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# ABOUT THE FEATURES OF FORMING EFFECTIVE MANUFACTURING OF THE ENTIRE RANGE OF CHILDREN'S FOOTWEAR, INCLUDING THOSE WITH PATHOLOGICAL DEVIATIONS

***Abstract***: *In this article, the authors examine the role of quality as a tool for promoting a quality philosophy in the production of competitive and in-demand products at light industry enterprises located in the Southern Federal District and North Caucasus Federal District. Furthermore, the authors convincingly confirm the feasibility of such implementation, provided innovative technologies are implemented, including versatile and multifunctional equipment, creating the prerequisites for the production of a full range of footwear, namely men's, women's, and, most importantly, children's footwear, for which demand is quite high in Russia's regions.*

***Key words***: *quality, preference, demand, competitiveness, market, profit, demand, buyer, manufacturer, financial stability, sustainable technical and economic performance, priority, assortment policy, economic policy.*

***Language***: *English*

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**Introduction**

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A children's footwear range should be targeted to customers with varying income levels. To achieve this, leather of varying quality can be used in shoe production: expensive leather, such as chevrolet, or cheaper leather, such as chrome-tanned pigskin. Shoes made from this material can be worn for "going out" and then removed once home to give the child's feet a rest.

When developing the product range, it is also necessary to take into account the fact that more girls are born in the Southern and North Caucasian Federal Districts than boys, so shoes for girls should be produced in larger quantities than shoes for boys.

If children's footwear manufacturers take into account all anthropometric characteristics, buyers will have the opportunity to choose products within a specific price range, tailored to the climate of the Southern Hemisphere, the Federal District, and the North Caucasus Federal District, depending on their financial situation.

One of the most important demands Russians place on footwear in general, and children's footwear in particular, is that it adheres to the latest fashion trends. Recently, these trends have begun to extend not only to school-age models, but also to those for school-age children and toddlers. This applies to both well-known international brands and domestic manufacturers. Of course, all footwear markets worldwide have different price points, but what makes our Russian market unique is that:

a huge sector of cheap shoes, a relatively small one of mid-priced shoes, and a very small one of expensive shoes;

there is a big gap between cheap shoes (up to 9 euros per pair) and expensive ones (from 200 euros per pair).

The first sector includes not only companies from Southeast Asia but also Russian wholesalers placing orders in China. The second, middle sector includes Russian factories, as well as Eastern European and Turkish companies producing footwear under their own or licensed brands. The third sector includes renowned global manufacturers and even fashion houses. At the intersection are European-made collections made from natural materials, adapted for the Russian market but at a reasonable price.

Representatives of the largest low-cost sector, where the level of competition is very high, strive to reduce the cost of their products by manufacturing them in cheaper factories, as well as by using cheap materials and components.

It's worth noting that parents' demands for the hygienic properties of children's shoes have increased dramatically, specifically the use of natural materials for the upper. Many manufacturers in the low-cost segment, seeking to reduce prices, use only genuine leather insoles and linings. To ensure a child's feet remain healthy, careful thought must be given to the design of children's shoes, ensuring they meet all requirements set forth in both the GOST standard and technical regulations.

Considering that foot growth is generally complete by age 18, one can imagine the importance of wearing footwear that meets these standards. As feet grow, they undergo a transformation: when a child first begins crawling, they still have bowed, "O"-shaped legs. As these bowed legs disappear due to growth, they develop an "X"-shaped form, with the inner sides of the knees touching. Until approximately age 6, a small child's foot continues to grow, maintaining this "X" shape. When learning to walk, the child strives to align their body vertically, and the feet are subject to significant stress. The feet and lower legs begin to develop as they begin to experience functional load on the muscles, ligaments, and tendons, and begin to adapt to each other. When a child begins to stand independently, the foot must be able to develop freely. This applies to subsequent stages of development and to older children. From a hygienic standpoint, footwear should protect the body from cooling and overheating, protect the foot from mechanical damage, help the muscles and ligaments maintain the arch of the foot in a normal position, provide a favorable microclimate around the foot, and help maintain the required temperature and humidity in any microclimate. External environment: Footwear should meet hygienic requirements: lightweight, comfortable, not restricting movement, and appropriate for the shape and size of the foot.

Tight and short shoes make walking difficult, constrict the foot, impair circulation, cause pain, and over time, change the shape of the foot, disrupt normal growth, deform the toes, contribute to the formation of hard-to-heal ulcers, and, in cold weather, frostbite and increased sweating. Shoes that are too loose are also harmful. Walking in them quickly becomes tiring and can cause chafing, especially around the instep. The support surface and stability are significantly reduced. The torso leans backward. This deviation, especially at a time when the pelvic bones have not yet fused, causes a change in its shape and alters the position of the pelvis, which can negatively impact labor. This creates a large lumbar curve. The foot rolls forward, the toes are compressed into a narrow toe box, increasing the load on the forefoot, leading to a flattening of the arch and deformity of the toes. High-heeled shoes make it easier to twist the ankle, making it easier to lose balance.

The sole should be flexible. A rigid sole makes walking difficult (the bending angle is limited, and the heel of the shoe lifts off the heel), reduces ankle muscle performance, and increases shin skin temperature and sweating. While it's important to ensure maximum forefoot mobility, it's equally important to ensure maximum heel stability. The back should be strong, preventing slippage. The back should protect and tightly cover the heel, preventing deformation.

In winter, footwear should retain heat. For this purpose, fur, felt, cloth, and felt are used. On cold winter days (at least -10°C), schoolchildren can wear boots and shoes made of porous rubber, insulated with synthetic fur (Dacron with cotton) or lined with wool or felt. Chronically cold feet can cause vascular spasms and serious tissue malnutrition due to restricted blood flow. In the summer months, the most hygienic, lightweight, open-toe shoes with a wide cutout are sandals, open-toe sandals, leather shoes, or shoes with leather soles with uppers made of textiles or other porous materials (basket, denim, etc.). Such shoes promote good ventilation and rapid sweat evaporation due to air circulation around the foot (due to the choice of material).

In damp, rainy weather, rubber boots or shoes with waterproof soles, such as rubber, nylon, etc., are comfortable. However, these shoes are not very breathable, so they should only be worn with insoles that absorb sweat well: felt, fabric, or, in summer, woven straw or cardboard. Care must be taken to ensure that the lining does not become wet. Shoes that meet hygienic requirements help avoid unpleasant, sometimes painful, symptoms. Therefore, shoes should not squeeze the foot, impair blood and lymph circulation, or interfere with the natural development of the foot. There should be 0.5 - 1 cm of space in front of the big toe. Hygienic requirements for footwear for children and adolescents include shoe design requirements, which are determined by the structural features of the foot during growth, and the materials from which the shoes are made. The size, style, and stiffness of the sole of children's shoes should not interfere with foot development.

The anatomical and physiological structure of a young child's foot differs significantly from that of an adult. A child's foot is characterized by a radial shape, with the greatest width at the tips of the toes. The foot becomes fan-shaped. The heel-to-forefoot relationship is different: children have a relatively longer heel counter, which must be taken into account when designing shoes. The skeleton of the foot in children is formed by cartilage. Ossification is complete only with the end of growth (around age 21), so a child's foot is easily deformed under mechanical stress. Therefore, qualities such as sole thickness, flexibility, weight, and thermal insulation properties are subject to hygienic standards.

Shoe height is regulated depending on the type and style of shoe. The lower part of the shoe (insole, sole, heel) must have optimal rigidity: resistance (expressed in N/cm) to bending along the junction of the toe and metatarsal bones up to an angle of 25 degrees. "Shoe flexibility is regulated and must be 7 N/cm for goose-foot shoes, 10 N/cm for preschool shoes, 9-13 N/cm for school shoes for boys, and 8-10 N/cm for school shoes for girls."

A heel artificially raises the arch of the foot, increasing its elasticity, protects the heel from bruises on the ground, and also increases the wear resistance of the shoe. When resting on a bare foot (without a heel), most of the load falls on the back of the foot. Heelless shoes are only allowed for young children (booties) until the child begins to walk. In shoes with a 2 cm heel, the load is distributed evenly between the forefoot and back of the foot. In shoes with a high heel, that is, higher than 4 cm, the main load falls on the forefoot (with a heel height of 8-10 cm, the load on the forefoot is 7 times greater than on the back). Therefore, the heel height should be no more than: for preschoolers - 5-10 mm, for schoolchildren aged 8-10 - 20 mm, for boys aged 13-17 - 30 mm, for girls aged 13-17 - up to 40 mm. Children's shoes must be securely and comfortably secured to the foot without restricting movement. Various types of fastenings are used for this purpose, including laces, Velcro, straps, zippers, and others. Open-toed shoes without fastenings (like pumps) are not permitted for school shoes. The weight of shoes depends on the materials used, their design, and the type of fastening. Shoe weight limits are set.

Currently, there are virtually no scientifically sound methods for planning and modifying a company's product range based on market conditions. These methods would rely on regular marketing research, market segmentation, product positioning, and comparative assessments of the competitiveness of a company's products and similar products from domestic and foreign manufacturers. Domestic researchers have been studying the issue of assessing product competitiveness for many years, but a unified methodological approach to addressing this issue remains elusive. Specifically, there is no scientifically sound method for assessing the competitiveness of footwear as a product, allowing manufacturers to purposefully and promptly change their product mix. In this regard, the challenges of developing a footwear assortment in the industry that best meets the needs and demands of the child population, taking into account market competition and production capabilities, are particularly pressing and present both practical and scientific interest. To revive children's footwear production in the Southern and North Caucasian Federal Districts, it is first necessary to establish a number of footwear manufacturing enterprises in the following regions of the district, each with a distinct socio-demographic status and employment situation in the republics: Chechnya, Dagestan, Ingush, and Kalmykia. Newly established enterprises require government support, as their own funds are insufficient, and borrowed funds are unavailable due to high interest rates. These enterprises must address the general challenges of technologically modernizing the industry, replenishing working capital, and improving the efficiency of scientific and technical support for the production of high-quality and affordable children's footwear. It is essential to intensify the work of regional and city social welfare agencies in organizing targeted assistance for children and their parents, including large and single-parent families. We believe this is a problem not only for private business but also for the state, as the downward trend in oil prices is becoming persistent, worsening the economy, and, if action is not taken in the industry, could lead to a decline in real annual GDP growth rates (due to reduced profitability). This will lead to serious negative consequences for the economy. Positive economic development could have occurred without a shock if the state had provided initial assistance in reviving the light industry, as it remains in crisis today, explaining unemployment and a low quality of life, especially in small towns where, until 1992, city-forming garment, footwear, and other light industry enterprises were mandatory. It's worth noting that today, only a fifth of light industry output is produced by small businesses. Reasonable expectations here are paradoxical: according to proposals by the Chamber of Commerce and Industry of the Russian Federation and the Russian Union of Industrial Enterprises, it is clear that by 2035, limited production volumes by small businesses (!) will be permitted, reaching up to 60-70% of total output. And once again, in furtherance of the above.

**Main part**

Why isn't this growth systematic? The key point is this: a huge market (the taxable base for imported light industry goods and products increased by $746 million), loyal consumers, capacity, qualified personnel, products (counterfeit, falsified, and smuggled), and domestic footwear will find their customers. To gain an understanding of the footwear market assortment in the Southern and North Caucasus Federal Districts, we analyzed the children's footwear selection in the retail network of these regions, which is shown in Table 1.

**Table 1. The structure of the assortment of children's shoes by price**

| Shoe manufacturing companies | Types of footwear | Price categories, RUB | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | up to 1400 | 1400–1900 | 1900–2400 | 2900–3400 | 2900–4400 | 4900–5400 | 5900–6300 | 6800–7500 |
| Antelope, Moscow | sandals with a strap | | | X | | | | | |
| | Boots | | | | | X | X | | |
| | Sports shoes | | | | X | | | | |
| Kotofey, Yegoryevsk, Moscow region | orthopedic shoes | | | | X | | | | |
| | Boots | | | X | X | X | | | |
| | Boots | | | | | | | X | |
| | low shoes | | | | X | X | | | |
| Foma, Moscow Region | Shoes for small children | | | X | | | | | |
| | Boots for small children | | | X | | | | | |
| Bombini, Moscow | Shoes for teenagers | | | X | | | | | |
| | Boots for teenagers | | | | | | X | | |
| | Low shoes for teenagers | | | | | X | | | |
| Bagheera, Voronezh | Shoes | | | | | | X | | |
| | Boots | | | | | | | X | |
| | Boots | | | | | | | | X |
| RIL, Rostov-on-Don | Sandal strap | | X | | | | | | |
| | Czechs | X | | | | | | | |

Based on an analysis of the range of children's footwear supplied to the retail chain, it can be concluded that, in general, demand for footwear is met by manufacturers from other regions.

It is essential to rehabilitate children's footwear production at shoe factories located in the Southern and North Caucasian Federal Districts. This will fully satisfy demand and, most importantly, take into account the anthropometric characteristics of children's feet in these regions, significantly reduce the risk of pathological abnormalities and promote a healthy lifestyle.

The surface should be soft and easily conform to the shape of the foot. It is advisable to choose a product made entirely of leather (even the sole). The sole of a new pair should have a raised heel. The heel height should be low, around 5-10 mm for children's shoes. The rise of the sole should start somewhere from the middle of the foot. The toe box should not be narrow. New shoes should be comfortable, with a light feel when walking. The materials used for sewing should not cause irritation or allergic reactions. Shoes should not hurt or rub. The elasticity of the sole is average. The base should bend easily when walking. If the sole of a new pair is dense and does not bend, then the rigidity of such a base is unlikely to change over the period of wear. From generation to generation,

There's a common misconception that rigid construction only compresses the foot. This misconception leads to a plethora of shoe models on the market that offer no protection or support. Under pressure from marketers, stores focus more on brand value than on fit. Here, orthopedists and shoemakers play an important educational role: they determine whether the child will be comfortable in the shoes. Let's outline the design features of shoes for children with special needs, namely:

- heel area. Heel width is just as important as shoe length. Shape, curves, and volume are all critical factors when it comes to fitting. A semi-rigid heel counter helps strengthen the last in this area. The shoe should fit perfectly on the heel. If the heel is too narrow, the heel won't fit all the way; if it's too wide, it will shift left and right, and the shoe will hang off the foot, deviating from the direction of movement, causing discomfort to the child.

- the toe area. This part of the shoe shouldn't squeeze the foot. On the contrary, it's good when the child can spread their toes and the big toe is completely unconstrained;

- Length and fit. For each specific size, the manufacturer determines the appropriate parameters (boot length, heel width, comfort factors). The shoemaker must take these characteristics into account and suggest the styles that best suit the child's foot shape (Figure 1);

- Length and height. Measure the maximum length of your foot and add at least one and a half sizes (one size equals 6.66 mm) for your height. Standard foot sizes used today already take this into account. If berets open too wide, it's sufficient to add one size, or 6.66 mm, instead of one and a half.

Sometimes parents are tempted to go up a size to extend the life of their shoes. This can be a good choice if the length is halfway between two sizes. However, it's important to know when to stop: if the shoe is too big, the foot will lack lateral support, and the vamp may fold, making it difficult to walk. This will cause the child to waddle, which will further increase the discomfort.

- toe lift. A slightly upward curve of the toe allows for free movement of the foot while walking, prevents falls, makes creases in the vamp less noticeable, and protects the toe of the shoe from premature wear (Figure 2);

- inserting your foot into the boot. The opening should be wide enough for your foot to easily fit into the shoe. This task will be significantly simplified if you unlace the boot completely, unfasten all Velcro fasteners, etc.

Below a size 28, the cut of cycling boots makes it difficult for the foot to fit into the shoe; in derby boots, on the other hand, the opening will be quite wide, meaning the choice is left up to the parents, taking into account the child's sensations;

- fastening system. The fastening system should securely hold the heel in place to prevent the foot from slipping forward and the toes from getting pinched.

If the shoes are lace-up, the tension should be evenly distributed along the entire length, and sufficient space between the uppers will ensure proper tension. When purchasing shoes with Velcro closures, make sure the fastening is high-quality and sufficiently durable.

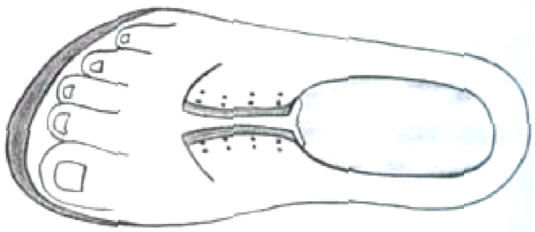


**Figure 1. Characteristics of the position of the foot in the shoe by length**

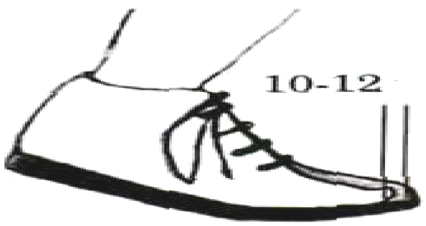



**Figure 2. Peculiarities of shoe toe formation**

If shoes are held on the foot with buckles, the tension will likely not be precise enough. It's not always possible to predict the placement of the perforations in the strap. Shoe fastening systems comply with regulations and precisely fit the instep. If a shoe has a fixed instep, this is a serious drawback, and the child will likely feel uncomfortable in such shoes.

- Socks. Socks made from natural fibers are recommended. Avoid thick, coarse socks with a high synthetic fiber content, which prevent the foot from breathing and add bulk. It's also important to ensure the seam at the front of the sock doesn't rub against the toes. Finally, if the socks are too big, they will roll down.

