

STUDY OF WALKING KINEMATICS IN CHILDREN WITH RIGID FLAT FEET

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Relevance. Rigid flat foot is the most common type of foot dysfunction. Currently, unsatisfactory results and recurrence rates after conservative and surgical treatment of rigid flat foot remain high, accounting for over 20%. In our opinion, the characteristics of pathogenetic elements in the rigid form of flat foot, as well as indicators of biomechanical disorders in the neuromuscular structure of the lower leg and foot depending on the disease stage, have not been adequately considered when selecting correction methods.

Objective: To determine the significance of walking kinematics diagnostics in patients with rigid flat feet by comparing pre- and postoperative data in the gait laboratory.

Materials and methods. The study included 51 patients with rigid flat feet (42 boys and 9 girls). The average age of patients was 10.5 ± 1.4 years. Patients were grouped according to disease stage based on our classification "No. DGU 42326 - Algorithm for classifying children with rigid flat feet" (2024) to develop indications for surgical correction. Surgical treatment was performed using our developed method (patent for invention No. FAP 2416 (2024)). The significance of walking kinematics diagnosis in patients with rigid flat feet was studied in the gait laboratory, comparing pre- and postoperative results.

Results. As the disease progressed, indicators such as "step time," "stance time," and "swing time" significantly increased, while "average walking speed" and "cadence" decreased accordingly ($p < 0.01-0.001$). Additionally, a pattern of worsening pathomorphological changes in the foot was observed, accompanied by increased energy expenditure during walking due to impaired biomechanical properties of the pronator and supinator muscles of the lower leg and foot, correlating with disease progression.

Conclusion. The gait laboratory results substantiated the pathological mechanism of biomechanical disruption in the muscular structure of leg and foot pronators and supinators, varying with disease stage, which leads to pathomorphological changes in the ankle and foot joints. The developed surgical correction method for rigid flat foot allowed for the restoration of impaired biomechanics of active lower leg stabilizers while ensuring proper formation of the foot arch.

Discussion.

Rigid flatfoot is characterized by an outward rotation of the forefoot and a shortening of the ankle joint lever arm due to valgus deformity of the heel. This leads to a decrease in lever strength and, accordingly, the flexibility of the midfoot.

From a kinetic standpoint, flatfoot involves a disruption of lever function and a loss of kinetic energy. This can cause symptoms such as muscle fatigue, discomfort, or pain in the foot, calf, or knee joint after walking long distances [11,].

Kinematic results showed that foot plantarflexion decreased to the same extent as dorsiflexion in the ankle joint. In flatfoot, the angle between the talus and navicular bones is increased. Therefore, in flatfoot, more energy is required for supination and inversion for the foot to become a stable lever during walking [13, 14].

In podiatric practice, there are more than 100 methods of surgical correction for flat-valgus foot, but there is no optimal surgical treatment method. All surgical methods used in childhood are divided into 4 groups: soft tissue, bone tissue, extra-articular, and intra-articular operations. In many cases, good results are achieved when the aforementioned surgical methods are combined.

However, the proportion of various complications and relapses remains high, reaching 23.7%. Due to the multi-component nature of morphological changes in the joints and the multifactorial causes of flatfoot formation, an individual approach is necessary when developing indications and choosing a treatment method in each case.

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