

PHYSICAL REHABILITATION OF FUNCTIONAL VIOLATIONS AND DEFORMATIONS OF CHILDREN FOOT

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Annotation. *Purpose:* To substantiate a comprehensive methodology for physical rehabilitation of children with functional disorder “hollow foot” in the initial stages of its development. *Material:* The study involved 58 children aged 8-14 years with the disorder and deformities of the lower extremities. *Results:* The changes after six months of targeting funds to rehabilitate musculoskeletal structures of the musculoskeletal system of experimental and control groups of children. The technique of rehabilitation, including: implementation of a specially designed set of corrective exercises, wearing special orthopedic individual insoles, foot massage and calf muscles, electro-stimulation effects on the musculoskeletal structure of the foot and lower leg dynamics. *Conclusions:* “hollow foot” is the least studied morphofunctional disorder; developed technique of physical rehabilitation for positive changes in the condition of the musculoskeletal system in children of the main group, the lack of specific rehabilitation interventions during the initial stages of the “hollow foot” leads to the aggravation of the disorder.

Keywords: musculoskeletal, apparatus, disorders, hollow foot, children, physical, rehabilitation.

Introduction

Different morphofunctional feet disorders are known among which more frequent than all met the omission of longitudinal and transversal arches, that is flat-foot, means varus or valgus foot deformation, flat-foot is deformation by which a foot turns inside, i.e. in position of supination and in position of the sole bending and adduction; and other foot deformations to which other combinations of the above-stated disorders are inherent. [1, 2, 3, 4].

A hollow foot is a type of cyllosis, a physical rehabilitation of which is the least studied and causes many contradictions. For a hollow foot the increase of hogging of longitudinal foot arch is characteristic and at the expressed forms of deformation its middle part does not touch footstep, but at exertion it leans against a heel hillock and on the heads of metatarsus bones [4, 5, 6]. The area of footstep diminishes due to it, that results in the increase of exertion on supporting parts of foot and as a result overstrain and deformation of musculoskeletal structures appear, the function of equilibrium and stability gets worse as a result, and gait becomes sickly and dissymmetric. In the neglected cases deformation is fixed; retracted soft fabrics of sole, sole aponeurosis and even skin fix the pathological setting of foot. In not neglected cases, if to press on the head of the first metatarsus bone from below, the concavity of vault disappears and a foot looks normal. The same smoothing of vaults originates from pressure of weight of body at leaning on a foot. If to raise a foot, deformation appears again.

In children deformation is so poorly expressed, that at examination it is often not recognized. There is a typical sign of hollow foot, which appears in children: at the attempt of child to unbend a foot and set it in position of the back bending fingers acquire a claw-shaped form. On the early stages of deformation an imprint of sole is normal, and sometimes it looks even like an imprint of a flat foot. Later on an imprint expansions of footing surface under the head of the first, metatarsus bone and narrowing of footing surface of external edge show up in the middle part. Then the increase of curvature of foot vault results in that its external edge disappears in the middle part of imprint. When the unbent fingers acquire a claw-shaped form, and a foot is fixed in the sole bending, finger-prints disappear and the area of heel imprint diminishes.

A youth hollow foot is observed often simultaneously with splitting arches of sacrolumbar region of spine. It develops gradually, noticeably makes progress in the period of the most growth, in age from 8 to 15 year old [5]. The changes of the morphofunctional state of foot result in violations of the state of all locomotor system. Different deformations of spine appear, knee-joints, shortening of one lower extremity, that considerably violates a carriage and have an adverse effect on physical development of a child [8, 10, 14, 16].

For the correction of above-said disorders different rehabilitation methods, fitness programs and technical means, are recommended [2, 4, 11, 12, 13, 15]. However, in respect of hollow foot that is substantial disorder, the method of its rehabilitation is not developed practically and requires a further study and additional researches.

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Purpose, tasks of the work, material and methods

A research purpose is a ground and development of complex method of physical rehabilitation of children with functional disorder «hollow foot» on the initial stages of its development.