- shell. Ideally, the lining should be made of genuine, unpolished leather (close contact between the foot and the leather lining is a comfort factor), and appliqués and decorative stitching should be soft to the touch. Gathering seams should not be located in painful areas (joints, ankles, and insteps). A flannel lining at the top of the boot prevents injury to the sensitive areas of the lower leg, and under the tongue cushions pressure when instepping.

- break the shoe. First, make sure the gathering seams won't rub your child's foot. To soften the leather, stretch it in different directions with your thumb, pressing especially hard on the back of the shoe. For sandals, stretch the straps.

It is recommended to wear new shoes for short periods of time first before wearing them regularly;

- Ankle tear. If the shoe is low, use your fingertips to bend the top of the ankle outward to prevent the edges from breaking your foot; for high-top models, use a special shoe horn.

Characteristics of shoe parts

The vamp is the part of the upper that covers the bottom of the instep and toes.

Ankle boots are the part of the upper that covers the side of the heel and reaches the laces.

The tongue is the part located under the lacing.

**Figure 3. Characteristics of shoe upper parts**

**Figure 4. Features of the toe and back position on the last**

The heel counter is a semi-rigid tab on the back of the shoe, between the leather upper and the lining. Its function is to keep the back of the foot aligned with the walking line and prevent the heel from dropping (Fig. 3).

The toe cap is a rigid insert between the leather upper and the lining that protects the toes from impacts and prevents deformation of the shoe (Fig. 4).

A heel counter is a semi-rigid heel counter that fits between the leather upper and the lining. It secures the foot in place and prevents the heel counter from collapsing or wrinkling.

A shank is a rigid insert in the insole that begins at the heel and ends approximately a centimeter in front of the foot's crossbar (an imaginary line that crosses the foot at its widest point, where the toes meet the shaft). The shank provides the necessary rigidity to the bottom of the shoe and protects it from deformation. Grasp the front half of the sole of a child's boot with one hand and the heel of the other and begin twisting them in opposite directions. A good shank resists this twisting and barely changes its original position.

The gel ensures that the transverse fold formed on the shoe last during walking is aligned with the transverse fold of the sole, which follows the arch of the foot. The back of the shoe naturally follows the foot's movement, helping it move forward and providing comfort for the child.

The main (set-in) insole is the leather or other material component that supports the foot. It absorbs natural moisture and adapts to the shape of the foot's footprint.

The removable (hygienic) insole should be thin and placed over the insert. Unpolished genuine leather is recommended. Synthetic film linings can cause foot overheating and are not recommended for use in children's footwear.

Orthoses and insoles. If children's shoes are offered with a sufficiently thick insole, then replacing it with an orthotic or, in other words, an orthopedic insole will maintain the fit parameters corresponding to the selected size (which is not the case with shoes with a thin insole). The boot depth will remain unchanged, and the heel will still fit perfectly. For an orthopedist, the insole can serve as a template when choosing an orthosis when the question arises about the need for orthopedic shoes for a child.

Thick rubber provides good walking dynamics. The sole surface should be textured to prevent slipping (Figure 5).

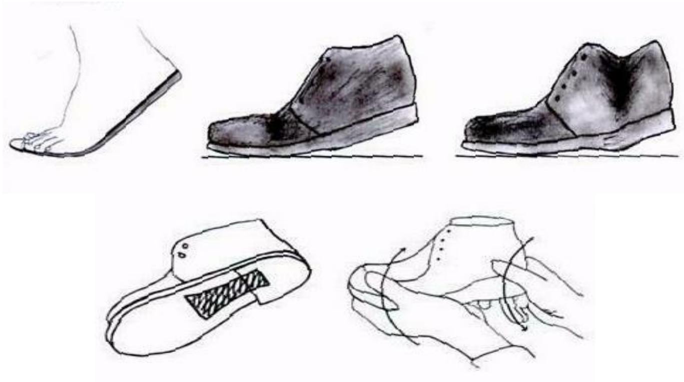


**Figure 5. Features of the location of the intermediate and main parts of the bottom of the boot**

Characteristics of modern models of children's shoes and assessment of their comfort.

Mary Janes are children's shoes with a deep cut and an adjustable strap at the instep. These shoes provide excellent heel support (Figure 6).

**Figure 6. Low-cut shoes with a strap**

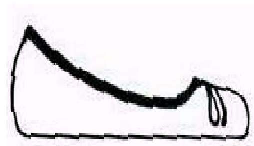


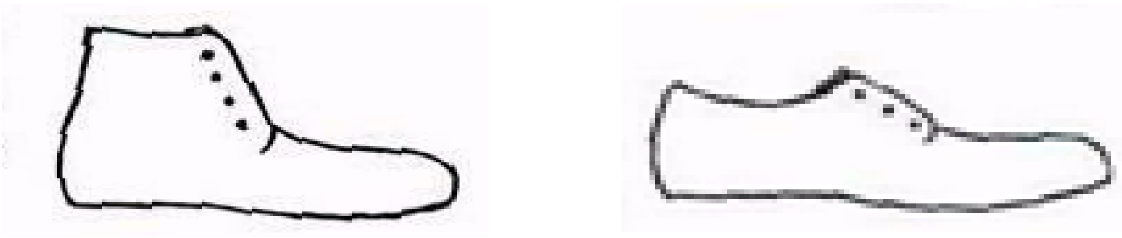
**Figure 7. Features of ballet-type dance shoes**

Ballet flats are dance shoes made of fabric with a rigid toe cap held in place by straps wrapped around the ankle (Figure 7). In folk tradition, this style is made primarily of thin, elastic leather, with a flat sole and a small heel. These shoes are very flexible and offer no support. The neckline, like that of pumps, is deep, and the vamp is short, reaching only to the bottom of the forefoot. Ballet flats are held in place by longitudinal tension, allowing the toes to be visible beneath the leather vamp.

Ballet flats hug the foot perfectly, but offer no support or protection from impacts. The last's structure emphasizes lightness and flexibility, so ballet flats lack the reinforcements typical of other types of children's footwear. In fact, they adopt some of the basic elements of classic pumps. While pastel-colored ballet flats look great with colorful summer dresses, children shouldn't wear them regularly except for special occasions.

Ankle boots are high-top models that cover the ankle, provide good support, and keep the baby's foot securely in place. These boots are an excellent choice for children up to size 26, guaranteeing comfort (Figure 8, a).

Low-cut shoes. Some shoe models can cause chafing in the ankle area. In such cases, the upper edges of the ankle boots should be stretched beforehand (Figure 8, b).



**A B**

**Figure 8. Features of boots and low shoes for children**

Derby. The derby cut with adjustable cuffs and a wide boot opening makes them ideal for children. These shoes provide excellent heel support.

Cycling shoes. The tongue base is very low, at toe level. Arch support will be quite weak. However, the heel is held in place quite securely (Figure 9).

Boats with a lifting strap. The strap secures the foot in place (Figure 10, a).

Pumps with ankle straps. The ankle strap securely holds the foot in place at the heel. However, it can cause chafing at the ankle. Often, the shoe visibly moves away from the foot on the sides when walking (Figure 10, b).

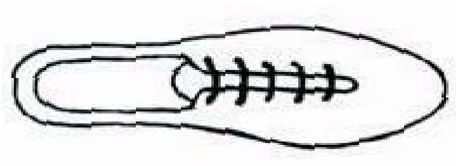


**Figure 9. Features of cycling shoes**

**A B**

**Figure 10. Features of the Boat type boots "with lifting strap" (a )and "with bracelets" (b)**

Moccasins. The cut of moccasins is not suitable for children's feet. These shoes lack any elements that would allow for adjustable tension in the instep area to securely hold the heel, causing discomfort for the child.

Sandals. These are a must-have footwear in summer. Toddler sandals should have a closed heel to provide at least minimal support, and the toe cap should be stiff enough to protect the toes.

The fit and design of sandals must be well thought out: support and protection of the foot are the top priority, and the placement of the holes should be considered by the designer and the orthotist.

How to choose shoes for a baby? It would seem simple: buy bright shoes or sandals with a pretty clasp and off you go, baby! But aesthetic considerations for children's shoes shouldn't overshadow rational evaluation criteria. Parents who focus solely on the visual appeal of shoes risk exposing their child to dozens of problems later in life. In the first years of life, bones and ligaments are still very fragile and easily deformed by improperly selected shoes or a lack of proper exercise. However, their enthusiasm and desire to prevent such foot deformities in children aren't always justified; there's a middle ground.

Almost all children are born with healthy feet. Parents' job is to prevent their child from developing foot problems in the future due to poor grooming or poorly chosen footwear. To do this, it's important to understand the child's developmental patterns and take them into account when choosing footwear.

Around 6-9 months, a baby undergoes a significant developmental leap: they begin to master movements in an upright position. These movements are crucial because they contribute to the development of speech comprehension and active speech, as well as practice navigating the world around them.

By the 8th month, the baby usually begins to show transitional movements towards independent walking: the baby stands up, sits down, sits down, rolls over, and shifts from foot to foot.

Then, by 10 months, he learns to move forward with support (it is better if these are the mother's hands, and not artificial devices like a "walker"), and at 11 months, a normal child takes his first independent steps.

In the first year of life, a child should be able to walk 3-5 meters without support, overcoming small obstacles in the form of scattered toys and baits invented by parents.

When discussing normal development, it's important to keep in mind that 25% of children start walking early, while 20% have a delay. However, if a child starts walking too early, which often occurs with increased motor excitability, or if they aren't walking independently by 12 months, and are also quite phlegmatic and overweight, a pediatrician should be consulted.

Important conditions for normal development of walking are:

- creating an appropriate environment: the presence of multiple points of support in the space; the ability to move around without the risk of damaging expensive polish or mom's favorite vase; the presence of objects that stimulate interest in walking, for example, moving toys, etc.;

- a hard surface for walking (this should not be a carpet or mattress);

– a daily set of gymnastics and massage before a night swim;

- the active involvement of an adult's hands in teaching walking. Any skill (sit, stand, or walk) requires patient teaching, sometimes requiring considerable time and effort. And yet, remember that the warmth of a hand not only helps a child learn, but also contributes to the development of a healthy psyche and a tender attachment to their parents;

- the child's ability to stand, leaning on the entire foot without support, while the feet should be parallel to each other; the ability to walk forward on the entire foot and the child's understanding of the words "walk" and "sit", which is achieved through frequent repetition.

Another important condition for the development of walking is footwear.

It should protect the foot from mechanical damage, provide a favorable microclimate for the foot, and correspond to the anatomical and physiological characteristics of the child's foot.

The sole should be elastic and flexible so the foot can perform the same movements as when walking barefoot. In general, letting a child run barefoot is very beneficial, thus strengthening the ligaments and muscles of the little foot.

Don't put your baby's shoes on until they start walking. To ensure proper foot placement, choose shoes with a sturdy heel that holds the heel securely and prevents it from slipping or turning sideways.

The optimal heel height for a preschooler is 5–10 mm. The heel artificially raises the arch of the foot, thereby increasing its spring properties; it also protects the heel from bruises on the ground and increases the shoe's durability.

The toe box of the shoe must be wider than the heel, meaning the shoe should have ample room in the toe area. Narrow shoes can lead to foot deformities and poor circulation in this area.

When choosing shoe size, you should also remember that shoes that are too loose often cause abrasions on the skin of the foot.

Be sure to pay attention to the presence of an arch support in the shoes.

The main size indicator is the foot length, which is determined by the distance between the heel's longest point and the tip of the longest toe. The unit of measurement is 1 mm. The difference between the numbers is 5 mm. The regulations stipulate that children's shoes are manufactured in three different sizes within each size.

It is also not recommended to take the shoes "at close range".

Lightweight and soft, shoes should fit snugly to the foot with various fasteners, straps, and laces that allow for adjustable instep. It's best if they're made of natural materials, which provide better breathability and ventilation within the shoe.

So, when choosing shoes for a child, it is necessary:

- give preference to leather shoes with a wide toe box, adjustable buckles and a small heel;

- pay attention to the fullness and size of the shoes (there should be a gap of about 1 cm between the big toe and the toe of the shoe);

- Try on shoes while standing on both feet. Measure your child's foot length at least once every three months.

All these parental cares will be rewarded with a healthy musculoskeletal system of the child's foot.

For children who already have foot problems, we recommend corrective anatomical insoles and a specialized exercise program. The earlier such treatment is started, the higher the likelihood of a good outcome. It's important to choose the right orthopedist and strictly follow their recommendations.

How to measure a child's foot correctly to determine the size?

At home, while standing under weight, trace your child's foot on a piece of paper and measure the length from heel to toe, adding 5 mm. Use Table 2 to find your size, which only fits the Perseus last:

**Table 2. Method for determining the length of a child's foot**

| Shoe size "Perseus" | Foot length + 5 mm (cm) | Shoe size "Perseus" | Foot length + 5 mm |
|---|---|---|---|
| 17 | 11.5 cm | 27 | 18.0 cm |
| 18 | 12.0 cm | 28 | 18.5 cm |
| 19 | 12.5 cm | 29 | 19.0 cm |
| 20 | 13.5 cm | 30 | 19.5 cm |
| 21 | 14.0 cm | 31 | 20.5 cm |
| 22 | 14.5 cm | 32 | 21.5 cm |
| 23 | 15.0 cm | 33 | 22.0 cm |
| 24 | 15.5 cm | 34 | 22.5 cm |
| 25 | 16.5 cm | 35 | 23.0 cm |
| 26 | 17.0 cm | 36 | 24.0 cm |

In addition to size, children's feet differ in fullness and volume.

When producing Perseus footwear, individual completeness is taken into account:

1st fullness – narrow foot, 2nd fullness – wide foot with a high instep, which ensures that the shoe matches the natural proportions of the foot.

Don't forget that children's shoes, unlike adult shoes, should have a wide toe box and adjustable fastening on the foot (laces or straps).

Thus, during the period of intensive growth of the body—at 3 and 6 months, 1, 3, and 5 years—differentiation of bone shape and structure occurs. A weak skeletal system, connected by ligaments that are still too elastic, as well as weak muscles, cause significant fluctuations in the height of the longitudinal arches of the foot under load. This contributes to the development of static foot deformities, which can lead to a violation of statics and kinematics. In children of this age, during the period of learning to walk, the conditions for the development of flatfoot deformity arise, since to increase the support surface and maintain balance, the child places his feet wide, leaning on the inner parts of the foot. The widespread belief that flatfoot in children under 6 years of age is physiological and does not require correction is not entirely true. This is up to 5-6 years,

It's not true that children under three years of age don't have flat feet. Flat feet can be congenital, or they can develop due to dysfunction of the central nervous system, endocrine system, infections, and a host of other causes. The most detrimental factor isn't the pain and deformity, but their consequences—impairment of the entire musculoskeletal system, including the spine. Spinal curvature in children can be prevented, or at least its development halted, with timely treatment. The foot begins to develop before the age of five. The earlier flat feet are detected, the easier it is to treat. After five years of age, this becomes more difficult. However, with treatment, you can improve the condition of the foot, halt the progression of flat feet, and prevent spinal deformities.

Pay attention to your child's heel: is it vertical or does it tilt to one side or the other? From a very early age, throughout the period of intensive growth—at 3 and 6 months, 1, 3, and 5 years—regular visits to an orthopedist are essential. Self-medication is not recommended. Massage, physiotherapy, corrective devices (orthopedic insoles), and therapeutic exercises are prescribed by a doctor, who takes into account the child's age, the severity of the pathology, and the underlying cause of flatfoot. Orthopedic insoles must be custom-made, taking into account the anatomical, physiological, and static-dynamic functions of the child's foot. Children's shoes should have a low heel.

How to correct flat feet? Visually, the inner surface of the foot will have an angle pointing toward the opposite foot. In other words, don't try to put your child in extreme (classic) choreography positions until these joints are strong. First, "train" the heel to stand vertically and the foot to "feel" comfortable on the outside. Initially, it's essential to properly shape the outer arch of the foot. This is the key to the proper development of the rest of the arch.

Flat feet and clubfoot are among the most common defects today, and they are closely related. Flat feet without adduction are common; adduction without flat feet is the exception rather than the rule. Adduction itself contributes to heel locking, which is a sign of flat feet.

And one more very important detail, which we've already discussed: it's essential to choose the right shoes, and then modify them yourself.

Exercise is, of course, a huge stimulant for the correct formation of the foot, but no matter how much you do it, in terms of the number of repetitions, it is a drop in the ocean compared to the number of steps in the wrong shoes that our children wear per day.

Judge for yourself. The recommended daily pedometer reading for preschoolers (wearing sandals is mandatory!):

3 years - 9000 - 9500 movements;

4 years - 10,000 - 10,500 rubles;
5 years - 11,000 - 12,000 rubles;
6 years - 13000 - 13500..;
7 years - 14000 - 15000.

What? For comparison, we adults do about 5,000 movements per day, compared to the standard of 10,000. There's only one solution:

- organize useful games;
- wear the “right” shoes;
- return to the skipping rope.

How to refinish shoes?

Try to find shoes with a firm sole or low heel. The problem isn't so much the heel itself (even stilettos can be helpful), but its shape and placement, and most importantly, the lack of support under the base of the fifth metatarsal bone, which plays a dominant role in the formation of the arch. (This is the bone on the outside of the foot, roughly in the middle.) The sole shouldn't be wide. The less it protrudes beyond the shaft, especially the heel, the better. What should parents or a shoemaker who makes orthopedic shoes do??

1. Cut the heel at an angle of 5 - 10. Remove the structural obstacle of the boot.

2. Determine the cutting angle ( α cp) and cut from the base to the top or near the top edge of the sole (depending on its design). This helps the muscles abduct the foot.

