance shoe decreases.

To ensure the necessary degree of locking shoe on the foot ribbons "Velcro" bertsami design proposed in the recess in the crook of the ankle joint [], thus changing the distribution of resistance forces. EXAMPLE proposed constructive solution is shown in Figure 3.

Figure 3 - Possible changes in the shape tibia orthopedic shoes

In the embodiment represented type tape fasteners are arranged in two directions, for fixing the leg and dorsum of the foot. Increases not only fixation of the shoe on the foot, but also the comfort of use of the product. The design provides a high-quality relationship between consumer preferences and medical supplies. This model is included in the range of Rostov orthopedic factory and widely used.

When analyzing structures orthopedic shoes in terms of fixing of the foot in vnutriobuvnom space, which is achieved by frame parts [14], methods for fixing the foot and volume parameters of the shoe pad can be divided into 3 main fixation degree (Figure 4)

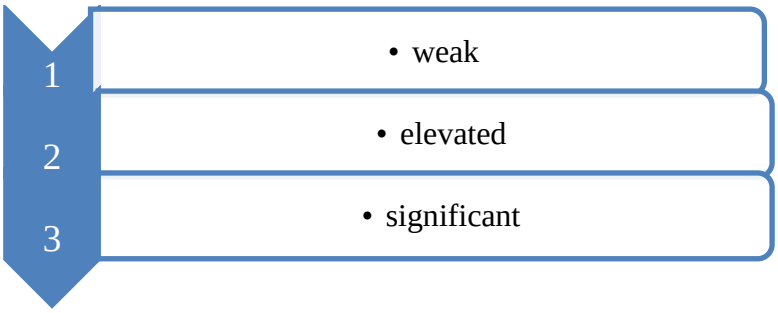


Figure 4 - The degrees of fixation of the foot in space vnutriobuvnom

Figure 4 shows a construction of the shoe with high rigid backdrop (shaded) with a weak degree of fixation. shoe design is indicated for minor deviations in the lower extremities. Hardness backs provided using polymer materials, or skins increased thickness.

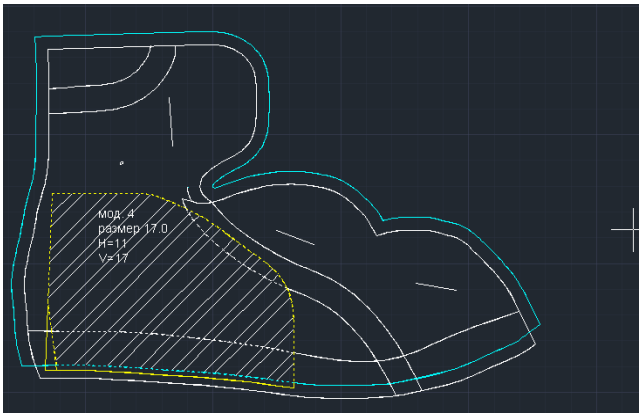


Figure 5 - Structure of shoes with high backdrop rigid (with a weak degree of fixation of the foot in space vnutriobuvnom)

In such designs, the recommended methods of fixing the shoe on the foot are buckles, belts "Velcro" or laces.

In the model with a higher degree of fixation of the foot (Fig. 6) as the frame parts used hard high Berecz (shaded). Recommended method of fixing the shoe on the foot are the buckles and laces.

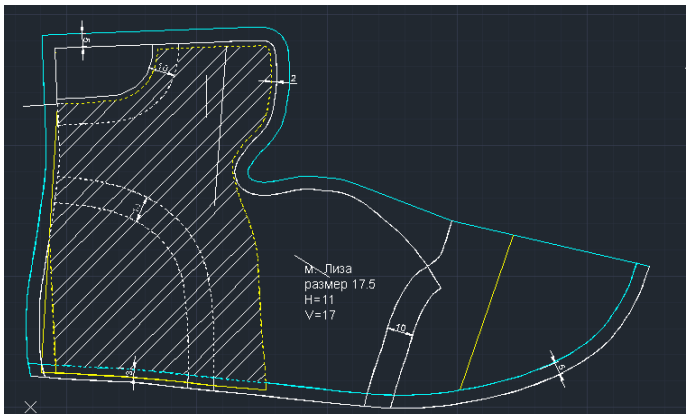


Figure 6 - Structure shoes with hard tibia (with a higher degree of fixation of the foot in space vnutriobuvnom)

In the model shown in Figure 7, the carcass parts are high rigid ankle boots in combination with rigid barrels, which ensures a significant degree of fixation.

This design of shoes designed for children with significant deformities of the lower extremities.

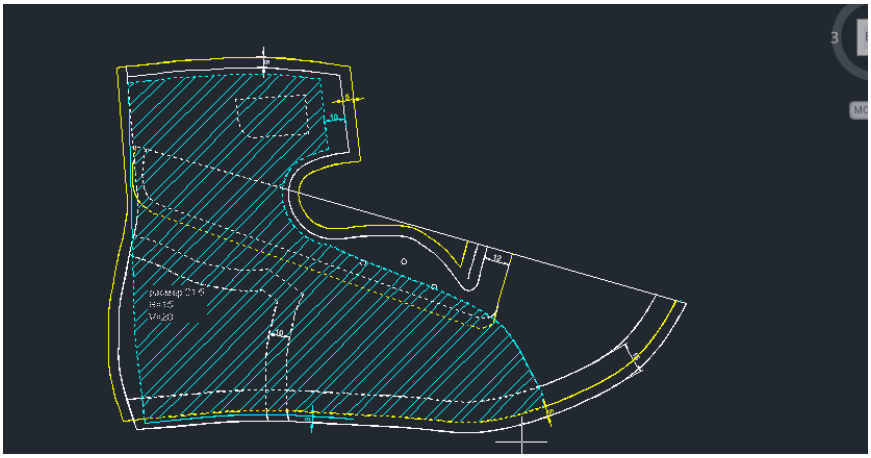


Figure 7 - Construction bertsami shoes with hard and rigid barrels (with considerable degree of fixation of the foot in space vnutriobuvnom)