Materials and methods. 58 children of 8-14 years old took part in research on age-dependent gradation in accordance with the methods of inspection. Two groups were formed: basic and control one in amount of 30 and 28 persons accordingly. An inspection was conducted together with a doctor-orthopedist in the specialized center of orthopedics help with the use of analysis of ink imprints feet (method of plantography), sciagraphy pictures (method of sciagraphy), and also visual examination with measuring of valgus and varus deformation of heels in degrees, sizes of

shortening of lower extremities in mm, by determination of kind and degree of deformation of spine, knee-joints and fingers of foot, registration of cases of cramps and pains. For all children a hollow foot was diagnosed on the initial stage of development or the indirect signs of hollow foot took place (pain, cramps in muscles). Majority of children also had signs of flatfoot – flattening of foot vaults. Different morphofunctional feet disorders are known among which more frequent than all met fallen longitudinal and transversal arches, that is flat-foot, means varus or valgus talipes, flat-foot is deformation by which a foot turns inside, i.e. in position of supination and in position of the sole bending and adduction; and other feet deformations to which

Research was conducted during 6 months. In a control group during this period children executed exercises with the use of the generally accepted complexes for forming a correct foot and prophylaxis of flatfoot.

In a basic group for the correction of violations of locomotor system the author method of rehabilitation was executed. It was included:

1. implementation of the specially developed complex of correcting exercises for the rehabilitation of hollow foot taking into account the features of this disorder (2 courses for 18 classes with the pause of 2 months between courses);
2. carrying of the special orthopedic individual insoles, made from the foam polyethylene with enhanced elasticity, resiliency and perfection of letups under a hollow foot (used during all course of rehabilitation);
3. massage feet and gastrocnemius muscles (2 courses for 10 sessions during 6 months), and also daily self-massage of feet (in a that period, when the sessions of massage were not executed by a specialist);
4. electrostimulative affection on musculoskeletal structures of foot and shin in a dynamics. The examinees executed physical exercise in a sitting position on a chair - in turn by a right and left foot (by the sole surface of a foot), carried out circular rotations forward-back on the floor of the special skating trainer-rink, on the working surface of which, a water-wet electrode, executed from soft porous material, was dressed. The working surface of skating rink, which sole part of foot moved on, simultaneously revolving a skating rink, was executed as a cone and it didn't contact with the floor. The second electrode was fixed by a rubber bandage on-the-spot shin. Electrostimulative influence during the reduction of muscular structures of shin and foot was produced by the source of impulses of electric current – «Mioritm». During a 6-monthly period, 2 courses of 12 sessions for 20 minutes (in a day) were conducted [2].

Measurements of the state of locomotor system were conducted before the beginning of research, and also after each of the stages of rehabilitation. The levels of distinctions processed and compared findings between initial and eventual indexes.

Research results.

After the arranging of rehabilitation influences on the children of basic group the considerable changes of the morphofunctional state of musculoskeletal structures of foot are marked, shin, talocrural and knee joints, spine, which are presented in the table 1.

Table 1.

*Changes of the morphofunctional state of locomotor system in the basic group of children from 8 do 14 years old.
(n=30)*

| Types of violations and strains | | Before applying the corrective action, the number of cases | | After applying the corrective action, the number of cases | | |
|---------------------------------|-----------------|--|-------|---|-------|---|
| | | left | right | left | right | |
| Longitudinal arches | | 30 | | 23 | | |
| Transverse arches | | 29 | | 29 | | |
| 1 | | 2 | | 3 | | |
| Valgus heel | On 1°-5° | 9 | | 16 | | |
| | On 6°-10° | 10 | | 2 | | |
| | On 11°-15° | 1 | | 0 | | |
| | On 16°-20° | 6 | | 0 | | |
| | On 21°-25° | 0 | | 0 | | |
| | On 35°-40° | 1 | | 0 | | |
| Varus heel | On 1°-5° | 0 | | 1 | | |
| | On 6°-10° | 2 | | 0 | | |
| Hammer toes | | 26 | | 22 | | |
| fan-shaped fingers | | 1 | | 0 | | |
| Deviation of the 1st toe | | 1 | | 0 | | |
| | | left | right | left | right | |
| Shortening of the lower limb | Free lower limb | 1-3 mm | 1 | 4 | 1 | 2 |
| | | 4-5 mm | 3 | 5 | 3 | 0 |
| | | 6-10 mm | 3 | 2 | 0 | 2 |