3. Round the outer part of the sole and part of the heel to ensure smooth rolling and shaping of the outer arch of the foot.

4. Glue the heel insert (from the middle, at an angle of 25-30 °° °). This creates the internal and transverse arches by twisting the forefoot relative to the back.

5. Glue the insert under the heads of the 2nd-4th metatarsal bones (under the bases of the 2nd-4th toes). This helps form the transverse arch and strengthen the big toe. Note: the apex is horizontal for the adducted foot, and convex for the flat and abducted foot. The insert thickness is 3-5 mm, depending on the age and degree of flattening of the foot.

Now, what can you say about the upper part of your friend's or partner's shoe? I'm sure we'll be more verbose in that case.

Believe me, children who aren't yet interested in fashion (at least until they're 6) will wear what you give them well. Others are more difficult. It's psychologically very difficult to "ruin" a new outfit you bought with your own money! Especially when someone—and there will definitely be one—from your family regularly hurls comments like, "You're wasting your time, you should have done that," "Everyone's going and it's okay," "He'll win anyway." "Don't work," and so on.

You'll have to choose. Either you ruin your shoes, or they'll cripple yours and your children's feet! There is, however, another option: start producing physiological footwear (not to be confused with orthopedic footwear). We believe this is the most sensible solution. But not everyone can afford it.

A drowning man's life is his own doing! Improve your footwear, master the physiological movements, and you'll see excellent results. Many shoe models, of course, won't allow you to follow all of our recommendations. The shoes will simply fall apart. Fix at least part of them. They'll still work!

We won't describe the physiological problems that arise from limited toe mobility. We'll say one thing: bound and confined by the narrow space of a shoe, they contribute to the development of foot defects instead of their intended purpose—stimulating proper foot development.

Amazing! The shoe shape is almost perfect. Check out these children's ballet shoes. They're simply wonderful! All that's left to do is remove the seam on the outside and slightly adjust the heel. But even in this form, they're much more useful than modern sandals and ballet shoes. And it's entirely possible that they can help correct clubfoot and flat feet in children. Theoretically, it's possible. The key is to identify the underlying cause of the defect. Then it will be easier to choose a set of corrective measures.

The problem of preventing and correcting health problems in preschool-aged children has become particularly pressing. This is primarily due to the large number of preschool-aged children (84.9%) with various health problems. This increases the importance of organizing preventive and corrective work directly in the preschool educational institution (PEI), where children are present almost daily and where, therefore, timely and regular interventions can be ensured. However, according to R.B. Sterkina and Yu.V. Korkina, a system for rehabilitating children in preschool settings is currently virtually nonexistent. There is a lack of coordination among medical and pedagogical staff in providing corrective care to children, and a clear lack of awareness among teachers and parents regarding corrective and preventive issues related to the development, upbringing, and education of children. Despite the traditional declaration of the importance of early detection and correction of mental and physical developmental deficiencies in children, correctional pedagogical activities have not become a priority in the actual practice of the education system, although they should be considered a mandatory part of the state educational standard. When organizing preventive and corrective work in preschool educational institutions, special attention should be paid to the prevention and correction of musculoskeletal disorders (postural defects, flat feet), as they constitute the largest proportion of functional deviations. In particular, studies have found that 67.3% of older preschool-age children have flat feet. Flat feet are considered a functional disorder of the foot, externally manifested by a lowering of the arches of the foot, which is caused by weakened muscles and stretched ligaments. Other authors define flat feet as a foot deformity consisting of a decrease in the height of the arches, combined with heel pronation and supination contracture of the forefoot. As a result, the medial edge of the foot drops, its ligamentous apparatus is pathologically stretched, the position of the bones changes; the muscles that support the arch of the foot, which play an important role in maintaining the arch of the foot, weaken and atrophy. which is caused by weakening of the muscles and stretching of its ligaments. Other authors understand flatfoot as a deformation of the foot, consisting of a decrease in the height of its arches in combination with heel pronation and supination contracture of the forefoot. As a result, the medial edge of the foot drops, its ligamentous apparatus is pathologically stretched, the position of the bones changes; the muscles that support the arch of the foot, which play an important role in maintaining the arch of the foot, weaken and atrophy. which is caused by weakening of the muscles and stretching of its ligaments. Other authors understand flatfoot as a deformation of the foot, consisting of a decrease in the height of its arches in combination with heel pronation and supination contracture of the forefoot. As a result, the medial edge of the foot drops, its ligamentous apparatus is pathologically stretched, the position of the bones is changed; The muscles that support the arch of the foot, which play an important role in maintaining the arch of the foot, weaken and atrophy.

The foot is the support and foundation of the body, so naturally, any disruption to this foundation inevitably impacts the development of a growing body. A change in the shape of the foot not only reduces its functional capabilities but, most importantly, alters the position of the pelvis and spine. This negatively impacts the function of the spine and, consequently, the child's posture and overall well-being. Insufficient development of the muscles and ligaments of the feet negatively impacts the development of many movements in children, leads to decreased motor activity, and can become a serious obstacle to participation in many sports. Therefore, strengthening the musculoskeletal system, and the feet in particular, is essential for preventing pathological abnormalities.

It's interesting to note that developing a proper arch in children's feet, as well as preventing and correcting their functional impairments, was highly valued in folk educational traditions. For example, when preparing a child to learn to walk upright, it was customary to gently slap their feet to strengthen their foot muscles while reciting various ditties, jokes, and fairy tale excerpts.

And although much of the invaluable experience of folk pedagogy, collected over centuries, has been lost today, such pistils, nursery rhymes, jokes, the so-called small folklore genres, reflect the traditions and worldview of their creators, their correctness and validity.

During preschool age, the foot is in a stage of intensive development; its formation is not yet complete, so any adverse external influences can lead to various functional disorders. At the same time, children's bodies are highly flexible at this age, so it is relatively easy to halt the development of flat feet or correct it by strengthening the muscles and ligaments of the foot.

Successful prevention and correction of flat feet is possible through the integrated use of all physical education tools: hygiene, natural health factors, and exercise.

**Table 3. Prevention and correction of flat feet in children by means of physical education.**

| Physical education tools | Nature of use |
|---|---|
| hygiene factors | Footwear hygiene and proper selection for appropriate use. Wash your feet with cool water before bed, after walking barefoot, etc. |
| Natural health factors | Walking barefoot on natural dirt paths (grass, sand, pebbles, etc.) set up in group areas during the warmer months, and on artificial dirt paths (boxes filled with washed river pebbles) during the colder months. Foot hardening procedures (salt path, foot rubbing, contrast foot douching, the "Riga" method, intensive foot hardening) are available, tailored to the individual needs of children and in the absence of contraindications, under the supervision of a physician. |
| Physical exercise | Special exercise routines are designed to strengthen the foot and calf muscles and shape the arches of the feet. A distinctive feature is the use of figurative exercise names ("Kittens," "Ducklings," "Funny Zoo") and other exercises with objects (hoop, ball, jump rope). During physical education classes, one routine is learned and performed over two weeks, and for the following two weeks, it is included in the morning exercises. Another routine is used for the next four weeks. Then, for the next two weeks, the previous routine is repeated during the exercises after the afternoon nap. |

Features of children's shoes with their preventive properties for the treatment of flat feet.

Maintaining and improving health cannot be solved solely through medicine; the external environment and lifestyle are crucial. It's important to understand that lifestyle is not simply the presence or absence of bad habits. Lifestyle is a social category and includes levels of wealth, culture, education, and healthcare, as well as the quality of food consumed. Shoes, for example, can also be considered a product that can impact children's health. The significant prevalence of foot deformities in children, such as flat feet, makes the mass production of footwear with preventative properties a pressing issue. Shoes with preventative properties represent a significant segment of the consumer market for children's and teenage footwear. They feature design solutions that ensure maximum comfort, special features (anatomical insoles, half-insoles, and linings), a rational, scientifically proven internal shape, and the use of high-tech materials. During shoe manufacturing, materials are strictly selected based on physical, mechanical, and hygienic properties. New design solutions and materials are being tested on preventative footwear designed to provide maximum comfort for the user and create the necessary conditions for the prevention of foot diseases and deformities. They are strictly selected based on physical, mechanical, and hygienic parameters. New design solutions and materials are being tested on preventative footwear designed to provide maximum comfort for the user and create the necessary conditions for the prevention of foot diseases and deformities. They are strictly selected based on physical, mechanical, and hygienic parameters. New design solutions and materials are being tested on preventative footwear designed to provide maximum comfort for the user and create the necessary conditions for the prevention of foot diseases and deformities.

What are preventative and orthopedic children's shoes?

First of all, what kind of footwear is considered orthopedic? According to GOST R 57761-2017, orthopedic footwear is defined as footwear whose design takes into account pathological deviations in the foot, lower leg, or thigh. Based on this definition, consider this: does a healthy child need "orthopedic" footwear? Should the right children's shoes be orthopedic? In our understanding, no. But there's so much confusion on this issue that orthopedic shops and pharmacies often sell correct children's shoes called orthopedic. In reality, these are prophylactic shoes, or simply shoes made for everyday wear in accordance with GOST 26165-2003. Prophylactic shoes are shoes designed to prevent the development of pathological deviations in a child's foot.

This definition comes from the renowned Albrecht Institute in St. Petersburg. Thus, "orthopedic" footwear for children is currently divided according to GOST R 57761-2017 into children's preventative and therapeutic footwear.

Preventative footwear is the correct type of children's footwear recommended for healthy children whose feet look appropriate for their age. Let's look at its signs.

What materials should children's shoes be made of?

Made from soft, natural, and breathable materials. Both the upper and the lining of the shoe should be natural to prevent sweating and irritation of the delicate skin of the child's feet.

Let's clarify the characteristics of the materials used for preventive footwear.

What should the sole be like? It should be:

Flexible, so as not to interfere with the functioning of the foot and calf muscles. Moreover, the sole should bend not just anywhere, but precisely at the joints where the metatarsus meets the toes.

Non-slip to reduce the risk of falls.

With a forward roll, meaning the toe should be slightly raised off the ground. This is essential for developing a proper gait (Figure 11 ).


**Figure 11. Appearance of preventive children's shoes**

What should the toe box of a proper children's shoe be? It should be wide. Children's shoes shouldn't have a tapered toe box, so their toes feel free. Should there be a heel? Yes, a small heel of 5-10 mm is recommended. Firstly, it prevents the child from falling backward, which often happens to infants. Secondly, it increases the load on the foot muscles and helps train their musculature. The heel shape should be as shown in Figure 12.

**Figure 12. Heel shape for preventive children's shoes**

This is a Thomas heel that is extended on the inside to support the midfoot and prevent it from rolling inward.

What should the backrest be like? It should be closed and rigid so that the child's heel is properly supported and doesn't fall through.

What kind of fastenings should there be? They should be adjustable to ensure a secure fit for the child's foot.

The Velcro fasteners shown in Figure 13 are the most convenient.

**Figure 13. View of children's preventive shoes with Velcro fasteners**

Is an arch support necessary in children's shoes? An arch support is a small raised area on the inside of the insole that sits under the longitudinal arch of the foot and "supinates," or turns the foot outward (Figure 14).


**Figure 14. Corrective part – arch support for preventive and orthopedic children's shoes**

This element is the subject of the most disagreement among orthopedic doctors, with the prevailing opinion being that it's unnecessary in preventative footwear. Why? Specifically:

Firstly, it should be positioned precisely under a specific spot on the foot. But often, children are bought shoes "to grow into," with the arch support positioned in the wrong place. This can only harm the child's developing foot.

Secondly, if you support the area where the arch should form, how can it form? In our opinion, an instep support only hinders the development of the child's own foot muscles.

Moreover, arch supports come in different shapes and sizes: small, soft ones or, conversely, hard, high ones. The latter should be custom-made for a specific foot. Soft, low arch supports are recommended only for children's athletic shoes. During intense physical activity, it's important to maintain the arch. However, if athletic shoes are used for purposes other than their intended use, but rather to "force" them, an arch support is unnecessary. Shoes with arch supports are more accurately described as "therapeutic and preventative" and, in our opinion, should be recommended by an orthopedist in the early stages of flatfoot in children.

Thus, the signs of proper children's shoes, intended for a healthy child, are:

natural materials.

Flexible, non-slip, rolling sole.

Wide toe.

Heel 5 - 10 mm

Hard ass.

Adjustable buckles.

Lack of arch support. At least in preschool shoes.

But it's more accurate to conclude that forced arch correction in children under 6-7 years of age disrupts the development of their feet. If a child shows signs of mild flat feet, an orthopedist will prescribe an insole with a longitudinal arch in preventative shoes. This would be the best solution.

Therapeutic footwear for children, available in orthopedic stores and pharmacies, is divided into anti-varus and anti-valgus. Some manufacturers still produce stabilizing footwear, which is used for both mild varus and mild valgus deformities. These shoes position the foot correctly, stabilizing it (Figure 15).

**Figure 15. Appearance of summer orthopedic children's (therapeutic) shoes**

As you might guess, anti-varus shoes are used for varus foot deformities, meaning a child walks on the outer arches (a "clubfoot"), while anti-valgus shoes are used for varus foot deformities, meaning the feet "collapse" inward. Moreover, these deviations go beyond the physiological characteristics of a child's foot. An anti-varus foot looks as if the left foot has been confused with the right. In more complex cases, orthopedic shoes are custom-made for the individual child, taking into account the pathological changes in their foot.

Medical footwear is manufactured using a special orthopedic last (GOST R 53800-2010). A last is a wooden or plastic shoe mold designed specifically for a specific pathology. Different types of lasts are used for different pathologies. These shoes, unlike prophylactic ones, are higher in height to support not only the foot but also the ankle joint in the correct position. Along with a rigid back, they have rigid uppers, or rigid side inserts of a specific length. Therapeutic footwear has a Thomas heel: anti-valgus shoes have an extended inner edge, while anti-varus shoes have an extended outer edge (Figure 16).


**Figure 16. Characteristics of children's orthopedic shoes**

Medical shoes should not have an arch support. If necessary, an orthopedist will prescribe an insole based on the specific foot condition, possibly an individual one.

Dear adults, remember that children's feet are very receptive to correction. They are soft and pliable. The main thing is not to delay. Foot pathologies in children can be corrected up to the age of 10.

Increased comfort requirements for children's preventative footwear represent a combination of anthropometric, hygienic, and psychophysiological factors. Using footwear that does not meet hygiene requirements, or that has even a slight deviation in the shape and size within the shoe compartment relative to the shape and size of the foot, can lead to deviations from the normal anatomical structure and function of the foot, and, consequently, negatively impact the child's overall health.

Foot diseases and deformities are becoming increasingly common in children. Footwear plays a significant role in the development of these deformities, the most common of which are early-stage flat feet and excessive sweating.

Comfortable conditions in shoes are determined by their ability to maintain the required humidity and temperature within the shoe compartment, which, in turn, depend on the materials chosen for their manufacture and their design. Moisture released from the surface of the foot is removed from the interior of the shoe compartment through moisture exchange processes, thanks to the sorption capacity and vapor permeability of the materials, and the so-called ventilation effect, which removes moisture from the space between the foot and the shoe.

Closed-toe shoes remove a small amount of moisture through ventilation. However, artificial leather (IL), rubber, and PVC with low vapor permeability and hygroscopic properties are widely used for the uppers of closed-toe shoes. A large amount of moisture accumulates inside the shoe cavity, causing discomfort and skin problems. When using low-permeability materials for the uppers of closed-toe shoes, moisture is wicked away from the foot primarily by absorption by the inner parts—the lining and insole. Most of the moisture is concentrated in the main part and insole, so the material of these components must be moisture-absorbing. Insole materials are characterized by high density, high durability after soaking in water, and low abrasion when wet. Furthermore, insole materials should be flexible, porous, vapor- and water-permeable, have low thermal conductivity to prevent foot overheating in hot and cold conditions, maintain their dimensions with changes in humidity, do not warp when wet or dry, and be elastic. A removable insole improves the thermal insulation properties of the shoe bottom, increases shock-absorbing capacity, extending wear life and making walking easier. The insole should be flexible, soft, resilient, and have a low density, do not warp when wet or dry, and be elastic. A removable insole improves the thermal insulation properties of the shoe bottom, increases shock-absorbing capacity, extending wear life and making walking easier. The insole should be flexible, soft, resilient, and have a low density, do not warp when wet or dry, and be elastic. A removable insole improves the thermal insulation properties of the shoe's bottom, increases shock absorption, extending wear life and making walking easier. The insole should be flexible, soft, resilient, and have a low density.

Omnipel (Italy) has developed Micro - Air, a material for insoles. It is a flexible, polyurethane-based composite material with an open-cell structure that allows air and water vapor to pass through. The pumping effect created by walking creates a pleasant microclimate in the shoe compartment. Its advantages also include good shock-absorbing properties, suitability for use in all types of footwear, and low deformation pressure under repeated static and dynamic loads. Micro - Air can be laminated and, if necessary, treated with fungicides and activated carbon.

Emsold has developed Carbosan, a compound for foam components. It contains activated carbon, which has a deodorizing effect by absorbing substances released by the foot. The resulting foam components (insoles, footbeds) have good shock-absorbing properties, kill bacteria and fungi, and have a structure with high hygienic properties. Another promising area is the production of insole materials based on flax fiber. The use of textile-containing fabrics in artificial materials technology is driven by the unique properties of flax—high strength, hygroscopicity, and antibacterial properties.