Availability of renewals in gelenochnoy parts significantly increases the fixation foot during vnutriobuvnom space compared to the previous design. Recommended method of fixation on the foot are the buckles and laces.

Summarizing the data on orthopedic insoles, frame parts, fixation methods shoe on the foot, as well as standard designs making shoes, we proposed to allocate 7 rehabilitative properties of structural levels. These levels describe the main functions of rehabilitation using orthopedic shoes. The classification scheme is shown in Figure 8.

From the scheme should be that for patients with 1-3 levels of motor functions, footwear is made on GMFCS scale [].

For levels 2-5 pads should be used in accordance with the GOST P 53800-2010 "Pads orthopedic shoe. General specifications "[15], or individual blocks with parameters as close to the parameters obtained by measuring a stop. Particular attention should be paid to the angle between the chassis and the tibia parts pads. In levels 2-5 shoe remains fixed angle, which has a rehabilitation effect. Footwear layers 6 and 7 may be fabricated from a cast of the foot. The angle between the chassis and the tibia part of the foot may

be prescribed by the doctor - orthopedist on the results of examination of the patient.

A more detailed description of the frame parts orthopedic insoles and shoes at the level structures rehabilitation effect is given in Table 2.

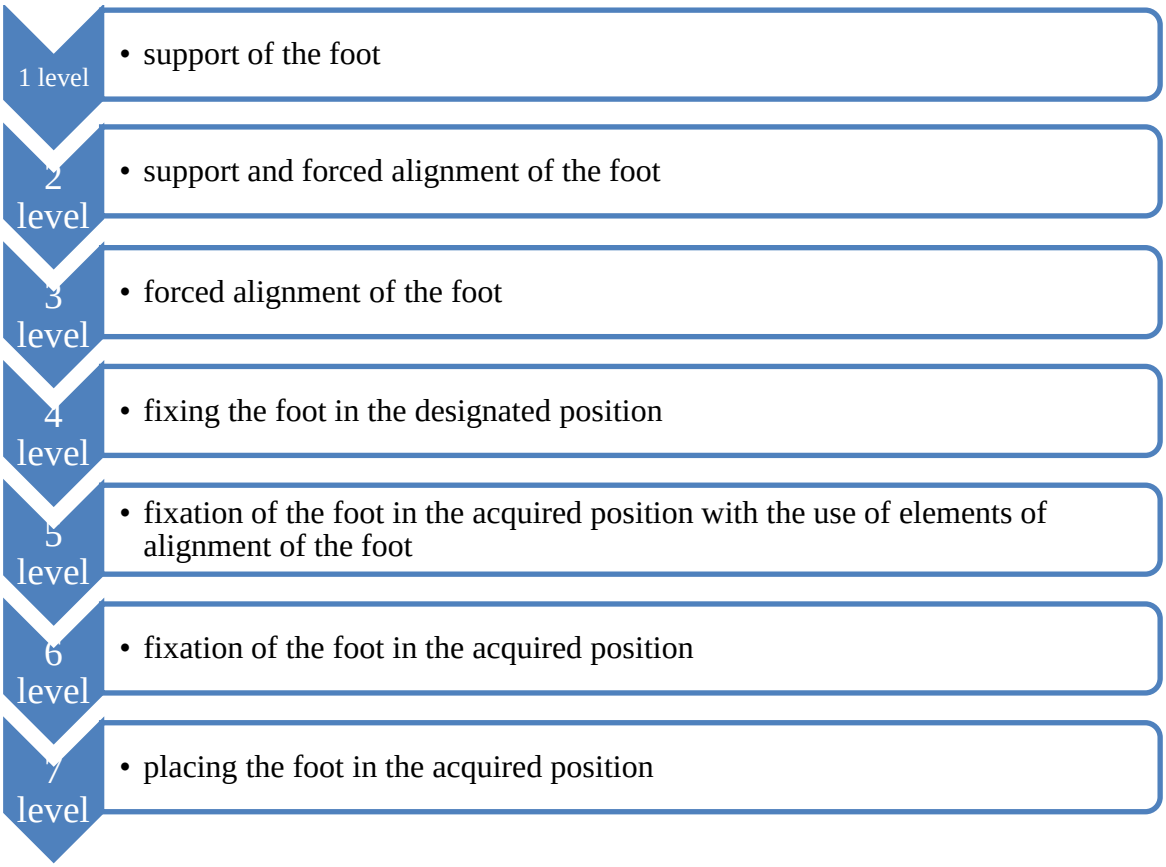


Figure 8 - Classification of rehabilitative properties of structures orthopedic shoes