| Types of violations and strains | | Before applying the corrective action, the number of cases | | After applying the corrective action, the number of cases | | |
|--------------------------------------|---------------------|--|----|---|----|----|
| | | | | | | |
| semi - pelvis | > 10 mm | 4 | 1 | 2 | 0 | |
| | no | 2 | | 16 | | |
| | 1-3 mm | 2 | 3 | 2 | 0 | |
| | 4-5 mm | 8 | 0 | 1 | 0 | |
| | 6-10 mm | 4 | 0 | 1 | 0 | |
| | > 10 mm | 1 | 0 | 0 | 0 | |
| Gonycampsis | | X-vivid | 4 | | 0 | |
| | | O-vivid | 1 | | 1 | |
| Scoliosis | | C-vivid | 17 | | 9 | |
| | | S-vivid | 2 | | 0 | |
| Bringing forefoot | | | | 8 | | |
| Pain in the leg muscles | | | | 3 | | |
| Convulsions | In the calf muscles | | 16 | | 0 | |
| | In toes | | 8 | | 1 | |
| Area of support legs on plantogramme | less than normal | On 6-10% | 0 | 0 | 1 | 0 |
| | | On 11-20% | 1 | 2 | 3 | 3 |
| | | On 21-30% | 2 | 4 | 2 | 0 |
| | | On 31-40% | 2 | 4 | 1 | 4 |
| | | On 41-50% | 5 | 2 | 3 | 4 |
| | | On 51-60% | 3 | 3 | 6 | 5 |
| | | On 61-70% | 2 | 3 | 4 | 3 |
| | | On 71-80% | 3 | 3 | 4 | 8 |
| | | On 81-90% | 0 | 0 | 1 | 0 |
| | On 91-100% | 7 | 5 | 4 | 1 | |
| | Norm | 5 | 4 | 1 | 2 | |
| | Overweight | 0 | 0 | 0 | 0 | |
| Feet condition on the radiograph | | Norm | 1 | 0 | 17 | 14 |
| | | I degree | 22 | 21 | 10 | 13 |
| | | II degree | 7 | 9 | 1 | 1 |
| | | III degree | 0 | 0 | 0 | 0 |

We suppose less correct grant of research results as average digital datas, because for every child the individual complex of signs and degree of deformity of musculoskeletal structure of foot, shin, knees and spine were identified, thus these changes were fixed both toward an increase and diminishing from a norm. Therefore, we bring these changes over of the morphofunctional state of foot, shin, knees and spine in the expanded form, using such universal data as an amount of the set cases of one or another type of violations or deformations of locomotor system at the examined children before and after the arranging of correcting influences.

The changes of the state of locomotor system are fixed almost in all links. The improvement of the state of longitudinal vaults of foot is marked. From data of sciagraphy from 30 children with the first and second degree of flatfoot after a rehabilitation period 1 child left with the second degree of flatfoot, 10 children (left foot) and 13 children (right foot) – with the 1st degree, 17 children with deformation of the left leg, and 14 children with deformation of right foot got it settled into a shape.

19 children got the degree of deformation of talocrural joints diminished, and 10 children got it settled into a shape (out of 30 children with valgus and varus deformation of heel). The amount of children diminished with hammer, by fan-shaped toe and with the rejection of the first toe, the state of knees (X-vivid deformations are corrected) and spine became better (the cases of children scoliosis decreased twice). Before application of correcting influences only 2 out of 30 children from the experimental group didn't have a shortening of free lower extremity, while after completion of six-month period of rehabilitation already 16 from 30 children got the shortening disappeared. 13 out of 23 children had the diminishing of size of shortening of lower extremity and 14 out of 18 children got the diminishing of deformation of semipelvis. A tendency was set to the increase of footing area of the middle part for children who had datas of the diminished footing area. And the most important – most children didn't feel pain in the muscles of feet (22 out of 25 children), cramps in the gastrocnemius muscles of shin (16 out of 16 children), cramps in tiptoes (7 out of 8 children), that testifies the considerable improvement of the functional state of locomotor system. At the same time, children from the control group did not overcome the violation and deformation of musculoskeletal structures of foot,

shin, talocrural and knee joints, spine (table. 2), but even negative changes are fixed – the amount of children who began to feel the pain in feet, cramp, in shins and tiptoes was increased. The amount of cases of appearance of hammer toe was increased, the state of spine of some children became worse, for example, for the child Sergey A. C-vivid scoliosis became S-vivid. Most children from the control group got the footing area diminished, it talks about a tendency of forming the disorder of a hollow foot.