Silicone is widely used as a material for the manufacture of prophylactic shoe inserts for various areas of the foot, as it prevents the foot from slipping on the insole. Silicone is an elastic material, giving the foot a springy feel, which relaxes the muscles and tendons of the legs, improves circulation, makes walking more comfortable, and reduces foot fatigue. The side of the insole that contacts the skin is usually antibacterial, absorbing moisture and odors, which also adds comfort during long walks. Furthermore, the antibacterial coating allows the foot to more easily penetrate the shoe. Silicone is a material that almost never causes allergic reactions and prevents the growth and development of various types of fungi and bacteria. Doctors recommend silicone insoles for the prevention and treatment of flat feet, early diabetic foot syndrome, psoriasis, dermatitis, eczema, rheumatoid arthritis, heel spurs, during rehabilitation after injuries, and cracked and dry skin of the feet. Recently, silica gels have been widely used for drying shoes.

Experiments have shown that, under domestic conditions, drying shoes with silica gel is significantly faster and more efficient (more moisture is absorbed per unit of time). Silica gel regeneration (drying) occurs twice as fast and at a lower temperature than drying zeolites. Silica gel is an amorphous form of silicon dioxide, artificially produced as solid, irregular granules (resembling crystals) or solid, smooth spheres. The porous structure of interconnected voids creates a huge specific surface area (up to 800 square meters per gram). Silica gel is mass-produced and easy to use, and it can adsorb a wide range of substances. It is most often used to absorb water vapor, i.e., it can hold molecules (such as water) on its inner surface, which is why it is often called a "desiccant." The pore volume of silica gel typically exceeds 0.2 ml/g, and the inner surface area exceeds 400 square meters. The pore radius varies from 1 nanometer to several hundred nanometers. Silica gels are classified: by grain shape (granular or lumpy); grain size (coarse and fine); pore size (large-porous and fine-porous). According to GOST 3956-76, silica gel types are classified by a four-letter designation: the 1st letter characterizes the granule size (K - coarse, M - fine, A - activated, Sh - batch); the 2nd letter is always C (silica gel); the 3rd letter the pore size (K - coarse-porous, M - fine-porous); the 4th letter is the shape of the particles (G - granular, K - lumpy). and the internal surface exceeds 400 sq.m/g. The pore radius varies from 1 nanometer to several hundred nanometers. Silica gels are classified: by grain shape (granular or lumpy); grain size (coarse and fine); pore size (large-porous and fine-porous). According to GOST 3956-76, silica gel types are classified according to a four-letter designation: the 1st letter characterizes the granule size (K - coarse, M - fine, A - activated, Sh - batch); the 2nd letter is always C (silica gel); the 3rd letter pore size (K - coarse-porous, M - fine-porous); the 4th letter - particle shape (G - granular, K - lumpy). and the internal surface exceeds 400 sq.m/g. The pore radius varies from 1 nanometer to several hundred nanometers. Silica gels are distinguished: by grain shape (granular or lumpy); grain size (coarse and fine); pore size (coarse-porous and fine-porous). According to GOST 3956-76, silica gel types are classified by a four-letter designation: the 1st letter characterizes the granule size (K - large, M - small, A - activated, Sh - charged); the 2nd letter is always C (silica gel); the 3rd letter the pore size (K - large-porous, M - small-porous); the 4th letter is the particle shape (G - granular, K - lumpy). by pore size (large-porous and small-porous). According to GOST 3956-76, silica gel types are classified by a four-letter designation: the 1st letter characterizes the granule size (K - large, M - small, A - activated, Sh - batch); the 2nd letter is always C (silica gel); the 3rd letter the pore size (K - large-porous, M - small-porous); The 4th letter is the particle shape (G - granular, K - lumpy). By pore size (coarse and fine-pored). According to GOST 3956-76, silica gel types are classified by a four-letter designation: The 1st letter characterizes the granule size (K - coarse, M - fine, A - activated, Ш - charged); The 2nd letter is always C (silica gel); The 3rd letter is the pore size (K - coarse, M - fine-pored); The 4th letter is the particle shape (G - granular, K - lumpy).

The preventative properties of children's shoes largely depend on the spacer-support component, which distributes localized loads across the plantar and dorsal surfaces of the foot, thereby ensuring the physiologically normal functioning of the muscles and ligaments of the foot. The comfort of the shoe fit can be improved with an anatomically profiled insole. This eliminates functional impairments associated with physiologically normal foot deformities, and improves the musculoskeletal, shock-absorbing, and running functions of the foot.

Insertable prophylactic devices increase the support surface and contact area between the shoe and the foot, thereby reducing specific pressure and, consequently, foot fatigue during walking, which in turn ensures the quality of the footwear. A removable prophylactic insole with an anatomically moderate foot profile, made of hygienic material with antimicrobial treatment, solves the problem of shoe comfort. The moderate profile of a removable prophylactic insole is an important factor in creating comfortable footwear for any purpose for wearers without clinical pathology in the foot anatomy. Research is being conducted in this area to develop new designs for children's prophylactic insoles. A known insole design for children's preventive footwear, comprising an upper, intermediate, and lower layer, wherein the upper layer is made of leather, the intermediate layer is made of thermoplastic foam material formed during wear, and the lower frame layer is made of a dense thermoplastic material, and the intermediate layer is made of with a recess in the heel part under the heel tubercle in the area of 0.18 D , where D is the length of the foot, and with an even distribution of the outer and inner arches in the area of the shin with the highest point in the area of the calcaneocuboid joint in the section of 0.36 D. On the upper layer of the insole in the toe part there is a size scale and marking lines in the form of color zones, determining the correspondence of the shoe size to the foot length size. Another insole design features a leather top layer, a thermoplastic foam midlayer that molds during wear, and a dense thermoplastic frame layer underneath. The midlayer features a recess in the heel area for the heel tubercle measuring 0.18 D, where D is the foot length, and an even distribution of the outer and inner arches in the lower leg, with the highest point at the calcaneal joint measuring 0.36 D. The top layer of the insole features a size scale and color-coded markings in the toe area, indicating the correct shoe size for the foot length. Another insole design features a leather top layer, a thermoplastic foam midlayer that molds during wear, and a dense thermoplastic frame layer underneath. The midlayer features a recess in the heel area for the heel tubercle measuring 0.18 D, where D is the foot length, and an even distribution of the outer and inner arches in the lower leg, with the highest point at the calcaneal joint measuring 0.36 D. The top layer of the insole features a size scale and color-coded markings in the toe area, indicating the correct shoe size for the foot length. In another insole design, the midlayer is made of thermoplastic foam that molds during wear, and the lower frame layer is made of a dense thermoplastic material. The midlayer is made of a 0.18D cross-sectional area in the heel, where D is the foot length, and with an even distribution of the outer and inner arches in the shin, with the highest point at the calcaneal joint at a cross-sectional area of 0.36D . On the upper layer of the shin, the insole in the toe area has a size scale and marking lines in the form of color zones, determining the correspondence of the shoe size to the foot length. In another insole design, the midlayer is made of thermoplastic foam that molds during wear, and the lower frame layer is made of a dense thermoplastic material. 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The authors used questionnaires and interviews to collect data. The survey results were processed using mathematical statistics.

When analyzing the number of protective footwear in children's wardrobes, the child's age plays a leading role. For a more visual representation, the results are presented as percentages. The survey results showed that the vast majority of children aged 1 to 7 own one or two pairs of protective footwear in their wardrobes. The percentage of children owning four or more pairs of winter leather footwear has also increased.

The study found that children across all age groups typically own two pairs of leather shoes. The percentage of children in the two oldest age groups who own three or more pairs of shoes is quite high. The majority of respondents (60%) purchased their shoes at the market. This suggests that leather goods companies need to produce footwear that is in full demand.

When asked, "What do you think is the most important feature of preventative footwear?" most respondents answered durability, comfort, and the material the footwear is made of. Hygienic properties are not given due consideration. Children's preventative footwear should be mostly loose-fitting, brightly colored, and embellished. It's important to remember that children wear these shoes primarily outdoors, so they need to be absorbent.

Let's look at the responses to the question: "What difficulties do you encounter when choosing preventive footwear?" The following responses were given: high price, poor appearance, excessive stiffness, uncomfortable to put on the child's foot, unsatisfactory workmanship, and unsatisfactory quality of materials. Parents of 3- to 4-year-old children were particularly dissatisfied with the excessive stiffness of the heels. Parents of the first age group emphasized the importance of quality of workmanship and ease of putting on the child's foot when purchasing shoes. For children in the third age group, parents cited a discrepancy between the price and quality of children's shoes, excessive stiffness, and high price.

Based on the data obtained, it can be confidently stated that the brands of leading Russian companies, Sovenok and Kotofey, are the most popular among parents and children, despite the presence of local and regional manufacturers of preventative children's footwear.

Flat feet is a foot deformity that consists of a decrease in the arches of the foot.

Flat feet are more than just a cosmetic defect. They are often accompanied by pain in the feet and shins, increased fatigue when walking, difficulty running and jumping, impaired coordination, overload of the lower extremity joints, and earlier onset of osteochondrosis-related pain.

The causes of flat feet include: congenital pathology (11.5% of all congenital foot defects), rickets, nervous system diseases (paralysis, paresis of the lower extremities, generalized muscle hypotonia, etc.), foot injuries (fractures of the lower leg, ankles, wounds with damage to nerves, tendons, and muscles), and inadequate static loading. Typically, several causes act in concert. More or less pronounced factors, such as rickets, generalized muscle hypotonia, and inadequate static loading, are more common. The latter is usually caused not by impaired motor activity, but by wearing inappropriate footwear by children with impaired muscle tone and increased elasticity of the sac-ligament apparatus.

Types of flat feet

The following types of flat feet are distinguished:

- longitudinal;
- transverse;
- combined (longitudinal-transverse).

Degrees of longitudinal flatfoot

I: arch angle 131–140°, arch height 35–25 mm. No foot bone deformities.

II: arch angle 141-155°, arch height 24-17 mm. The talus is shortened, and its neck is not accentuated. Deforming arthrosis of the talonavicular joint or calcification of the ligamentous apparatus on the dorsum of the foot may be present.

III: The arch angle is 156° or higher, and the arch height is less than 17 mm. A small protrusion on the plantar surface of the calcaneus becomes massive. There is also a flattening of the transverse arch, abduction contracture of the big toe, pronation of the foot, and outward deviation of the heel.

Degrees of transverse flatfoot.

I: the angle between the 1st and 2nd metatarsal bones is 10–12, the angle of deviation of the 1st toe is 15–20.

II degree: the angle between the 1st and 2nd metatarsal bones is 13-15°, the angle of deviation of the 1st toe is 21-30°.

III degree: the angle between the 1st and 2nd metatarsal bones is 16-20, the angle of deviation of the 1st toe is 31-40.

IV degree: the angle between the 1st and 2nd metatarsal bones is more than 20, the angle of deviation of the 1st toe is more than 40.

Diagnosis of flat feet. Children with flat feet may complain of increased leg fatigue, pain in the feet and shins when running, walking for long periods, and at the end of the day. Headaches may develop after physical activity due to decreased spring function of the feet. In the feet, pain is typically localized in the arch of the foot, at the inner edge of the heel, in the talocalcaneonavicular joint, and under the ankles. In the legs, pain is localized in the gastrocnemius or anterior tibialis muscles. The height of the medial and lateral arches of the foot is reduced, the foot is elongated and widened in the middle and forefoot. The navicular bone can be identified through the skin on the medial side of the foot. A characteristic slapping gait with toes pointed outward when standing is characteristic.

no flat feet    I degree flat feet    flat feet grade II    III degree flatfoot

**Figure 17. Characteristics of the number of degrees of flat feet**

In children    In adults

34 years old    5 – 7 years    8 – 18 years old    I am st.    2nd century    III century

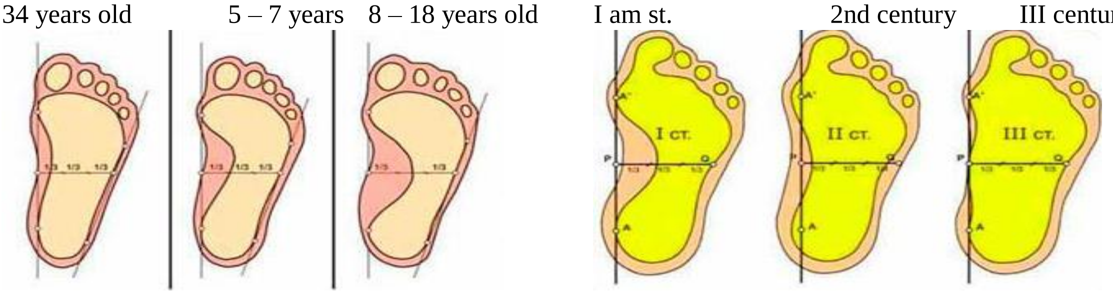



**Figure 18. Features of flat feet in children and adults**

Longitudinal flatfoot

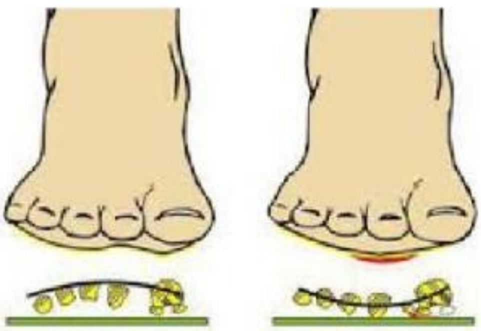
flat feet

normal foot

transverse flatfoot

normal foot    Initial stage of deformation    Severe deformation

**Figure 19. Features of transverse and longitudinal flatfoot**



alignment speed

A

normal foot

flat feet

b

**Fig. 20. Types of feet in children and adults: a - longitudinal; b - transverse**

**Figure 21. Assessment of the degree of flat feet**

**Figure 22. Measuring feet for pathological deviations**

**Figure 23. Selection of corrective elements for feet with pathological deviations**

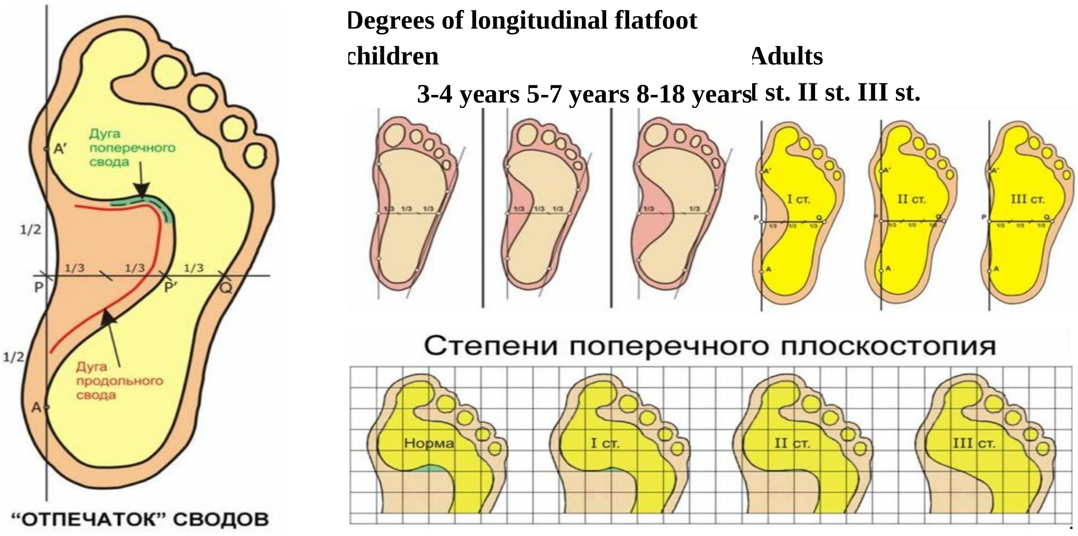



**Figure 24. Characteristics of the degree of flat feet in children and adults**

A diagnosis of flatfoot is confirmed by plantography—taking footprints. A plantograph is used to perform plantography. It consists of a frame with a waterproof fabric stretched over the underside and coated with paint. The child places their foot on the plantograph and stands with equal weight on both feet. The foot being examined is outlined. Sometimes a point is placed between the third and fourth toes at the level of the metatarsal heads. On the plantogram, this point is connected to the center of the heel. The resulting line is the boundary between the weight-bearing and spring arches. Normally, the weight-bearing arch is painted, while the spring arch is free. There are other ways to process the plantogram.

Recognizing flatfoot in children has some peculiarities, as the feet of a growing organism go through certain stages of development, which should be taken into account.