Table 2 - Classification shoes at the level of the rehabilitation effect

levels	Frame details	Features of orthopedic insoles	Features design shoes
1	hard heel	supporting arch	Shoes with high tibia part with any method of fixation on the foot
2	hard heel	supporting arch and additional corrective elements (pronator, supinator)	Shoes with high tibia part with any method of fixation on the foot
3	high heel hard or hard Berecz	supporting arch and additional corrective elements (pronator, supinator)	Shoes with high tibia part with any method of fixation on the foot
4	Hard Berecz in combination with a rigid edging or use corsets	supporting arch and additional corrective elements (pronator, supinator)	Shoes with high tibia part with the fixation on the foot straps or laces
5	Hard Berecz in combination with a rigid edging or use corsets	supporting arch, additional corrective elements (pronator, supinator) and elements which compensate the deformation of the foot (the insole from a cast)	Shoes with high tibial part of the design of the "envelope" with the fixation on the foot straps or laces
6	Hard Berecz in combination with a rigid edging or use corsets	supporting arch, additional corrective elements (pronator, supinator) and elements which compensate the deformation of the foot (the insole from a cast)	Shoes with high tibial part of the design of the "envelope" with the fixation on the foot straps or laces

7	hard heel or other carcass detail required to move	with elements feet compensating strain	Shoes with high tibia part of the design of the "envelope" with any method of fixation on the foot.

To ensure full rehabilitation design effect, in addition to the design features of the model is important to its color, acting on the psyche of the child with cerebral palsy, which should be taken into account.

There are numerous methods of designing various shoe designs [16]: the design of boots, shoes, shoe, shoes, boats, moccasins and remeshkovo - sandalwood. In all cases, the design process is carried out on the block, meaning that parts of the right and left polupary complete shoes are symmetrical and do not differ.

When creating an orthopedic shoe frequent asymmetry that gives us reason to pay attention to the aspects of the techniques for the development of such structures, which are in accordance with the terminology adopted by us belong to the category of mass and ultra-a customized.

Currently there are various techniques of designing footwear, including computer-based technology arrays basic geometrical forms of structural elements forms of footwear. On shoe factories widespread specialized CAD designed for constructing footwear (ShoeMaker, «ASSOL-shoes", "ASCO-2D", "IRIS", etc.) []. They contain tools and functionality to develop and design all kinds of shoes, as well as creating a database, which is not about small businesses or workshops for the manufacture of footwear to order [16]. To improve the quality of drawings with simultaneous reduction, the complexity and the creation of electronic databases, we propose a technique shoe design using CAD broad spectrum.

Designing shoe according to [] is characterized by simplicity, adaptability, structuring, low material and labor costs.

However, in practice, the most common prosthetic - orthopedic companies is to design footwear of URC obtained with paper templates [16], which comprises the following steps:

- design sketch of shoes;
- obtaining averaged sweep surface side pads (URC);
- URC inscribing a coordinate axis, application of the basis grid, and auxiliary control lines;
- tracing constructive basis shoe upper, intermediate and inner parts;
- manufacture of parts of footwear patterns.

Therefore, maintenance works represent the proposed design techniques used in comparison with the practice of prosthetic - orthopedic companies (Table 3.).

In the second stage of the URC is placed into conventional coordinate axis with the heel heights and slanting girth. The upper edge of footwear is designed with an angle of inclination of 84-86 degrees starting from the foot or deformation. The inclination of the upper edge checked visually during the "fitting" bonding primer on the block model.

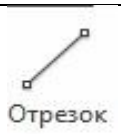
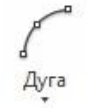
In AutoCAD package for the 2D- design digitizing circuit models and updating the drawing is carried out using the tools provided in Table 3.

Table 3 - Comparison of the initial stages and the proposed methods of designing footwear

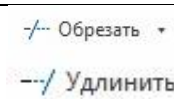
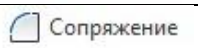
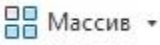
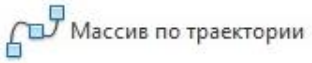
Stage	Traditional design methods	New design methods
1	Preparation conditional sweep the inner and outer sides of the side surface of the pad. Preparation averaged sweep surface side pads (URC)	Drawing on the grid block basis, control and auxiliary lines (technique Peshikova VF, Ars Sutor). Drawing a sketch of the future model on the outer side of the pad. Getting the URC. Preparation scanning trace pads.
2	Inscribing URC in the coordinate axis. Application grid basis, auxiliary and control lines	Building a high-rise options footwear, based on the results of measurements of the foot of the customer and the type of lower limb deformities
3		"Trying" gluing soil-derived models of shoes to a shoe with a note if necessary, further adjustments

4	Drawing constructive basis top, the pad parts and shoe mezhpodkladki	Digitizing circuit model, the construction of the structural allowances. Building pads and shoes mezhpodkladki
5	Getting templates parts of footwear	Getting template parts from the finished drawing with the commands "Copy" and "Paste"
6		Storing the resulting drawing into a database indicating the required information.

Table 4 - Tools AutoCAD, used in the design

Marking tools	functional tool
1	2
	The depiction of objects, the construction of direct lines
	Long edge delineation
	Construction of perforations, eyelets, decorative elements round shape
	Construction of the heel rounding; rounding, which can not be built by conjugation
	Construction parts with a line of inflection

Continued Table 5

1	2
	Tools to adjust the drawing
	Building rounded parts
	Building design of allowances and offset drawing lines by a predetermined amount
	Construction of perforations, decorative elements of shoes
	Building Blocks for a Markup
	grouping objects
	Ungroup objects to adjust

Adjustments to existing drawings in the database as a result of "trying on" gluing grnt - model on the block are carried out electronically.