Comparison of inspection results was rotined by the noticeable improvement of the morphofunctional state of locomotor system of children from the basic group, while a proof tendency was set to its worsening for the children from the control group, that testifies to efficiency of the offered complex author method of rehabilitation of violations and deformations of locomotor system and, in particular, such morphofunctional disorder as a hollow foot.

Table 2.

Changes of the morphofunctional state of locomotor system in the control group of children from 8 do14 years old (n=28)

| Types of violations and strains | | Before applying the corrective action, the number of cases | | After applying the corrective action, the number of cases | | |
|--------------------------------------|---------------------|--|-------|---|-------|---|
| | | left | right | left | right | |
| Longitudinal arches | | 28 | | 28 | | |
| Transverse arches | | 24 | | 24 | | |
| 1 | | 2 | | 3 | | |
| Valgus heel | On 1°-5° | 10 | | 11 | | |
| | On 6°-10° | 9 | | 11 | | |
| | On 11°-15° | 3 | | 4 | | |
| | On 16°-20° | 1 | | 1 | | |
| | On 21°-25° | - | | - | | |
| | On 35°-40° | - | | - | | |
| Varus heel | On 1°-5° | 4 | | 4 | | |
| | On 6°-10° | - | | - | | |
| Hammer toes | | | | 27 | | |
| fan-shaped fingers | | | | - | | |
| Deviation of the 1st toe | | | | 2 | | |
| Shortening of the lower limb | Free lower limb | 1-3 mm | 5 | 7 | 4 | 7 |
| | | 4-5 mm | 1 | 2 | 2 | 2 |
| | | 6-10 mm | 6 | 2 | 5 | 3 |
| | | > 10 mm | - | - | 1 | - |
| | no | | | | 1 | |
| | semi - pelvis | 1-3 mm | 7 | 8 | 9 | 6 |
| | | 4-5 mm | 2 | 0 | 1 | 1 |
| | | 6-10 mm | 1 | 0 | 2 | 1 |
| | | > 10 mm | - | - | - | - |
| | Gonycampsis | X-vivid | 6 | | 7 | |
| O-vivid | | 3 | | 3 | | |
| Scoliosis | C-vivid | 12 | | 16 | | |
| | S-vivid | - | | 1 | | |
| Bringing forefoot | | 18 | | 18 | | |
| Pain in the leg muscles | | 18 | | 23 | | |
| Convulsions | In the calf muscles | 12 | | 15 | | |
| | In toes | 7 | | 9 | | |
| Area of support legs on plantogramme | less than normal | On 6-10% | 2 | 2 | 2 | 1 |
| | | On 11-20% | 10 | 6 | 11 | 3 |
| | | On 21-30% | 7 | 7 | 8 | 5 |
| | | On 31-40% | 1 | 6 | 2 | 7 |
| | | On 41-50% | 1 | 1 | 2 | 3 |
| | | On 51-60% | 3 | 1 | 6 | 2 |
| | | On 61-70% | - | 1 | 1 | 2 |
| | | On 71-80% | - | - | 1 | - |
| On 81-90% | - | - | - | - | | |

| Types of violations and strains | | Before applying the corrective action, the number of cases | | After applying the corrective action, the number of cases | |
|----------------------------------|------------|--|----|---|----|
| | On 91-100% | - | - | 1 | 2 |
| | Norm | | 3 | 1 | 3 |
| | Overweight | 3 | 2 | 1 | 0 |
| Feet condition on the radiograph | Norm | - | 2 | - | 1 |
| | I degree | 22 | 20 | 21 | 21 |
| | II degree | 5 | 5 | 6 | 5 |
| | III degree | 1 | 1 | 1 | 1 |

Conclusions

1. The research conducted by us allows to describe a hollow foot, as type of morphofunctional disorder a physical rehabilitation of which is the least studied and causes many contradictions.
2. Developed by us complex method of physical rehabilitation of people with violations and deformations of locomotor system and, in particular with such functional disorder as a hollow foot, resulted in the positive changes in the morphofunctional state of musculoskeletal structures of foot, shin, talocrural and knee joints, spine of children from the basic group.
3. Absence of the special rehabilitation measures at the initial stages of hollow foot results in aggravating of this disorder and increase of amount of children with pain in the muscles of feet, by cramps in gastrocnemius muscles and fingers.

The prospects of further study of morphofunctional disorders of foot will be realized in development of more perfect methods of diagnostics and more effective facilities of rehabilitation.

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