Anatomical studies show that newborns have well-defined arches. However, this arch is masked by abundant subcutaneous fat, causing the foot to appear flat when examined from the sole. Beginning in the second year of life, when the child begins to walk and learn to run, the longitudinal arch of the foot actually decreases due to the weight bearing on the still-weak foot. From the age of three, significant development and strengthening of the ligaments and muscles occurs, leading to a gradual increase in the arch height. Thus, the arched structure of the foot becomes increasingly defined. The older the child, the more pronounced the arches become upon examination. Therefore, the seemingly flat shape of the foot in young children cannot be attributed to true flatfoot but is merely a phase of normal development. It should be remembered that flat feet, as a normal variant, can persist throughout life and cause no functional impairment (a person can perform any work on their feet, including lifting heavy objects, without pain). Due to the already noted anatomical and physiological characteristics of children, determining flat feet based on footprints can be misleading, as almost all children experience flat feet in early childhood. If there is any doubt about the nature of a child's flat feet, the patient should be referred to a specialist—an orthopedist. Therefore, in addition to patient complaints, it is most accurate to determine the position of the osteochondral skeleton of the foot. It should be noted that flat feet, as a normal variant, can persist throughout life and cause no functional impairment (a person can perform any work on their feet, including lifting heavy objects, without pain). Due to the already noted anatomical and physiological characteristics of children, determining flat feet based on footprints is prone to error, as almost all children experience flat feet in early childhood. If there is any doubt about the nature of flat feet, a child (patient) should be referred to a specialist – an orthopedist. Therefore, in addition to patient complaints, the most accurate method is to determine the position of the osteochondral skeleton of the foot. It is important to note that flat feet, as a normal variant, can persist throughout life and not cause any functional impairment (a person can perform any work on their feet, including lifting heavy objects, without pain). Due to the already noted anatomical and physiological characteristics of children, determining flat feet based on footprints is prone to error, as almost all children experience flat feet in early childhood. If there is any doubt about the nature of flat feet, a child (patient) should be referred to a specialist – an orthopedist. Therefore, in addition to patient complaints, the most accurate method is to determine the location of the osteochondral skeleton of the foot. (And no pain). Due to the already noted anatomical and physiological characteristics in children, determining flat feet by the footprint can lead to errors, since all or almost all children have flat feet in early childhood. If there is any doubt about the nature of flat feet, the child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to patient complaints, the most accurate method is to determine the location of the osteochondral skeleton of the foot. (And no pain). Due to the already noted anatomical and physiological characteristics in children, determining flat feet by the footprint can lead to errors, since all or almost all children have flat feet in early childhood. If there is any doubt about the nature of flat feet, the child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to patient complaints, it is most correct to determine the location of the osteochondral skeleton of the foot. The child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to patient complaints, it is most correct to determine the location of the osteochondral skeleton of the foot. The child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to patient complaints, it is most correct to determine the location of the osteochondral skeleton of the foot. it is most correct to determine the location of the osteochondral skeleton of the foot. The child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to patient complaints, it is most correct to determine the location of the osteochondral skeleton of the foot. it is most correct to determine the location of the osteochondral skeleton of the foot. The child (patient) should be referred for consultation to a specialist - an orthopedist. Therefore, in addition to the complaints of patients, the most correct thing is to determine the location of the osteochondral skeleton of the foot.

Types and causes of flat feet.

An analysis of the conducted research allows us to identify three main functions inherent to the normal foot: springing - the ability to elastically straighten under the influence of a load; balancing - participating in the regulation of late activity during standing and walking; jogging - transmitting acceleration to the overall center of mass of the body during locomotor activity. The most important structural feature of the human foot is its arched structure. Since the longitudinal and transverse arches of the foot are convex upward, in an upright position, the pressure on the sole is distributed primarily across three points (the calcaneal tubercle, the heads of the first and fifth metatarsal bones) and the outer edge of the sole. Consequently, the effective support area of the foot is smaller than the area of its sole. The arch of the foot is supported and strengthened by the calf muscles, so its shock-absorbing properties are determined not only by the anatomical features of its bones, but also by the active work of the muscles. The human foot is naturally very well constructed. Over the course of evolution, the human foot acquired a shape that allows for an even distribution of load. But the ideal foot is found in less than half of humanity. According to scientists, 40 to 80% of the world's population suffers from flat feet, 90% of whom are women. The human foot has evolved to distribute weight evenly. But the ideal foot is found in less than half of humanity. According to scientists, 40 to 80% of the world's population suffers from flat feet, 90% of whom are women. The human foot has evolved to distribute weight evenly. But the ideal foot is found in less than half of humanity. According to scientists, 40 to 80% of the world's population suffers from flat feet, 90% of whom are women.

**Table 4. There are 5 types of flat feet:**

| Type of flat feet | Cause |
|---|---|
| Static flatfoot - 82.1% | Decreased muscle tone |
| Paralytic flatfoot - 5.7% | Consequences of poliomyelitis |
| Traumatic flatfoot - 6.2% | Result of tarsal fractures |
| Rickets flatfoot - 3.2% | Rickets |
| Congenital flat feet - 2.8% | Congenital malformations, narrowing of the amniotic vessels, etc. |

Types of static flatfoot

Acquired longitudinal flatfoot: This condition causes the foot to become deformed, with a flattening of the longitudinal arch. The causes of longitudinal arch deformity vary and depend on the condition of the musculoskeletal system, calcium levels, and external factors.

Traumatic form of deformation – resulting from fractures of the bones of the foot and ankle joint, with damage to the soft tissues that strengthen the arch of the foot.

Paralytic deformity develops due to paralysis or paresis of the muscles that support the arch of the foot. This foot deformity is typical of poliomyelitis, static paralysis, and spinal cord disorders. The muscles that support the longitudinal arch of the foot are shown in Figure 25.

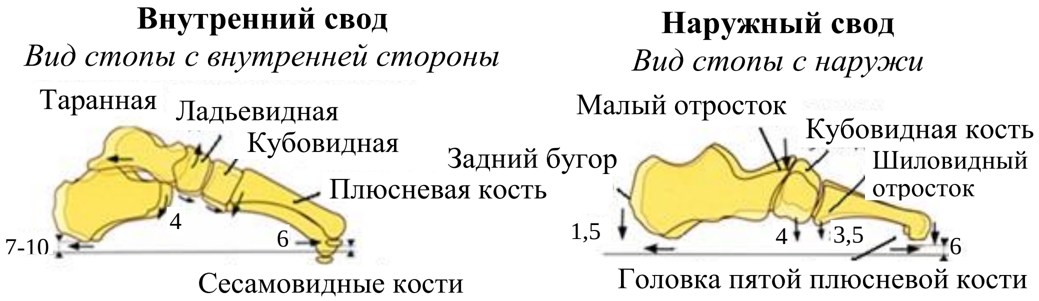



**Figure 25. Muscles that support the longitudinal arch of the child's foot**

Static foot deformity: develops as a result of foot overload. Causes may include rapid weight gain (obesity, pregnancy), heavy physical work associated with stress, as well as the depletion of compensatory abilities with age and general atrophic phenomena (poor diet, prolonged fasting, etc.).

The diagnosis of longitudinal flatfoot is made by an orthopedist based on a clinical examination, plantography, and radiography. Patients notice fatigue in the lower extremities. Frequent and intermittent pain occurs in the longitudinal arch of the feet and in the shins when walking and at the end of the day. As the disease progresses, pain in the hips and lower back becomes a concern. This leads to gait disturbances, swelling of the feet and ankles, and the development of arthrosis of the foot joints.

Surgical treatment of longitudinal foot deformity is used extremely rarely, and only in exceptional cases. Treatment for longitudinal flatfoot is primarily conservative, aimed at relieving pain and preventing the progression of the foot deformity. Warm foot baths with saline solutions and herbal infusions, as well as foot massage, are used. Therapeutic exercises are aimed at strengthening the muscles and ligaments of the foot. These include exercises for flexion and supination of the feet, flexion and extension of the toes, using objects such as a ball, rolling pin, etc. For severe pain, limiting weight-bearing on the feet, and usually bed rest, is recommended. A foot massage and therapeutic exercises are recommended for 2-3 weeks, followed by foot massage and therapeutic exercises. Physiotherapy procedures include paraffin and ozokerite applications, hydrocortisone phonophoresis, and novocaine electrophoresis. Conservative treatment courses must be repeated regularly throughout the year. Patients suffering from longitudinal flatfoot are recommended to wear orthopedic shoes and custom orthopedic insoles, which allow for a comfortable position for the foot.

The most common cause of transverse flatfoot development is constant increased static load on the feet due to constitutional predisposition, less often due to injuries, diseases of the nervous system. Transverse flatfoot is a consequence of insufficiency of the muscular-ligamentous apparatus in combination with functional weakness of the muscles of the foot and lower leg. However, the role of muscle weakness in the development of transverse flatfoot remains controversial, since the foot lacks muscles that bring the metatarsal bones together. Nevertheless, electromicrographic studies have revealed primary changes in the functional properties of the muscles of the lower leg and foot during the development of transverse flatfoot. Transverse flatfoot is clinically manifested by foot deformities. These are deviation of the big toe (1st finger) to the side; osteochondral growths along the inner edge of the head of the 1st metatarsal bone; tension of the extensor tendons of the toes (under the skin, on the dorsum of the foot); the appearance of skin calluses on the plantar part of the foot; Hammertoe is a deformity of the second and third toes. As this deformity develops, the inward-protruding head of the first metatarsal bone is constantly pressed against the shoe, which is one of the causes of osteochondral growths along the medial border of the bone and the development of bursitis of the first metatarsophalangeal joint. An outward-curved first toe and hammertoe deformities of the second and third toes are more susceptible to constant pressure from the edges of the shoe.

An orthopedist diagnoses transverse flatfoot based on a clinical examination, plantography, and radiographic examination. Patients with acquired transverse flatfoot typically complain of lower extremity fatigue during prolonged walking or standing. They also experience intermittent pain in the heads of the first metatarsal bone, pain emanating from the sole, and pain in the projection of the heads of the second and third metatarsal bones. All of this can make it difficult to find suitable footwear. Treatment for acquired transverse flatfoot is usually conservative, aimed at relieving pain and preventing further progression of the foot deformity. Traditional conservative treatment includes warm foot baths with saline solutions and herbal infusions, therapeutic exercises, and foot and calf massage.

The physiotherapeutic methods used include ozokerite and paraffin applications, electrophoresis of drugs (novocaine solution, etc.), and ultraphonophoresis with hydrocortisone. They also use various devices for foot correction: silicone cuffs placed on the forefoot; interdigital pads between the 1st and 2nd toes; custom-made orthopedic insoles for continuous wear in shoes. For grade 1 transverse flatfoot, only conservative treatment methods are usually used. Since it is impossible to correct the developed foot deformity with conservative methods, surgical foot correction methods are also used when indicated. For grades 2 and 3 transverse flatfoot, accompanied by persistent pain, impaired foot function (support and walking), and progressive foot deformity,

Clinically, orthopedic doctors distinguish 5 stages of flat feet:

1. Prodromal stage. During the first stage, fatigue increases when walking, and by the end of the day, changes in the feet appear, including sweating, corns, and calluses. Increased sensitivity to microtrauma, pain after prolonged static loads, and a feeling of fatigue by the end of the day are noted. Physical performance decreases, and general fatigue is pronounced. Headaches are possible due to the decreased spring function of the foot. The end result of all this is sleep disturbance.

2. Stage 2: Intermittent flatfoot. Foot pain increases towards the end of the day. The longitudinal arch of the foot visibly thickens and returns to normal after rest. Swelling of the feet and temporary muscle contractures are possible. These symptoms disappear by morning. Already at this stage, changes occur in the knee joints, swelling in the ankles, and impaired circulation in the lower extremities, manifested by heaviness in the legs and orthostatic edema. Foot pain leads to decreased mobility, with travel by car preferred. Insufficient muscle mobility leads to impaired microcirculation and changes in lymphovenous outflow. In these two stages, there are no significant visible changes in the feet.

The main complaints are thickened, loose tissue in the knee joint area, not always fatty in origin: the increased volume is caused by micro-effusions from the knee joint, which also suffers from flat feet. In other patients, the pathological process is localized in the ankle joint: it becomes wide, swollen, and loses its shape.

Stage 3 of flatfoot development. Fatigue develops quickly due to muscle strain. Pain is constant and aching. The longitudinal arch height decreases. Leg deformity is clearly visible; the contours of the navicular bone are prominent at the medial (inner) edge of the foot, and the calcaneus deviates outward, forming an unsightly bump, usually bluish-red in color and easily injured, leading to abrasions. Gait changes as the range of motion in the joints of the feet is limited.

Stage 4: Flatfoot. The longitudinal arch is sharply flattened. Pain in the medial malleolus quickly develops when walking. There is a pronounced reflex spasm of the calf and foot muscles. The tendons at the back of the foot are stretched. Deformation of the big toe is noted, with the formation of a bunion and rough calluses. The latter are often associated with calluses. The patient notices a plantar wart and visits a dermatologist, usually late in the process, when pain has already developed. Flatfoot is also a cause of calluses. Therefore, treatment without concomitant orthopedic correction may be ineffective.

Stage 5: Flatfoot contracture. Leg pain is constant. The foot is in a sharp pronation position (the inner surface is compacted). Walking is noticeably impaired and difficult.

Prevention of flat feet in the earliest stages includes timely and comprehensive treatment of rickets and central nervous system pathologies, as well as strengthening the muscles and ligaments of the lower extremities through gymnastics and massage. Later, starting at age one, when the child is learning to stand upright and walk, wearing appropriate footwear is equally important. Walking barefoot or in socks on the floor is harmful for preschool-aged children. They can walk barefoot on sand, pebbles, grass, up and down slopes, peas, and beans. To prevent flat feet and strengthen the foot muscles, it is helpful to use Plant insoles, which have massage elements in the arch area. These insoles are recommended to be worn for no more than 5-6 hours per day. It is convenient to place Plant insoles in shoes that the child wears at a preschool. The child's active time at a preschool is approximately equal to the recommended wearing time of the insoles. On weekends, the child doesn't attend preschool, so their feet can rest. If there are any foot defects, it's helpful to use orthopedic insoles to help correct the defect or have their shoes adjusted.

During the period of formation and differentiation of a child's foot, the risk of foot deformity is high. Foot deformities in children are associated with the fact that, in an effort to increase the support surface, the child tries to spread their legs as wide as possible, maximizing the use of the inner parts of the feet. Increased ligament extensibility and an insufficiently strong skeletal system also contribute. The risk of conditions such as hallux valgus and varus deformities is particularly high; toe deformities are less common. The orthopedist diagnoses the pathological deviation and provides recommendations to the parents and child on measures they should implement with the orthopedist's participation to alleviate the child's condition.

According to specialists from the St. Petersburg Scientific and Practical Center for Medical and Social Expertise, Prosthetics, and Rehabilitation of the Disabled, G.A. Albrecht, orthopedic insoles up to size 140 are only custom-made as prescribed by an orthopedic surgeon.

In cases of flat feet due to slow arch development, arch-forming insoles and half-insoles are recommended. They are made with a lining of the inner and outer longitudinal arches of the foot, which are located between the 0.20 L and 0.60 L sections. The maximum height of the longitudinal arches is the same both internally and externally. It is located at the level of the calcaneocuboid articulation, i.e. for sizes from 140 to 200 - in the 0.36 L section and ranges from 5 to 7 mm, for sizes from 205 to 245 - in the 0.33 L section and ranges from 8 to 10 mm. The depth of the recess relative to the edges of the insole in the heel is 3-4 mm for children's and small children's insoles and 5-6 mm for the rest.

For functional impairment of the musculoskeletal system and moderate static, non-fixed flatfoot, supination insoles and half-insoles are prescribed. These insoles feature a medial and lateral longitudinal arch pattern located between the 0.20 and 0.60 sections. In this case, the medial arch pattern is higher than the lateral arch pattern. The maximum position of the medial and lateral longitudinal arches is at the level of the calcaneocubital joint, similar to that described above. Depending on foot size, the lateral arch pattern ranges from 5 to 8 mm, and the lateral arch pattern ranges from 9 to 12 mm.

Features of resuscitation in children with impaired vital functions.

The problem of preventing and correcting health problems in preschool-aged children has become particularly pressing. This is primarily due to the large number of preschool-aged children (84.9%) with various health problems. This increases the importance of organizing preventive and corrective work directly in the preschool educational institution (PEI), where the child is present almost daily and where, therefore, timely and regular interventions can be ensured. However, at present, a system for the rehabilitation of children in preschool settings is practically non-existent. There is a lack of coordination among medical and pedagogical staff in providing corrective assistance to children, and a clear lack of awareness among teachers and parents regarding corrective and preventive issues in the development, upbringing, and education of children. Despite the traditional declaration of the importance of early detection and correction of mental and physical deficiencies in a child's development, correctional pedagogical work has not become a priority in the actual practice of the education system, although it should be considered a mandatory part of the state educational standard. When organizing preventive and corrective work in preschool educational institutions, special attention should be paid to the prevention and correction of musculoskeletal disorders (postural defects, flat feet), as they constitute the largest proportion of functional deviations. In particular.

The foot is the support and foundation of the body, so naturally, any disruption to this foundation inevitably impacts the development of a growing organism. A change in the shape of the foot not only reduces its functional capabilities but, most importantly, alters the position of the pelvis and spine. This negatively impacts the function of the spine and, consequently, the child's posture and overall well-being. Insufficient development of the muscles and ligaments of the feet negatively impacts the development of many movements in children, leads to decreased motor activity, and can become a serious obstacle to participation in many sports. Therefore, strengthening the musculoskeletal system, and the foot in particular, is of great importance. It is interesting to note that developing a proper arch in children, as well as preventing and correcting their functional impairments, was highly valued in folk educational traditions. For example, when preparing a child to master the skills of upright posture and walking, it was customary to lightly slap their feet to strengthen their foot muscles, saying:

Forge, forge, blacksmith, Put on the shoe: A golden shoe for the little foot. Give me a hammer to shoe the boot!

And although much of the invaluable experience of folk pedagogy, collected over centuries, has been lost today, such pistils, nursery rhymes, jokes, the so-called small folklore genres, reflect the traditions and worldview of their creators.

During preschool age, the foot is in a stage of intensive development; its formation is not yet complete, so any adverse external influences can lead to various functional disorders. At the same time, the body is highly flexible at this age, so it is relatively easy to halt the development of flat feet or correct it by strengthening the muscles and ligaments of the foot. Successful prevention and correction of flat feet is possible through the comprehensive use of all physical education methods: hygiene, natural health factors, and exercise.

Hallux valgus in children

"Planovalgus foot position" is a diagnosis parents often hear from pediatric orthopedists ((Figure 27 )). While the word "flat" seems self-explanatory, the second part of the diagnosis—"valgus"—is less so. What this condition is and what to do about it requires explanation. Valgus—in other words, an "X"-shaped position of the feet. Everyone knows what "exic feet" are—and the same applies to feet. Flattened and "rolled" inward—these are called planovalgus feet.