Scope of work will vary depending on the characteristics of the developed model. If corrections are already located in the base of the drawing data, it is necessary to perform operations and ungrouping,

advantageously using tools "offset" with simultaneous change of altitude and latitude of design parameters.

Figure 9 shows as an example the basic models Drawings for patients with the disease cerebral palsy developed in AutoCAD.

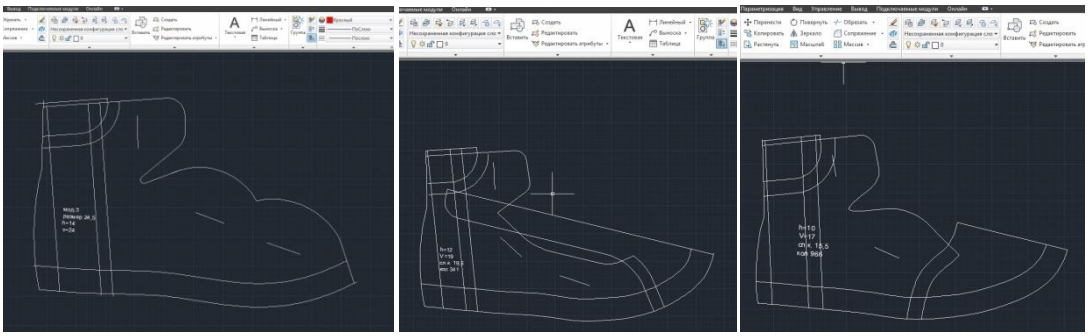


Figure 9 - The drawings of shoes designed in AutoCAD of the proposed method

Projecting contact shoes according to the proposed method accelerates DRAWINGS construction and allows to create a database based constructions as ultra - and mass a customized shoe.

In the manufacture of ultra-a customized orthopedic shoes, there are cases when the loops of the right and left feet of the patient are significantly different from each other. In this fashion designer, you must create an anatomically correct shoes and maximize the aesthetic appearance of the product. In most cases, the manufacture of shoes for patients with cerebral palsy Disease used shin pads, as to create a structure with a high rehabilitation footwear must effect a tight seal preform shoe uppers to the tube connector. In the case where the parameters of one of the stop corresponds to average and for the manufacture of shoes already has finished drawing the stack increased fullness, already ready-ground model must be applied to the most convex point heels and beams and lock (Figure 10). After determining where in enough volume, you must make the appropriate adjustments in the electronic ground.

Figure 10 - Position of bonding primer - patterns on the block

Important in terms of visual perception of the shoe is the construction details of the soft edge. Figure 11 is a diagram of the distribution of the views of consumers, a relatively soft edge sizes in the finished shoe.

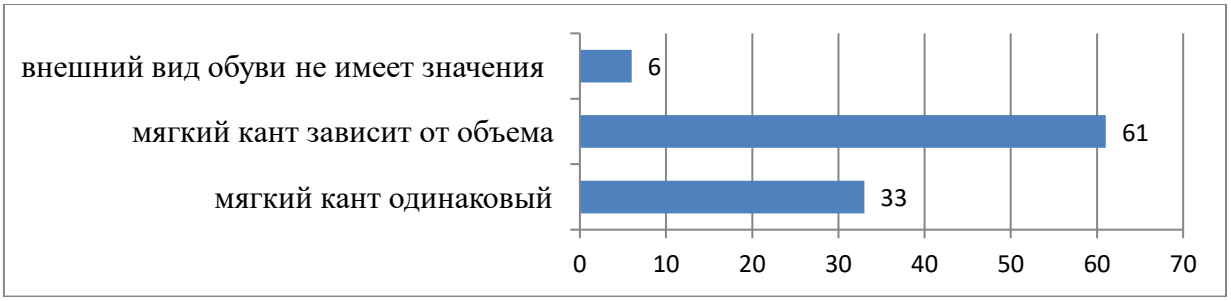
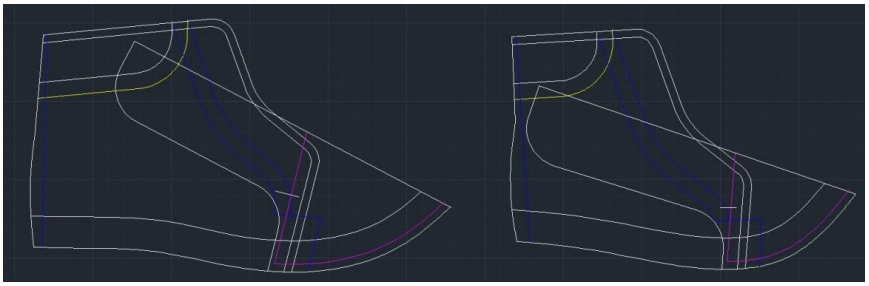


Figure 11 - Distribution of consumer views regarding the size of the soft edge in the finished shoes

Analyzing the difference in audio girths polupare found that visually soft edges recommended design of the same size with respect to the rear seam in that if the difference does not exceed 21% in girth. If the difference above 21% is recommended to increase the item soft edge, leaving the same distance from the edge of the tibia. Examples of the drawing and the finished shoe model presented in Figure 12 [17].



a

b

Figure 12 - Examples of the drawing (s) and the finished shoe models (b) ultra-a customized shoe with different parameters obhvatnymi

With increasing girths front arc tibia decreases. It is important to take into account the type of means of fixation on the foot. In the case with laces, it is appropriate to reduce the number of eyelets in polupare larger girth. The distance from the extreme edge of the eyelets to the tibia should remain the same.