The diagnosis of "flat-valgus (or knock-knee) feet" is quite common. This deformity causes the feet to become flatter and appear to collapse inward.

**Figure 26. Flat valgus foot in children**

The reason is that the weak ligaments of a child's foot can't always support the weight of the body. Consequently, the longitudinal arches flatten, the inner edge of the foot sags, and the forefoot retracts. If you look at a photo of flat feet in children from above, you'll clearly see the letter "X." The first signs of this X-shaped foot placement are noticeable as early as the child's first steps. The key is to identify the abnormalities immediately so that the foot deformity can be treated promptly.

Varus deformity of the foot in children

Signs of varus foot position include knee joints bent in an O-shape, not connected in a straight line. Therefore, when walking, the child will lean on the outer arches of the feet. Such deformities are most common in infants, as well as in children with cerebral palsy, brain tumors, and diabetes. Early diagnosis and successful correction of clubfoot and treatment of flat feet in children are possible – this requires regular visits to an orthopedist and following their recommendations.

This occurs because the weak ligaments of a child's foot cannot withstand the body's weight. Flattening of the longitudinal arches leads to sagging of the inner edge of the foot and abduction of the forefoot. This is how an "X"-shaped foot deformity develops. (Figure 27. )The first signs of flatfoot deformity appear simultaneously with a child's first steps. Custom-made orthopedic insoles can effectively correct flatfoot deformity and, when combined with children's orthopedic shoes, ensure the child's foot is in the correct position. Strengthening the musculoskeletal system of the foot is of great importance in treatment. Therefore, therapeutic exercise for the legs is an indispensable component.

A b

**Figure 27. Characteristics of varus foot deformity in children: a - X-shaped; b - "littered" inside**

Features of flat-valgus foot deformity.

As is well known, the adult foot has an arched structure. The longitudinal and transverse arches of the foot provide spring and balance, and also help the foot adapt to the supporting surface during walking. The arches of a child under 3 years of age are not yet fully formed. Due to the significant amount of subcutaneous fat, a child's foot at this age appears virtually "flat." As the child grows, the arch height increases, and each age group has a specific longitudinal arch height.

Since the foot, and particularly its plantar surface, bears projections of various organs in the human body, maintaining normal well-being requires the use of only appropriate footwear that supports normal functioning. This is especially important for growing children's feet, especially those with various deformities. According to various studies, the most common foot deformity is flatfoot, and one of its varieties is flatfoot. It is accompanied by the following abnormalities:

- flattening of the longitudinal arch; valgus position of the posterior section;
- abduction-pronation of the anterior section.

The highest incidence is observed in children of primary school and preschool age. However, physiological flatfoot, even in children under 3 years of age, must be distinguished from pathological flatfoot, when a decline in the longitudinal arches is combined with hallux valgus. If the valgus angle of the heel of a three-year-old child is greater than 70°, then the child has flat-valgus feet. Indirect signs of flat-valgus feet include characteristic heel wear, primarily along the inner edge, and heel deformity in shoes. Children with flat-valgus feet often complain of knee and ankle pain during physical activity, and fatigue occurs when walking and running. Flat-valgus feet require orthopedic treatment. Failure to treat them typically leads not only to changes in the shape of the foot but also to spinal deformities, including poor posture and scoliosis. Flat-valgus foot deformity is a very common deformity. This deformity causes the arches of the feet to become narrower, and the heel to deviate outward. It is more common in children. This causes rapid fatigue when walking, pain in the shins and knees, and swelling. Shoes tend to bend, become deformed, and the inner heel wears out. This can lead to pelvic misalignment, shortening of one leg, back pain, herniated discs, and other problems. Flat-valgus foot deformity is most often caused by joint hypermobility and weakness of the musculoskeletal system. With age, degenerative changes in the bones and joints of the feet and circulatory problems can develop. Care, especially in early childhood, is aimed at strengthening the muscles of the arches and shins. After an examination, an orthopedist will determine the degree of deformity, select the appropriate foot correction program, and manufacture custom-made orthopedic insoles or orthoses specifically designed for the individual patient. For a long time, there was no generally accepted clinical classification of flatfoot valgus. Existing classifications were based on the pronounced signs of deformity and the stages of its development. For example, P.P. Vreden's classification is well-known. It is based on the main clinical forms of flatfoot, representing a series of gradations that influence the choice of treatment method, which is necessary for a specific patient. For a long time, there was no generally accepted clinical classification of flatfoot valgus. Existing classifications were based on the pronounced signs of deformity and the stages of its development. For example, P.P. Vreden's classification is well-known. It is based on the main clinical forms of flatfoot, representing a series of gradations that influence the choice of treatment method, which is necessary for a specific patient. For a long time, there was no generally accepted clinical classification of flatfoot valgus. Existing classifications were based on the pronounced signs of deformity and the stages of its development. For example, the classification of P.P. Vreden is well known, which is based on the main clinical forms of flat feet, representing a series of gradations that influence the choice of treatment method:

prodromal form of flat feet; periodic flat feet;

simple form of flat feet; flat feet complicated by abduction of the forefoot; contracture of flat feet.

Among the developed classifications of flat-valgus foot deformities is the classification of posterior tibial tendon dysfunction by K.A. Johnson and D.E. Strom, as modified by M.S. Myerson. It is based on the relationship between the elasticity of the flat-valgus foot and the development of posterior tibial tendon dysfunction: the more severe the flat-valgus foot deformity, the more rapidly degenerative changes in the posterior tibial tendon occur, and the more rigid and persistent the flattening of the medial longitudinal arch. M.S. Myerson added a fourth stage to the three stages of flat-valgus foot development proposed by them, describing degenerative changes in the ankle joint. This classification is quite informative, as it includes both many signs of flat-valgus deformity and the stages of its development. Classification of flat-valgus foot deformities in children. According to statistics, almost every child under 5 years of age who has deviations in the development of the feet (40-80%) is also diagnosed with flat-valgus foot deformity.

In children, flattening of the arch typically occurs during the first steps; this is due to the significant strain placed on the feet when attempting to take a step. Of course, you can't expect a child to have perfectly correct foot placement or a hip-to-hip gait immediately after first standing.

Plano - valgus is accompanied by the following deviations:

flattening of the longitudinal arch;

abduction-pronation position of the anterior section;

valgus position of the posterior region.

The highest percentage is observed in children of primary school and preschool age. However, there are cases where this diagnosis can be considered self-inflicted.

The shape of the foot, developed over the course of evolution, ensures even distribution of body weight. The bones of the foot, connected by strong interosseous ligaments, form the arch, the role of which is to provide maximum shock absorption during running and walking. Convex arches are oriented in two directions—transversely and longitudinally. Therefore, the normal adult foot has three points of support: the head of the first metatarsal bone, the calcaneal tuberosity, and the fifth metatarsal bone. In children, flattening of the arch typically occurs during the period when the baby is just taking its first steps; this is due to the significant loads placed on the legs when attempting to take a step. Of course, you can't expect a baby to have perfectly correct foot placement or a hip-to-hip gait immediately after first standing. Parents typically first complain when the child takes their first independent steps. It's important to clearly distinguish between the physiological flattening of the arch of a child's foot before the age of three and the actual flat-valgus deformity, which requires orthopedic observation. Children under three have a "fat pad" on the plantar surface of their feet, so the arch isn't visible with a simple visual examination. However, it will be noticeable if asked to stand on their toes. Bone tissue continues to develop until the age of five or six, so only during this period does it make sense to discuss the presence or absence of flat-valgus deformity in a child. However, it's important to keep in mind that flat-valgus feet in children can lead to negative consequences such as: It's important to clearly distinguish between the physiological flattening of the arch of a child's foot before the age of three and the actual flat-valgus deformity, which requires orthopedic observation. Until the age of three, children have a "fat pad" on the plantar surface of their feet, so the arch is not visible with a simple visual examination. However, it will be noticeable if you ask the child to stand on their toes. Bone tissue continues to develop in children until they are 5-6 years old, so it is only during this period that it makes sense to discuss the presence or absence of flatfoot valgus. However, it is important to keep in mind that flatfoot valgus in children can lead to negative consequences such as: It is important to clearly distinguish between the physiological flattening of the arch of a child under three years of age and flatfoot valgus, which requires orthopedic observation. Until the age of three, children have a "fat pad" on the plantar surface of their feet, so the arch is not visible with a simple visual examination. However, it will be noticeable if you ask the child to stand on their toes. Bone tissue in children continues to develop until 5-6 years of age, so only at this stage does it make sense to discuss the presence or absence of flat-valgus deformity in the child. However, it should be noted that flat-valgus feet in children can lead to negative consequences such as: and the flat-valgus deformity itself, which requires orthopedic monitoring. Until the age of three, children have a "fat pad" on the plantar surface of the foot, so the arch of the foot is not visible with a simple visual examination. However, it will be noticeable if you ask the child to stand on their toes. Bone tissue in children continues to develop until 5-6 years of age, so only at this stage does it make sense to discuss the presence or absence of flat-valgus deformity in the child. However, it should be noted that flat-valgus feet in children can lead to negative consequences such as: and the flat-valgus deformity itself, which requires orthopedic monitoring. Until the age of three, children have a "fat pad" on the plantar surface of their feet, so the arch isn't visible with a simple visual examination. However, it will be noticeable if you ask the child to stand on their toes. Bone tissue continues to develop in children until they are 5-6 years old, so only during this period does it make sense to discuss the presence or absence of flat-valgus foot deformity. However, it should be noted that flat-valgus foot deformity in children can lead to negative consequences, such as asking the child to stand on their toes. Bone tissue continues to develop in children until they are 5-6 years old, so only during this period does it make sense to discuss the presence or absence of flat-valgus foot deformity. However, it should be noted that flat-valgus foot deformity in children can lead to negative consequences, such as asking the child to stand on their toes. Bone tissue in children continues to develop until 5-6 years of age, so it's only during this period that it makes sense to discuss the presence or absence of flatfoot deformity. However, it's important to note that flatfoot deformity in children can lead to negative consequences such as:

severe curvature of the spine;

constant pain in the legs;

"Adult" diseases - osteochondrosis, arthrosis.

In some cases, a child is diagnosed with hallux valgus in a hospital setting. In this case, the condition is congenital (vertical valgus).

Causes of foot deformation:

Connective tissue dysplasia (78%). Contaminated water and air, along with poor-quality food, lead to the connective tissue, which forms the basis of the ligamentous apparatus of joints (as well as all other organs), forming abnormally;

unsuitable children's shoes (soft models with flat soles that are not able to properly secure the foot);

the child does not participate in physical education in preschool institutions and at home;

genetic and endocrine (diabetes mellitus, thyroid disease) disorders;

osteoporosis (bone damage);

various foot injuries.

Doctors identify a number of theories that can be used to explain etiopathogenetic mechanisms:

anatomical theory;

vestimentary theory;

static-mechanical theory;

theory of hereditary muscle weakness;

theory of constitutional weakness of connective tissue.

Doctors distinguish three degrees of severity of flat-valgus foot deformity: mild, moderate, and severe. The so-called swing foot (vertical talus, paperweight foot) is the most severe deformity. It is detected immediately at birth, with an incidence of 1 in 10,000 newborns. The etiopathogenesis of this deformity is not fully understood. Doctors identify a malformation of the ovarian rudiment or a delay in its development at one of the stages of embryonic development as the most likely cause.

Normal foot parameters:

- if you draw two lines - along the lower contour of the calcaneus and the first metatarsal bone - so that the apex of the angle is in the area of the navicular bone, then this angle should be 125;

- longitudinal arch height - 39–40 mm;

- valgus position of the hindfoot from 5 to 7;

- the angle of inclination of the calcaneus relative to the plane of support from 20 to 25.

The height of the longitudinal arch of the foot in preschool children can normally be 19 - 24 mm.

The mild degree is characterized by the following parameters:

the height of the longitudinal arch of the foot is reduced to 15–20 mm;

the angle of the arch height is reduced to 140°;

angle of inclination of the calcaneus - up to 15;

valgus position of the posterior section up to 10;

forefoot abduction 8 - 10.

Average degree:

the arch of the foot is reduced to 10 mm;

the height of the arch is reduced to 150 - 160;

heel angle up to 10;

valgus position of the posterior section and abduction of the anterior section up to 15°.

Severe degree:

the arch of the foot is reduced to 0 – 5 mm;

the angle of the height of the arch of the foot is reduced to 160 - 180;

angle of inclination of the calcaneus - 5 - 0;

valgus position of the posterior section and abduction of the anterior section of more than 20°;

severe deformation is rigid and cannot be corrected;

constant pain in the area of the Shoparov joint.

The foot is the foundation of our body. If the foundation is uneven, it's impossible to build a stable, level house on it. Flat-valgus foot deformity leads to valgus (knock-knee) deformity of the knees and ankles, malposition of the pelvis, and poor posture. Misalignment of the spinal axes and extremities overloads the muscles, which will unsuccessfully attempt to maintain the body in the correct position. This leads to pain and the early development of arthrosis and osteochondrosis. Timely prevention of the progression of valgus foot deformity should be considered appropriate as it provides adequate orthopedic support, which, according to various authors, is needed by up to 78% of the population. Traditionally, orthopedic support is limited to the prescription of orthopedic shoes or insoles inserted into regular shoes. Orthopedic insoles are manufactured by prosthetic and orthopedic companies. In recent decades, attempts have been made to develop removable orthopedic insoles for the consumer. However, limited design options and a number of other shortcomings have prevented significant changes in the overall nature of orthopedic support. Flat-valgus feet in children are usually caused by joint hypermobility. Weak muscles and ligaments cannot support the child's weight, leading to pronation (valgus deviation). Treatment for flat-valgus feet in children requires a comprehensive approach. It is necessary to implement measures aimed at strengthening the musculoskeletal system involved in maintaining the arch of the foot. This includes therapeutic exercises, massage, and physical therapy. Custom-fitted orthopedic insoles are required.

When designing children's footwear, convenience and comfort are paramount. The quality of children's footwear is determined not only by its durability and aesthetic appeal, but also by its adequate comfort, which refers to the shoe's ability to provide conditions for normal foot function. Shoe comfort is a complex indicator, the properties of which are typically divided into three groups:

the first group consists of physiological properties that ensure normal biomechanical functioning of the foot;

The second refers to hygienic properties that influence the safety and harmlessness of wearing conditions; the third characterizes footwear in terms of its rationality and convenience, and represents anthropometric properties;

The third group of properties includes the support rigidity, moldability and the degree of compression of the foot by the shoe, which depends on the magnitude of the pressure that occurs.

Of particular interest in assessing shoe comfort is the "foot pressure" metric. The amount of pressure exerted by the upper on the foot and how it changes during wear primarily depend on the size and internal shape of the shoe, which are determined by the shoe's size and shape. Furthermore, an increase in foot size creates additional pressure due to the properties of the shoe material and its construction. It is known that during movement, the volume of a bare foot at the metatarsophalangeal joint increases by an average of 4%. The initial foot size does not remain constant throughout the day. It is affected by the duration and intensity of walking, as well as the microclimate in the shoe compartment. Increased foot temperature and humidity lead to an increase in its volume and, consequently, affects the amount of compression of the foot by the shoe. Excessive pressure negatively impacts the child's physiological state, manifesting itself in changes in humidity and temperature, a shift in the center of gravity, and the accumulation of static electricity on the skin. As a result, the child experiences discomfort, manifested by increased fatigue in the lower extremities and the occurrence of pain. Furthermore, prolonged pressure from the upper on the forefoot can contribute to the development of various pathological abnormalities. Soft edges and overlays used in uppers contribute to increased comfort in this group of shoes. The materials used for the upper and lower parts, which should be soft and flexible, as well as the fastening methods, are also crucial in the development of comfortable footwear. For unlined shoes, the upper can be made of elastic leather, including thicker leather, textiles, and artificial materials with properties similar (especially in terms of hygroscopicity) to elastic natural leather. Comfort (particularly hygroscopicity) is influenced by the lining used in the shoe. This is typically natural drum-chrome-tanned or aniline-dyed leather in light shades, as well as textiles. The thermoplastic back and toe cap should be soft and flexible, and have stable dimensions. One of the main factors reducing the cushioning rigidity of shoes is the design of children's shoe lasts. The recommended toe shapes for children's shoes—an extended oval and a rounded square—are predetermined by the stability of the last. Support comfort, as a component of the holistic concept of shoe comfort, reflects the conditions for the most favorable interaction of the plantar part of the foot with the shoe's lower system, which are determined by a set of optimal parameters obtained by testing the foot of a normal-weight person on average soil. Three main criteria are identified within the complex of support comfort assessment criteria, according to which design changes should be made, characteristics calculated, and shoe sole system materials selected. These are: The last 's extended oval and rounded square shapes are predetermined by the stability of the last. Support comfort, as a component of the holistic concept of shoe comfort, reflects the conditions for the most favorable interaction of the plantar part of the foot with the shoe's lower system, which are determined by a set of optimal parameters obtained by testing the foot of a normal-weight person on average soil. Within the set of criteria for assessing support comfort, there are three main criteria that guide design changes, calculate characteristics, and select materials for the shoe sole system. These criteria include: The last shape—an extended oval and a rounded square—is predetermined by the stability of the last. Support comfort, as a component of the holistic concept of shoe comfort, reflects the conditions for the most favorable interaction between the plantar part of the foot and the shoe sole system, which are determined by a set of optimal indicators obtained through contact between the foot of a normal-weight person and average soil. Within the set of criteria for assessing support comfort, there are three main criteria that guide design changes, calculate characteristics, and select materials for the shoe sole system. These criteria include: The last shape reflects the conditions for the most favorable interaction between the plantar part of the foot and the shoe sole system, which are determined by a set of optimal indicators obtained through contact between the foot of a normal-weight person and average soil. Within the set of criteria for assessing the comfort of support, there are three main criteria that guide design changes, calculate characteristics, and select materials for the shoe sole system. These criteria reflect the conditions for the most favorable interaction between the plantar part of the foot and the shoe's lower part, which are determined by a set of optimal parameters obtained during contact between the foot of a normal-weight person and average ground. Within the set of criteria for assessing the comfort of support, there are three main criteria that guide design changes, calculate characteristics, and select materials for the shoe sole system. These criteria are:

distribution of pressure on the supporting surface of the foot (criterion - pressure distribution);

reaction to the heel from the base in the phase of transferring body weight to the supporting leg (criterion - shock absorption);

tension that occurs in the plantar muscles and ligaments when the foot is loaded (criterion - extension force).

The transition from foot contact with elastic-plastic soil to contact with the rigid sole system of a shoe—asphalt (concrete)—causes high stress concentrations in certain areas of the sole, as the force of interaction is realized through a contact surface area reduced by approximately 1.3 times. This necessitates optimizing pressure distribution by altering the elastic and geometric parameters of the support. A prerequisite for designing footwear with supportive comfort is the installation of a profiled insole with a special treatment and a foam insert, allowing for easy adaptation to the foot. The problem of designing comfortable footwear cannot be solved without activating related industries and developing materials and products for these shoes. Footwear comfort indicators such as convenience, lightness, softness, and elasticity can only be achieved if the materials and products composing these shoes possess the appropriate properties. Footwear has been shown to be a factor influencing the formation, development, and normal functioning of the adolescent body. Thus, flattened feet lead to poor posture, spinal disorders, and abnormal positioning, and therefore, dysfunction, of internal organs. A decrease in the physiological curves of the spine (flat back), especially when combined with flat feet, leads to persistent microtrauma to the brain, memory, and attention deficits. A similar chain of events can be established when analyzing the impact of footwear on the emotional development of adolescents, which affects personal and social health. To do this, it is necessary to understand the process of social maturation of a child and the importance of their appearance, and therefore, of consumer goods such as clothing and shoes.

Calluses, abrasions, deformed toes and feet in general, etc. Consumer goods that shape a teenager's appearance are not just elements of clothing but also a way to express individuality, declare their interests, and indicate their belonging to a certain community. A teenager's lack of shoes in the style of their peers can be a source of misunderstanding. Conflicts in peer relationships generate difficult experiences, are perceived by teenagers as personal drama, and therefore impact their personal and social health. Another way footwear can influence a teenager's psychophysiological and social health is the increased self-criticism of their appearance, typical of this age. The fullness of the calf, large or small foot size, and other factors can influence the overall well-being of teenagers.

The main symptoms include the following manifestations:

when the knees are tightly squeezed, the distance between the ankles reaches 5 cm or more;

with X-shaped legs, the curvature of the joints is noticeable;

the toes and heel point upwards, and the axis of the foot is significantly curved;

A deformed foot negatively affects the child's condition: the legs hurt when walking, and swelling appears during the day.

If your child experiences foot pain or rapid shoe wear, carefully examine their feet for signs of flatfoot valgus. If you have any suspicions of joint or muscle problems, consult an orthopedist.

The correction details shown in Figures 28-31 will help correct flat-valgus feet.


**Figure 28. Corrective parts for correction of big toe deformity**


**Figure 29. Characteristics of corrective parts of shoes for children with varus and valgus foot deformities**

**Figure 30. Types of corrective parts for children with pathological deviations**

Another common condition in children is flatfoot. Flatfoot, characterized by a curvature of the arches and axis of the foot, is called clubfoot. However, there is a difference between these conditions. Figure 31 shows the specific positioning of the heel.

A b V

**Fig. 31. Characteristics of the heel position: a - correct position; b - valgus heel; c - varus heel**

Anti-valgus shoes are special shoes for children with hallux valgus.

Parents don't need to worry about special footwear ruining their child's appearance: corrective sandals, boots, and ankle boots are indistinguishable from traditional models. These fashionable styles have long since replaced the unsightly anti-valgus shoes introduced just 20 years ago (Fig. 32).

Antivalgus reliably fixes the ankle and talocalcaneal joints in case of flatvalgus changes of the foot.


**Figure 32. Corrective, anti-valgus orthopedic shoes.**

Thanks to the special design of anti-valgus shoes:

corrects the mobility of the joints and bones, stopping deformation;

Corrective shoes are distinguished by their high top, which allows for secure ankle support;

Orthopedic shoes require insoles, so all models have a removable insole that ensures the correct alignment of the longitudinal arch of the child's foot;

in case of severe pathologies, arch support insoles are manufactured in special laboratories;

Orthopedic parts are made to order.

An instep support is a special protrusion that is created by a specialist who shapes the arch to take into account the anatomical features of a child's legs.

Thomas orthopedic heel ensures a proper fit and helps prevent the foot from turning inward. The heel is made longer on the inside.

The most common lower limb abnormalities associated with cerebral palsy include flat feet, cavus foot, valgus and varus foot deformities, foot paresis, shortened lower limbs, and various toe deformities.

These conditions require specific modifications to shoe design. Shoes for children with cerebral palsy should be made of high-quality materials. Distinctive features include specially designed pads with a wide toe box to ensure a natural toe position, preventing the child's foot from becoming deformed and maintaining a comfortable position. Soles with sufficient elasticity and flexibility are recommended. Some models feature a prophylactic sole with a special heel with an extended crocodile to support and relieve pressure on the foot. This strengthens the sole under the midfoot and prevents it from collapsing. Using a heel helps both prevent and treat foot defects. Orthopedic care for patients with foot drop is determined by active ankle mobility and the presence of lateral foot deviations. In cases where dorsiflexion of the ankle is preserved and there are no lateral foot deviations, shoes with a cuff and elastic bands are prescribed. If the drop is not fixed and there are minor lateral foot deviations, orthopedic boots with a cuff and elastic bands, as well as double-laced shoes, are recommended. Significant lateral deviations of foot drop require orthopedic boots with a single-sided rigid upper and a heel extender, and the midplantar layer should be supplemented with a pronator or instep support. In cases of fixed drop or excessive ankle mobility, boots with double-sided or circular rigid uppers are recommended. A circular rigid upper, along with more secure support, provides some forward support necessary for rolling. The product range is limited. The recommended models for children with cerebral palsy are boots and high sandals. Shoe height is calculated based on doctor's prescriptions and is presented in Table 4 in accordance with GOST R 54407-2011. A circular hard cap, along with more secure fixation, creates some forward support necessary for rolling. The product range is limited. The recommended models for children with cerebral palsy are boots and high sandals. Shoe height is calculated based on doctor's prescriptions and is presented in Table 4 in accordance with GOST R 54407-2011. A circular hard cap, along with more secure fixation, creates some forward support necessary for rolling. The product range is limited. The recommended models for children with cerebral palsy are boots and high sandals. Shoe height is calculated based on doctor's prescriptions and is presented in Table 4 in accordance with GOST R 54407-2011. Recommended footwear for children with cerebral palsy includes boots and high sandals. Shoe heights are calculated based on doctor's prescriptions and are presented in Table 5 in accordance with GOST R 54407-2011.

**Table 5. Calculation of parameters for individual orthopedic footwear**

| Gender and age group of footwear | Shoe height, mm, not less than boot |
|---|---|
| For kids | 0.3/+53 |
| Small nursery | 0.3/ + 59 |
| preschool institution | 0.3/+63 |
| For schoolgirls | 0.45/+50 |
| For schoolchildren | 0.4/+55 |
| Virgo | 0.3/+45 |
| boy | 0.3/+45 |

Experience has shown that, on average, the shoe height is 50 mm too high from the outer ankle bone. The heel height is 20 mm. This heel height is optimal for children's shoes. Strict requirements are also placed on the shape of the shoe's toe cap. The toe cap shape must be anatomically correct, closely matching the shape of the child's foot. It should not deform or compress the toes. For ease of donning, ankle boots are typically designed to be shortened, allowing for maximum shoe opening. Laces are the most effective method of securing the shoe, as these shoe designs require maximum support for the child's foot and adjustment to individual foot parameters. A comfortable, anatomical insole plays an important role in shoes for children with hallux valgus and varus foot deformities. A supportive arch is a mandatory element of the insole. Additionally, based on the doctor's instructions, an instep or pronator for the toe or heel of the foot is designed onto the bottom part. The design of the midfoot in this type of shoe also has its own characteristics. These include a high, rigid cap and a rigid back with extended wings. An instep or pronator for the toe or heel of the foot is designed onto the bottom part. The design of the midfoot in this type of shoe also has its own characteristics. These include a high, rigid cap and a rigid back with extended wings. An instep or pronator for the toe or heel of the foot is designed onto the bottom part. The design of the midfoot in this type of shoe also has its own characteristics. These include a high, rigid cap and a rigid back with extended wings.

Acceptable methods of fastening shoes to the foot are shown in Figure 33.

B.C.

**Figure 33. Models of footwear for children with valgus and varus foot deformities: a - with laces; b - with buckles; c - with Velcro fastener**

Two basic boot designs are used: boots with a custom vamp and ankle boots with a custom vamp. The front vamp line is offset toward the toe to allow for more tongue "exposure," which is important for putting the shoe on and taking it off and securing it to the foot. A tall, rigid beret is made of stiff leather or plastic. Its purpose is to securely support the foot and ankle, allowing for strengthening. Research has shown that one of the most common designs is a sporty cuff with a shortened vamp. The lining material can be fabric, genuine leather, pile, or fur, depending on the season. A list of materials is presented in Table 6.

When designing the upper parts, the following features should be highlighted: the angle between the upper edge of the shin and the fold line of the vamp should be close to 90° for the greatest distance under the laces, due to which the fixation of the foot is largely ensured.

**Table 6. List of materials used for the production of orthopedic shoes for children with varus and valgus foot deformities**

| Name of parts | Materials and designations of normative and technical documents |
|---|---|
| Upper parts | Upper leather according to GOST 939, GOST 3717, GOST 1838, GOST 9705, elastic leather; shoe fabric according to GOST 28000, shoe fabric |
| Upper interior details | Leather for shoe lining according to GOST 940, GOST 1838, fabrics for shoe lining according to GOST 19198, GOST 28000, GOST 29298 and according to technical documentation, knitwear according to technical documentation |
| Upper intermediate pieces. Lining | Interlining fabrics according to GOST 19196, GOST 29298, cotton interlining fabric with a hot-melt adhesive coating |
| sock | Leather according to GOST 29227, GOST 1903, shoe nitro leather-T according to GOST 7065, elastic and thermoplastic materials for the toe cap - according to technical documentation |
| Background | Leather according to GOST 29277, GOST 1903, cardboard according to GOST 9542, shoe nitro leather-T according to GOST 7065, thermoplastic material for the heel - according to technical documentation |
| External parts of the bottom. Sole | Leather for shoe bottoms according to GOST 29277, GOST 1903, porous rubber sheets according to GOST 12632, lightweight porous rubber sheets |
| the hard part | Leather for shoe bottoms according to GOST 1903, GOST 29277, saddle leather according to GOST 1904 (for false backing) |
| soft part | Leather according to GOST 939, GOST 940, rawhide according to GOST 1562, saddlery yuft according to GOST 1904 |
| metal part | Steel grade 65G according to GOST 14959, steel grade I2Kh1VN10T according to GOST 5632, steel grade 40 according to GOST 1050, aluminum according to GOST 21631 |
| Accessories. Fastening shoes to the foot | Blocks, hooks, rivets, eyelets, buckles, fasteners, metal frames, shoe laces, textile fasteners, elastic shoe tape - according to technical documentation |

| | |
|---|---|
| Molded insole (on the midsole layer) | Leather according to GOST 29227, GOST 1903, GOST 1838, GOST 939, saddlery leather according to GOST 1904, leather for shoe lining according to GOST 1904, leather for shoe lining according to GOST 940 |

If the shoe's fit requirements are more stringent, a combined fastening method may be incorporated into the design. Allowances for intermediate pieces should also be considered. The thickness of intermediate pieces can reach 2-3 mm, so it is recommended to add 0.5-1 cm to the specified foot circumference. This significantly impacts the shoe's performance. The design may cause chafing on the shins due to the rigidity of the pieces, so a slightly soft edge is recommended. An excessively soft edge is not recommended, as it can reduce the fit. Designing designs with these requirements in mind ensures a high-quality balance between consumer preferences and medical restrictions. Comfort models feature a so-called Thomas orthopedic heel, which extends from the inside to support the midfoot and prevent inward roll. The molded sole features a Thomas heel.

Thomas sole with heel

Properly selected shoe styles play a crucial role in footwear for children with cerebral palsy. Shoes must meet GOST requirements and have specific design elements specific to these models. Orthopedic shoes are distinguished by the presence of parts of a specific shape and size. Special parts include soft, hard, and metal, as well as interlinings. Special soft parts include: additional lacing, a tightening strap, a side internal strap, drawstrings, and a cuff. Special hard parts include: the heel, toe cap, vamp, half-vamp, shaft, tongue, valve, upper, and a contoured upper insole. These parts provide additional support and improve the stability of the shoe.

A rigid heel counter is the intermediate or outer part of the upper of orthopedic shoes, located in the heel-calf area.

Depending on the length of the wing, a distinction is made between a rigid back with an extension across the shin or with an extension up to the fifth finger, depending on the orthopedic surgeon’s prescription.

Rigid back extension, design elements

A rigid toe cap increases lateral strength and is often used in orthopedic shoes.

A one-sided rigid beret is a detail located in the heel-calf part of an orthopedic boot.

A double-sided rigid beret is an internal or intermediate component located in the heel-shaft section of an orthopedic boot. This component has protrusions on the lateral surfaces of the shin above the ankles, limiting the mobility of the subtalar joint.

A circular corset is a part of orthopedic footwear that covers the back, sides, and back of the foot and lower leg above the ankles, limiting mobility in the ankle joint.

The midsole layers include: arch support, webbing, back webbing, cork, pronator and instep.

Midsole pads are the inner parts of the upper of orthopedic shoes that distribute the load across the plantar surface of the foot. They are located between the contoured insole and the main insole.

The arch support has a minimal thickness and is necessary to smooth out the contours of the heel of orthopedic shoes. It serves to support the longitudinal arches of the foot. Insole with arch support (see block).

The shank is located in the calcaneal-calf area and has a certain thickness at the heel that fades toward the radial area. The shank is wedge-shaped and serves to compensate for shortening of the leg. Shank angles can be vertical or sloped in one direction or another (outward, inward, forward, or backward).

The plug is located under the entire plantar surface of the foot. The thickness of the radial and heel portions of the plug is equal. A wedge-shaped fork is not used to compensate for lower limb shortening in children to prevent the foot from becoming abnormally positioned in an equinus position.

A pronator is an insole that lifts the outer edge of the foot. A pronator with an arch support (view from the insole surface of the block).

An insole is a part of the insole that raises the inner edge of the foot.

There's a pronator or arch support for the entire foot, forefoot, or heel of the midsole. Shoe designs vary by intended use, gender, age group, and possible associated deformities, so each design has its own unique characteristics.

For severe foot deformities, children's complex orthopedic shoes are prescribed, which are usually custom-made. They have also found application in rehabilitation programs for children with disabilities, including those with varus and valgus foot deformities (Fig. 34).

The main purposes for which orthopedic shoes are prescribed to children with varus and valgus foot deformities include:

correction of the position of the ankle joint and foot and maintaining it while walking;

correct redistribution of the load from individual parts of the foot to the foot as a whole;

compensation of anomalies, such as shortening of the leg;

improved support and ease of movement.

**Figure 34. Complex footwear for disabled children with varus and valgus foot deformities**

The main difference between special footwear and orthopedic shoes is the presence of a special shoe designed for a specific deformity. Orthopedic shoes for children with cerebral palsy must also meet the following characteristics (Figure 35):

- the presence of a high back - it is necessary for reliable fixation of the ankle joint, therefore it should be of an optimal degree of rigidity;

- the presence of high and rigid uppers used to prevent the foot from collapsing when walking;

- there should be a low heel and removable insoles, the latter should have additions with special elements.

Shoes should also be comfortable to put on and take off, so good opening is also an important factor.

Typically, complex orthopedic footwear for children with cerebral palsy is divided into three broad groups. These groups are based on the shoe's complexity and the condition it is intended for. So, let's look at:

1) anti-valgus shoe ;
2 ) anti-war models ;
3 ) stabilizing orthopedic shoes .


**Figure 35. Orthopedic special shoes for children with varus and valgus foot deformities**

Anti-valgus shoes. The main purpose of this type of footwear is to treat the "X" position of the feet, which occurs when the ligaments of the foot are unable to support the child's body. This may be due to excess weight or weak arch muscle tone. This causes the inner edge of the foot to sag, while the forefoot is pulled outward. Anti-valgus shoes are characterized by:

Double-sided high shin of a rigid type, providing stabilization of the ankle joint in a vertical position;

an elongated inner part of the shin that prevents the heel from falling;

an instep support with longitudinal projections necessary to support the arch of the foot.

Antivarus models are designed to correct clubfoot, a condition in which the knee joints bend laterally. As a result, the child must lean on the outer arches of the feet when walking. This condition requires shoes with rigid rearfoot support and simultaneous forefoot abduction. Such specialized footwear should be equipped with:

high butt up to a third of the ankle in its lower part;

the back is hard, widened on the inside to the toes;

pronator insole.