If you are using tapes "Velcro" or belt buckles are kindly requested to take into account the width of the belt, with respect to both polupar. In agreement with the customer, the number of belts in polupare may be different.

The reason for varying heights of shoes in a pair can be a shortening of the limbs, and significant strain on only one of stop.Obuv different heights in the pair is assigned a doctor and agreed in advance with the patient. In the design of such structures need to strictly maintain the altitude and latitude parameters of the tibia part of the shoe. Examples of shoes with different heights tibial portion shown in Figure 13.

Figure 13 - Examples of ultra-a customized shoe with different heights tibia part

When the height difference tibia to 3 cm, the number of fixing elements, such as buckles, belts "Velcro", recommended to leave the same. In case of fixing laces - the number of eyelets may vary.

When the difference in heights bertsami than 3 centimeters, the number of bands and buckles "Velcro" should be sufficient to secure the foot. From an aesthetic point of view, we recommend cutting height zadinok and soft edges leave the same. When present in the cork mezhstelechnom layer, decorative elements stack folding assembly must be positioned in an anatomically correct level by stretching the edge parts up and down along the vertical axis of the shoe.

When producing a customized ultra-orthopedic shoes difference in trace length of 1 cm is common and is not complicated in terms of design. In this case, the addition may be carried out uniformly length by lengthening the vamp and the rear of the tibia.

When the difference of the track length to 5mm, during manual tightening shoe polupary can be manufactured the same size.

An interesting from the viewpoint of design is to provide a shoe construction with a difference of track length greater than 1 cm. As an example, Figure 14 is a drawing polupar summer shoes with a difference of 50 mm track length (220 mm and 270 mm, respectively).

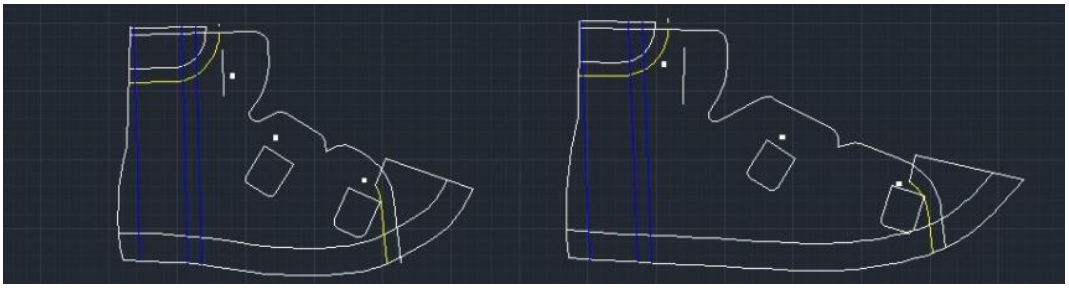


Figure 14 - Drawing of shoes with a difference on the track length of 50 mm

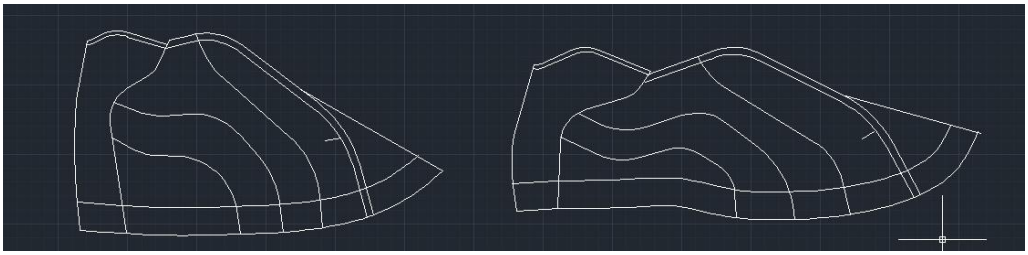
Construction of soft edging is performed by the method described above.

In the construction of uppers, it is necessary to calculate the length for both polupar shoes. The combination of different track lengths in the presence of the toe portion mezhstelechnogo layer compensating the shortening of the lower limb, it is necessary to take into account the height of the latter to determine the length vamp (Figure 15).

Figure 15 - Example ultra-a customized shoe with different lengths and the presence of trace layer mezhstelechnogo

The whole component or tibia part expands uniformly on the horizontal axis. In this assembly in the folding of the foot should be built for each polupary separately.

The length and height of the parts constituting Berecz drawn fashion, starting from the most harmonious visual perception of future construction. Drawing and photo of finished shoes with different trace length are shown in Figure 15[1].



a

b

Figure 16 - Drawing (s) and photograph (b) of the finished shoe with a different trace length

When the distribution of fixing elements (belts and buckles "Velcro") must first analyze the patient's disease and destination of frame parts of shoes. Recommendations on the distribution of fixing elements are shown in Figure 17.

Bilateral symmetrical shortening manifests itself in non-compliance of the proportions of the limbs and trunk. It occurs in achondroplasia (underdevelopment long bones leads to dwarfism) and other hereditary diseases. By asymmetrical shortening cause malformations of the upper and lower extremities. Unilateral shortening cause various diseases. Allocate following kinds of it: the true (anatomical), relative (dislocation), apparent (projection), total (functional or clinical). When true shortening the total length of the leg and the thigh of one lower limb than the other. It occurs when the bone due to organic lesions or congenital deformation of certain diseases. With relative shortening violated ratio between segments limb. This is due to the displacement of the articular ends of the bones due to congenital dislocation or intraarticular fractures. Relative shortening characterized in that one limb shorter than the other appears, but when measuring it turns out that the femur and tibia of the two legs have the same length. Apparent (projection) shortening occurs because the forced flexion due to pathological fixed installation in the spine or joints.

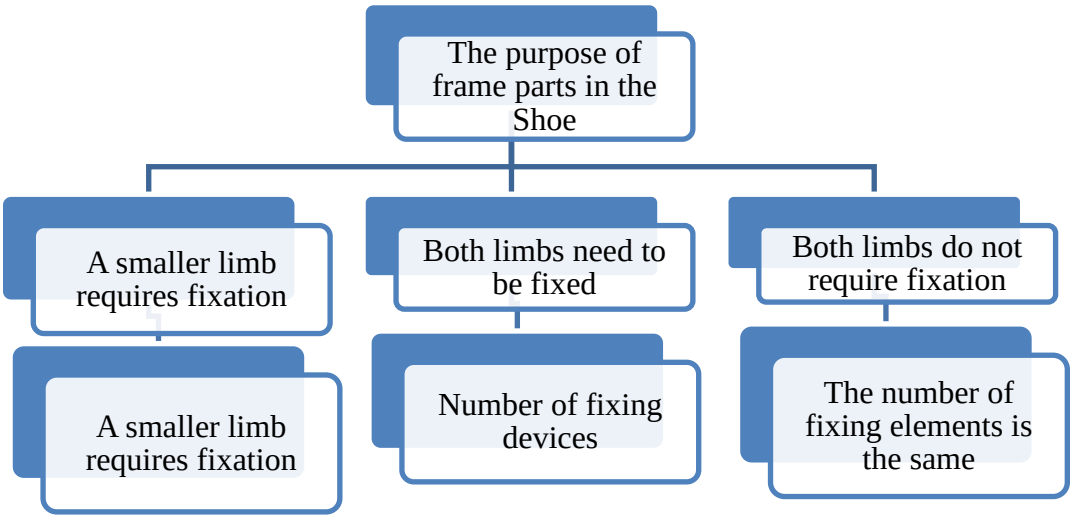


Figure 17 Recommendations for the distribution of fixing elements to shoes with varying trace length

As can be seen from Fig. 17, the number of the retaining elements depends on the purpose (functions) of frame parts of shoes.

Interesting from the point of view of designing a customized ultra-shoe is the creation of designs of orthopedic shoes for shortening the limb. Considered

pathological shortening one or two limbs of more than 2 cm [18]. The classification of lower limb shortening is shown in Figure 18.

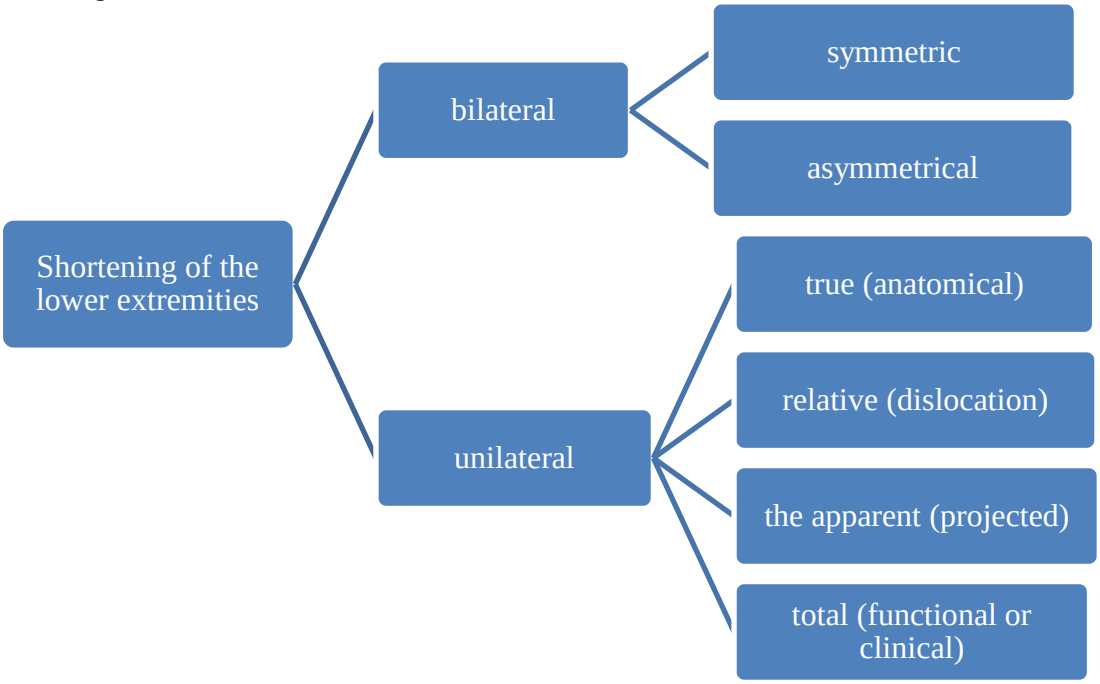


Figure 18 - Classification of lower limb shortening

The reasons for this flexion: post-traumatic contracture, occurs most often due to the development of ankylosis. When shortening the projection, as well as with a relative, length of legs seem different, but measurements show that they are the same. An example of such a defect can be scoliosis lumbar pelvic misalignment. Total (functional or clinical) shortening is characterized by the fact that the patient is several kinds of limb shortening. Orthopedic shoes in most cases appointed only for one-way true shortening when due mezhstelechnogo layer certainly less along the length of the leg is brought to the level of healthy. Figure 19 is a drawing and photograph of the finished product to the patient with track length 195mm and shortening of 35mm, which is used to compensate the tube 35 * 20 mm.