Stabilizing orthopedic footwear is used for equinovargus and equinovarus foot anomalies, typical of cerebral palsy. (Figure 36). The footwear develops motor skills, creating a correct gait and preventing further deformities. Distinguishing features of these models include:

high back to mid-calf;

double-sided hard beret;

arch support insole;

fixing element in the sole.

**Figure 36. Shoes for equinovargus and equinovarus foot anomalies**

Simple, therapeutic orthopedic footwear serves diagnostic, preventative, and therapeutic purposes. While wearing these shoes, you can independently check for any foot defects in your child by examining the areas of the sole that have been subject to abrasion.

If a child's feet are developing properly, these shoes can be worn as a preventative measure to ensure proper joint development. If any foot deformities are detected, regular wear of preventative shoes with orthopedic insoles is recommended.

The primary purpose of these shoes is to prevent foot pathologies and promote proper arch development. A key advantage of these shoes is the factory-installed orthopedic insole, which helps prevent flat feet and relieve pain when walking.

These shoes are made using only high-quality, natural materials: leather and nubuck, allowing the foot to breathe. These models feature a high, rigid back. The closure design helps secure the child's foot in the correct position. The heel is optimal, and the sole is flexible and non-slip. These shoes ensure proper foot development for both preventative and therapeutic use.

Experts (orthopedists, pediatricians, neurologists) note the practicality, convenience, and comfort of these shoes, as well as their compliance with modern requirements for children's footwear. Caring parents buy beautiful, expensive shoes that, unfortunately, are, at best, unsuitable for their child and often harm their feet.

Hard surfaces (asphalt, concrete, linoleum, laminate) surrounding children in the city also have an impact. Children with problematic feet cannot wear regular factory-made shoes, even those labeled "orthopedic." To address this issue, children's shoe designs have been developed to prevent flat-valgus foot deformity. Shoes for children with flat-valgus feet should have a rigid heel counter that provides adequate ankle support using laces, straps, or Velcro. Sketches of shoe designs for flat-valgus foot deformity have been developed (Figure 37).

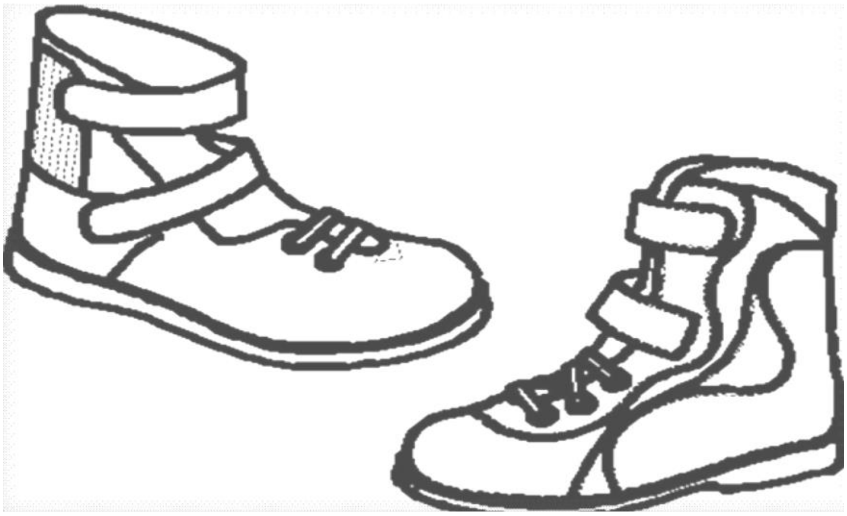
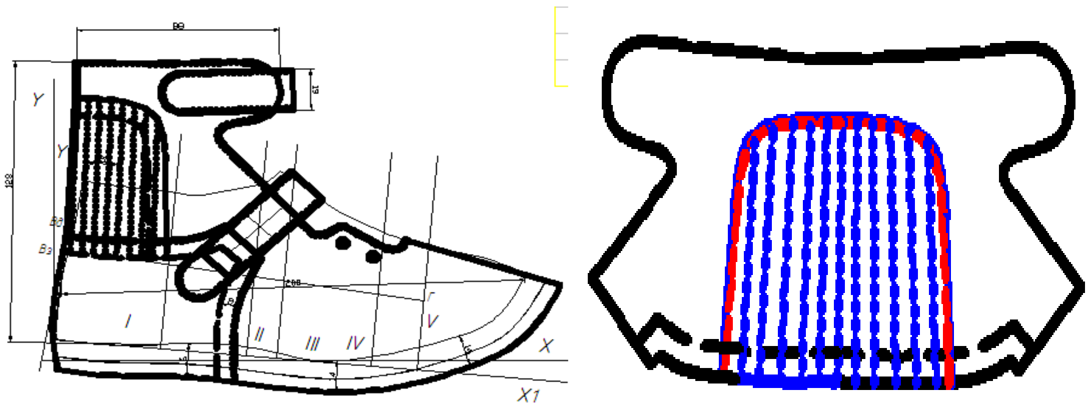


**Figure 37. Sketches of shoe models for flat-valgus foot deformity**

To support the ankle joint, a heel section design is proposed that creates a certain rigidity through technological parameters. Specifically, the heel section utilizes an additional unit consisting of an outer section, an intermediate section, and a lining (Figure 38, b). The intermediate section is made of batting and is attached to the upper section with parallel lines at a specified distance (Figure 38, a). This creates the necessary heel rigidity.




A b

**Figure 38. Design of the upper parts of children's shoes for the prevention of flat-valgus feet: a - ground model of the upper part of the shoe for prevention; b - the upper part of the shoe at the heel**

Based on research to determine consumer preferences, it has been established that currently sold children's shoes with preventive properties have some shortcomings related to both materials and design and external features.

Consumers are experiencing a clear shortage of domestically produced children's preventative footwear. Based on an analysis of the design features of preventative footwear, the key design features have been identified. To address the issue of providing a secure fit for the child's foot and the necessary heel stiffness, designs have been developed that secure the ankle with laces, straps, or Velcro. To support the ankle, a heel design is proposed that creates a certain rigidity through technological parameters. Specifically, the heel uses an additional unit consisting of an outer part, a midsection, and a lining.

It has been shown that anthropometric studies of feet and the development of scientifically based requirements for footwear design for children and adolescents are a pressing issue for the footwear industry. It has been determined that the primary factor in formulating requirements for children's footwear should be maintaining health, as this age group is vulnerable to environmental influences. The role of footwear within the complex of health factors has been determined. It has been established that footwear influences all categories of health: somatic, personal, and social. Therefore, the use of orthopedic devices in the form of insoles and other inserts can serve as an effective means of increasing its preventive properties, including for flat-valgus feet.

It has been established that anthropometric studies of feet and the development of scientifically based requirements for footwear design for children and adolescents are a pressing issue for the footwear industry. It has been determined that health should be the primary factor in determining requirements for children's footwear, as this age group is the most vulnerable. The role of footwear within the complex of health factors has been determined. It has been proven that footwear influences all aspects of health: physical, personal, and social.

The use of orthopedic devices in the form of insoles and other inserts in standard, mass-produced footwear can be an effective means of enhancing its preventative properties, including the prevention of flat feet in children. To achieve this, specialists in the design and production of mass-produced footwear must receive current information on new designs of these orthopedic devices, as well as indications for their use.

Based on the conducted research to determine consumer preferences, it was established that currently sold children's shoes with preventive properties have a number of shortcomings related to both materials and design and external features.

Parents of children with pathological deviations, including flat feet, are experiencing a clear shortage of domestically produced preventative footwear for children. Based on an analysis of the characteristics of preventative footwear, their key design features have been identified. Footwear with preventative properties represents a distinct segment of the consumer market for children's and teenage footwear. These footwear features design solutions that ensure maximum comfort, special features (anatomical insoles, half-insoles, linings, and other corrective elements), a rational, scientifically proven internal shape, and the use of high-tech materials in shoe manufacturing, carefully selected for their physical, mechanical, and hygienic properties.

To address the issue of tightly securing the child's foot and ensuring the necessary rigidity of the heel portion of the shoe's upper, a back design is proposed that additionally secures the ankle joint using laces, straps, or Velcro.

To fix the ankle joint, a heel section design is proposed in which a certain rigidity is created through technological parameters. Specifically, an additional unit consisting of an outer part, an intermediate part, and a lining is used in the heel section.

**Conclusion**

The shoe's unique upper design, combined with an anatomical arch support, provides the most effective arch support and corrects the angle of the foot. Therefore, it's crucial to maintain a close relationship between the orthopedist and the manufacturers of corrective components to ensure the comfort of the child's foot and high levels of parental confidence in the prevention of pathological deviations in their child.

Thus, the database consolidates and structures the information needed by fashion designers, reduces design time, and guarantees consumers the production of sought-after orthopedic footwear that takes into account the pathological deviations of children's feet. Based on research conducted to determine consumer preferences, it was established that currently available children's footwear with preventative properties has a number of shortcomings related to both materials and design and appearance;

- to solve the problem of tight fixation of the child's foot and ensuring the necessary rigidity of the heel part of the upper part of the shoe, a design of backs is proposed that additionally fixes the ankle joint with the help of laces, straps or Velcro;

– to fix the ankle joint, a design of the heel part of the shoe is proposed, in which a certain rigidity is created due to technological parameters, namely, in the heel part an additional unit is used, consisting of an outer part, an intermediate part and a lining;

The shoe's unique upper design, combined with an anatomical arch support, provides the most effective arch support and corrects the angle of the foot. Therefore, a close partnership between the orthopedist and the manufacturers of corrective parts is essential to ensure the comfort of the child's foot and a high level of trust in the child and their parents regarding the prevention of pathological deviations in their child.

- Concepts of mass-customized and ultra-customized footwear. The term "mass-customized orthopedic footwear" refers to footwear whose design is developed based on the average typical characteristics of a group of patients with similar diagnoses. Customization is achieved by adjusting insertable corrective elements, design features of models that regulate the volume of the shoe space, and frame components that ensure a rehabilitative effect. Ultra-custom footwear is a model developed taking into account the individual anatomical features of a specific patient's foot, based on standard designs of mass-customized footwear.

An analysis of the anthropometric characteristics of the feet of children with cerebral palsy was conducted to refine the parameters of lasts for mass-produced customized footwear. It was found that in the Southern Federal District and North Caucasus Federal District, lasts for children's orthopedic shoes do not correspond to the average foot parameters of children with cerebral palsy. Last parameters were proposed for the production of custom-made footwear for children with cerebral palsy.

– the degree of consumer satisfaction with the designs of orthopedic shoes manufactured on blocks with adjusted parameters was identified;

– a concept for creating shoe lasts with adjustable volume for ultra-individual footwear models was proposed;

– an analysis of the range of children's orthopedic footwear was conducted, from which 4 main designs of mass-produced and individual orthopedic footwear with a high rehabilitation effect for patients with cerebral palsy were identified, namely:

- boots with adjustable uppers;
- summer shoes with a high calf and open toe;
- summer shoes with a high calf and a vamp with an elongated tongue;
- Summer shoes with a high calf and closed toe:

- a classification of orthopedic footwear based on its rehabilitation effect has been proposed, which is based on the results of studies of the rigidity of the structure, methods of fixing the shoe on the foot, and corrective elements of the removable orthopedic insole;

– a method for designing ultra-individual orthopedic footwear using the AutoCAD program is proposed for the following cases:

- with different foot circumferences;
- with different heights of boots in a pair;
- with different track lengths in pairs;
- In the case of shortened lower limbs, a database of designs of mass-produced and individual orthopedic footwear for children with cerebral palsy is proposed, including standard designs recommended for the production of comfortable orthopedic footwear for this disease.

Issues addressed by the authors:

- the possibility of carrying out preventive and corrective measures to restore the impaired vital functions of children;
- resuscitation of severely impaired vital functions of the body in children;
- rehabilitation deformation of the feet in children with cerebral palsy;
- Correction of foot arch deformities in children with clubfoot; corrective devices for restoring impaired functions of the child's body - contains answers to virtually every question parents have, allowing them to make an informed choice of corrective devices for restoring impaired vital functions of the child's body.

Please remember that manufacturers use their own sizing charts. Therefore, the same Latin letters in the size charts do not guarantee that two models are the same size. Always read the specifications and refer to the size chart carefully.

The development of measures was carried out taking into account strategic goals and legislative acts that determine state policy in the field of light industry development in the medium and long term:

- Increasing the competitive advantages of the light industry in the production of children's footwear, demand and consumer preferences, technical regulation:

— ensuring compliance of Russian products with international standards of quality, environmental safety and design;

— increasing the production volumes of competitive new-generation products with qualitatively new consumer output characteristics, functional properties and a high share of added value in demand by the market;

— faster growth of the useful effect compared to the growth of costs for new and previously developed types of homogeneous and functionally homogeneous products, efficiency of fulfilling orders and customer requirements.

- Technical re-equipment and modernization of children's footwear production:

— modernization of most of the existing technological equipment, allowing for the improvement of its technical, economic and operational characteristics;

— creation of new equipment with a high degree of automation, corresponding to the global competitive level and capable of mastering advanced technologies and ensuring rapid change of product range, development of technical documentation and requirements for its production;

— the use of leasing for the acquisition of imported equipment or direct purchases of new high-performance imported equipment and spare parts for it that are not produced in our country;

— development of VIP projects (anti-crisis programs) for the financial recovery of the industry, providing for technical re-equipment, modernization, reconstruction and creation of high-tech production, attracting foreign capital, investments from Russian businesses and budgetary funds for their implementation.

- Development of innovative activities in the light industry for the production of children's footwear:

— implementation of structural and technological restructuring, development of proposals for the preservation and development of the intellectual potential of the light industry, creation of a state scientific and innovation center for the light industry;

— development and advancement of basic industrial technologies (including nanotechnologies and nanomaterials, inter-industry level system information technologies), modular and flexible technological systems for the production of competitive, world-class science-intensive products used in strategically important areas;

— organization of serial production of an innovative product at enterprises in the industry, including modifications of the product and technological process, structural changes in the range of manufactured products, training and retraining of personnel for servicing equipment operating using new technologies;

— development of international cooperation with foreign countries on the basis of bilateral and multilateral agreements and programs for the development, acquisition and implementation of technologies, licenses, and the holding of joint scientific and technical symposiums, conferences, and exhibitions.

**References:**


1. (2026). *About opportunities normative documentation, developed V framework systems management quality (QMS) For digital production defect-free import-substituting products:* monograph edited by Doctor of Technical Sciences, Professor V.T. Prokhorov; Institute of the Sphere service And entrepreneurship (branch) Donskoy state technical university, Novocherkassk: Face, 227 pp.
2. (2025). *On the Priority of the Territory of Advanced Social and Economic Development of Small and Medium-Sized Cities in the Southern and North Caucasian Federal Districts in the Production of Products in Demand and Competitiveness by Market Consumers*; edited by prof. V. T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Doctor of Economics, prof. G. Yu. Volkova, OOO TsPOSN "Ortomoda". — Moscow: Editus, — 544 p.
3. (2024). *On the Importance of Forming an Advanced Social and Economic Development Area Based on Rostov Region Mining Cities for the Production of Products in Demand by Consumers in the Russian Federation and the Southern and North Caucasian Federal Districts*; Edited by Professor V.T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Doctor of Economics, Professor G.Yu. Volkova, Ortomoda Center for Advanced Social and Economic Development - Moscow: Reglet, 668 p.
4. (2024). *Methodological and socio-cultural aspects of the formation of effective economic policy for the production of high-quality and affordable products in the domestic and international markets*: monograph under the general editorship of prof. V.T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Novocherkassk: Lik, 379 p.
5. (2025). *Features of quality management in the manufacture of import-substituting products at enterprises in the regions of the Southern and North Caucasian Federal Districts using innovative technologies based on digital production*: monograph edited by prof. V.T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Novocherkassk: Lik, 584 p.
6. (2025). *Managing the actual quality of products rather than the advertised one through motivating the behavior of the team leader of a light industry enterprise*: monograph edited by Doctor of Technical Sciences, Professor V.T. Prokhorov; Institute of Service Sector and Entrepreneurship (branch) of the Don State Technical University, Novocherkassk: SUSU (NPI), 384 p.
7. (2025). *Enterprise competitiveness and product competitiveness are the key to successful import substitution of goods in demand by consumers in the Southern and North Caucasian Federal Districts:* monograph edited by Doctor of Technical Sciences, Professor V.T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Shakhty: ISOiP (branch) of DSTU, - 337 p.
8. Aleshin, B.S., et al. (2024). *Philosophy and social aspects of quality* / Moscow: Logos, 438 p.
9. Porter, M. (2024). *Competition*. Moscow: Ed. house Williams, 2024. 608p.
10. (1391). *"GOST R ISO 9001-2015. National standard of the Russian Federation. Quality management systems. Requirements" (approved by Order of Rosstandart dated September 28, 2015 N 1391-st) (together with "Explanation of the new structure, terminology and concepts", "Other international standards in the field of quality management and for quality management systems developed by ISO/TC 176")* Retrieved from

http://www.consultant.ru/document/cons_doc_LAW_194941/

11. (2015). *GOST ISO 9000-2015. Interstate standard. Management systems quality. Main provisions and dictionary*. Access mode: Retrieved from http://www.consultant.ru/
12. (2025). *Quality management system - the basis of technical regulation for the production of import-substituting products:* monograph edited by Doctor of Technical Sciences, Professor V.T. Prokhorov; Institute of Services and Entrepreneurship (branch) of the Don State Technical University, Novocherkassk: SUSU (NPI), 326 p.