a b

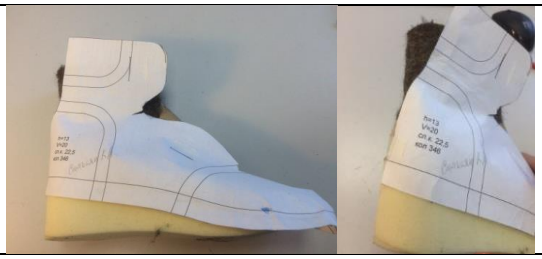
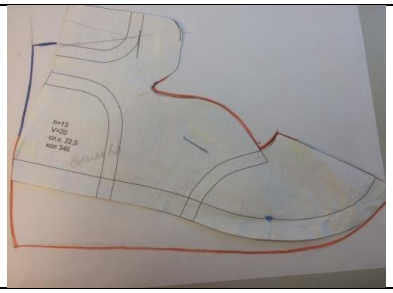
Figure 19 - Drawing (s) and photograph (b) of finished shoes for shortening the limb

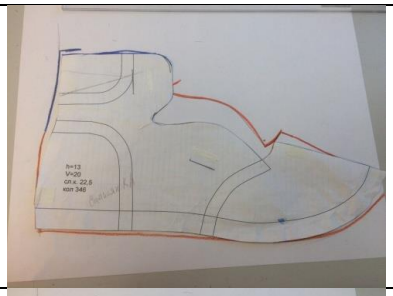
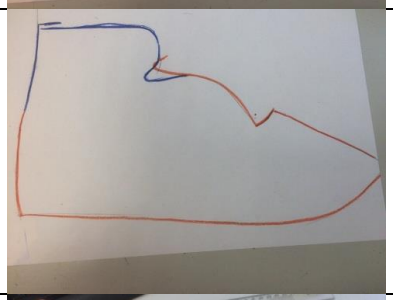
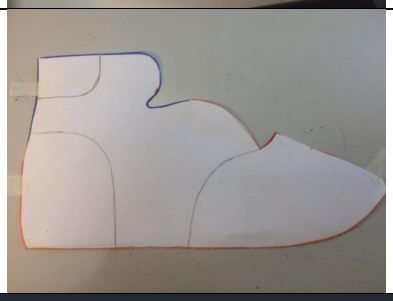
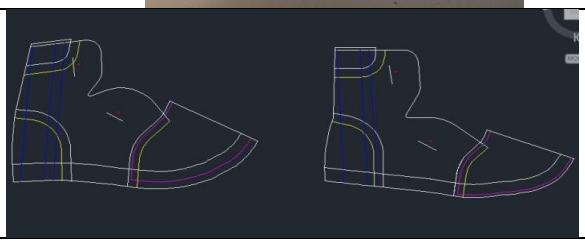
When the tube in the toe portion of a height greater than 3 cm for the most accurate landing pad to the workpiece is possible to provide the seam. An example of such a construction is shown in Figure 20.

Figure 20 The design of shoes with a seam on the vamp

Based on the analysis of the drawings, references and experience of the staff working in the field, developed a method of designing shoes for the shortening of the lower limb. Description of the method is presented as Table 5.

Table 5 - Methods for designing shoes for shortening the limbs

Description of the action	Illustration
1	2
The selection or construction of the ground-model to a healthy (without shortening) the leg (the original ground)	
Fixing bonding primer - patterns in the beam and the heel on the block with a stopper	
Gauging future adjustments: increase in the cap, gain on the rear seam retraction, correction adjustment, the adjustment of the angle of inclination of the upper edge of the tibia	
Adjustments to the drawing of the new model at a fixed ground-bonding patterns in the beam and the heel	

Adjustments in the drawing of the new model while fixing the original soil relative to the horizon	
Adjustments in the soil-model (in this case, reducing the height of tibia at the site of fixation of the ankle)	
Fitting gluing resulting preform to block	
Application drawing lines with the original soil with adjustments. (Performed manually or in electronic form).	
model Drawing Study	

The technique implemented in Rostov orthopedic factory. Analysis of the results is shown in the diagram (Fig. 21).

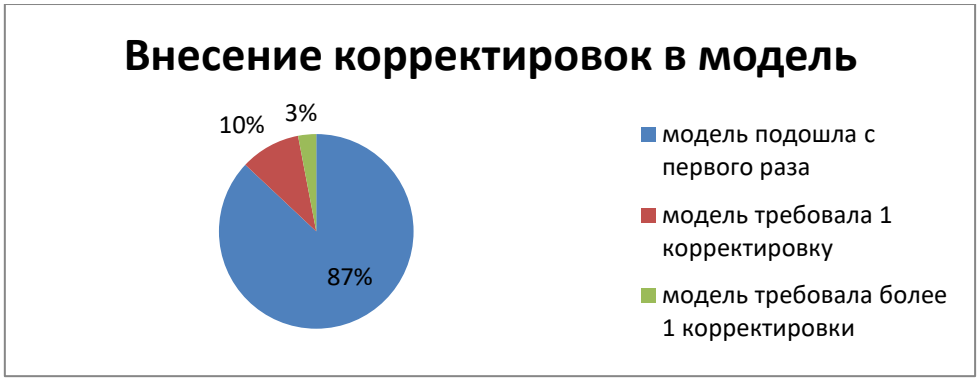


Figure 21 - A diagram illustrating the design quality of the shoe according to the developed technique

The diagram shows that with a probability of 87% obtained adjustments to the model is not required. In the remaining 13% require the inclusion of not more than 2 adjustments. This is due to the complexity of structures developed and the combination of shortening the limb with the other foot deformities.

When a large number of drawings there is need for their structuring and creation of databases (DB), whichThey are an effective means of representing and storing information []. ABOUTbedinenie drawings in the database makes it easier to access and edit information on the models of shoes, which reduces the burden on the staff and reduces the time required to find specific information. The software eliminates the redundancy and duplication of information. To create the database selected software MS Access software, which is included in MS Office, available at most enterprises []. Thus, the creation of databases in the program does not require the purchase of additional new software costs. Developed database [] has Switchboard form, which allows you to make the choice of model for further printing and adding new drawings, view reference information. When selecting a model of the previously proposed set displays a brief description and picture. Screen form MS Access program window, in which there is a variety of types and models of shoes are presented below.

When selecting a model of the proposed directory specifies the required size and high altitude latitude settings. The data base developed by one shoe size selected model can have a virtually unlimited number of drawings with different altitude and latitudinal parameters. When you select a drawing, there is a transition in the AutoCAD program. To avoid possible unintended corrections or deletions of the drawing, the changes in the open window are not saved. It is possible to adjust the drawing without further preservation (in the event that required printing is not all the elements of the file), as well as printing drawings.

Developed database can be extended by introducing new drawings at all stages DRAWINGS new altitude and latitudinal characteristics in the selected size; Adding a new dimension to the selected model; the introduction of a new model in the database. Such operations are carried out when you select "Add model" in the form of a database keypad. In addition to selecting and creating drawings developed database also includes references, where information necessary for the production of footwear with high technological properties and rehabilitation.

Screen form windows with a choice of background information as well as information concerning the pads for shoes.

Thus, database structures and combines information necessary fashion designer, shortens the time required to design and provide the consumers demand fabrication of orthopedic footwear considering abnormalities ditey stop.

Conclusion

On the basis of studies to determine consumer preferences found that [19]

- currently being implemented baby shoes with prophylactic properties has some drawbacks concerning both materials and design, and external signs;

- for deciding tight fit of the foot of the child and to provide the necessary rigidity of the heel portion of the shoe upper backs proposed design, retaining the ankle still further by laces, straps or "sticky";

- to fix the ankle proposed construction of the shoe heel, in which a certain stiffness is created at the expense of process parameters, namely the heel portion uses an additional assembly of the outer member, the intermediate member and the liner;

- developed design shoe upper together with the anatomical arch support provide the most effective support arch and correcting the angle of its inclination. Thus, it is important to have a permanent union between a doctor - orthopedist and manufacturers corrective detalny to garanitrovat stop child comfort and high confidence to him and his parents on the prevention education at their child patolgicheskih deviations;

- formulated the concept of "the masses - and ultra - a customized "shoes under the definition of"

mass a customized orthopedic footwear "shall mean footwear, which has developed a design based on typical features of the medium uniform in the diagnosis of patients. Customization is done at the expense of supplementary adjustments corrective elements, design features of models that regulate the amount of vnutriobuvnogo space and framework components that provide rehabilitative effect. Ultra-a customized shoe models are designed to meet individual anatomical characteristics of the foot of the particular patient based on standard designs mass a customized shoe;

- analysis conducted stop anthropometric characteristics of children with cerebral palsy to refine pad mass a customized shoe. It was revealed that in the regions of the Southern Federal District and the North Caucasian Federal District shoe lasts for children's orthopedic shoes do not meet the statistical average parameters feet of children with cerebral palsy disease. Parameters of blocks for the manufacture of mass-a customized shoe for children with cerebral palsy disease;

- revealed the degree of customer satisfaction designs orthopedic shoes, custom-pads with revised parameters;

- The concept of creating a pad with adjustable volumes for the construction of ultra-a customized shoe;

- an analysis range child orthopedic shoes, which are allocated from the base structure 4 mass a customized orthopedic shoes with high effect of rehabilitation for patients with cerebral palsy disease, namely:

- shoes with their configuration bertsami;
- summer shoes with high tibia part with open toe;
- summer shoes with high tibial portion and a vamp with an elongated tongue;
- summer shoes with high tibial part and closed toe:

- classification of orthopedic shoes, based on the rehabilitation effect, which is based on the results of studies on the structural rigidity, the methods of fixing the shoe on the foot, correcting elements supplementary orthopedic insoles;

- the technique of designing a customized ultra-orthopedic footwear using AutoCAD software for occasions:

- with different girths stop;
- with different heights in a pair of ankle boots;
- with varying trace length in the pair;
- by shortening the lower limbs:

- proposed database structures mass kastomizirvoannnoy orthopedic shoes for children with cerebral palsy, which includes standard design recommended for this disease to produce a comfortable orthopedic shoes.

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