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Foot defects in infants and children and three-plane manual therapy

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Abstract

The subject of the article are foot defects in infants and children as well as early diagnosis and application of three-plane manual therapy of foot defects in children. Foot defects in infants and children are a common problem and the examination of the correctness of foot is very important. Three-plane manual therapy of foot defects in children is one of the proposals that can be used in small patients because it brings therapeutic effects. Rapid implementation of therapy, gives us the ability to inhibit abnormal movement patterns and seek to the correct distribution of muscle tone

Introduction

The foot has a complex anatomical structure, it is made up of a series of bones, including the tarsal bones, midfoot and toes [1]. The proper functioning of all components of the foot is very important, and any deviations from the standard may indicate the existing irregularities [1].

A properly constructed foot under relieving conditions rests on the ground with three points: calcaneal tubercle and the head of the first and fifth metatarsal bones [2]. In the foot defect is distinguished by three basic periods differing in the nature of the observed changes: muscle failure, ligament insufficiency, fixed lesions [2]

The most common deformation of feet among children can include clubfoot, flat-crooked foot and sickle foot [3] Foot deformities can be divided into two groups. The first group concerns deformation of the foot with deflections of the transverse axis of the knee joint, longitudinal axis of the shank or longitudinal axis of the foot in the assignment of internal rotation with a deformed heel [3]. We include a sickle foot and a club foot in this group [3]

The second group contain deviations of the transverse axis of the knee joint and the longitudinal axis of the foot in the adduction, alignment with heel valgus, and in exceptional situations even with heel elevation [3]. We can include flat feet in this group, foot valgus, heel-crooked foot and flat crooked foot [3]

Three-plane manual therapy of foot defects in infants and children is one of the proposals for therapy based on neurophysiological foundations. The therapy mentioned above involves the mobilization of soft tissues [3]. During therapy, the foot is not only mobilized but also stretched, which means that traction is performed in three-plane localized movement pattern [3] Soft tissue therapy assumes initial positions based on three-plane general patterns from hip to foot, it has an inhibitory effect and removes limitations in the entire kinematic chain of the lower limb and the task is to correct the faulty setting [3].

It should be remembered, that foot defects may be a clinical symptom of systemic, genetic and, above all, neurological diseases [4]. Foot defects in children are a common problem, require specialist treatment and the method of therapy depends on the type of deformity [1,3]

Sickle foot

It is the most common congenital foot defect affecting 55% of all foot defects in children [3]. It is usually diagnosed in the first three months of life. The changes relate to the median deviation in all five arterioleal and metatarsal joints and the adductional forefoot

position relative to the rearfoot [3]. Currently, four types of sickle feet are distinguished according to Berg [5]. The first type is the usual adhesion of the metatarsal region, consisting in the attachment of the forefoot with the right rearfoot position. The second type is a complex metatarsal adduction of the anthropium admiration, lateralization of metatarsus, proper placement of the rearfoot [3.5]. The third type is a normal sickle foot- is characterized by adduction of the forefoot, correct metatarsus, rearfoot set in valgus [3.5]. The last type is a complex sickle foot in which the forefoot adduction is observed, lateralisation of the metatarsus, rearfoot set in valgus [3.5]. For the assessment of sickle foot acc. Berga is RTG. There are unknown reasons for the occurrence of sickle foot, but it is assumed that this is related to the deficiency of uterine space in the prenatal period [3,6]. 62

Club foot

It is the deformation of the foot, in which particular parts of the foot such as the tarsus, metatarsus and forefoot distorted in all three planes [7]. The etiology of the defect is not fully understood, it is assumed that there is a combination of genetic and environmental factors [8]. The clubfoot setting is a complex deformation that starts in the prenatal life and can be recognized after 12 weeks of pregnancy by ultrasound examination [3,9]. In the clubfoot, there is a horse deformation in the posterior rearfoot, varus in the central part and adduction in the forefoot [10, 11, 12]. These deformations are related to incorrect mutual tarsal bone formation. Calcaneus, navicular bone and cuboid bone rotate around the talus and set in reverse [3]. Often in this aberration, shortening of the Achilles tendon and sometimes the deepening of the longitudinal foot is present. Deformation begins with the talus [13]. The rest of the tarsal bone adapts to the defective adjustment of the talus [3]. The medial deviation of the navicular bone around the head of the talus is the greatest importance. The navicular bone is subluxated medially and often has close contact with the ankle.

A condition for the proper functioning of the joint is proper mutual interaction of every parts of the joint[3]. In the situation of blocking the peripheral joint within the limbs, the mutual interaction is disturbed and the mobility is impaired [3]. In this setting, muscles increased their tension on the neurophysiological path in the direction of limited mobility. Significant in clubfoot is contracture of the anterior and posterior tibial muscles and the triceps calf. The medial arch of the foot as a result of supine and flexion contraction is so much shortened that the heel is set up varus, and the forefoot in the adduction. The inversion movement is annulled because there is contracture. Conservative treatment should be started right after birth, it is based on gradual and systematic correction of distortion [8]. Stretching soft tissues and removing heavy muscle contractures in a neutral position for all joints results in partial unblocking of them, affecting the improvement of mobility [3]. Proper therapy consistent with the development allows to avoid surgical procedures in minor cases of defects [3].

Flatfoot

The flatfoot(lat. pes plano-valgus) is a very common problem among children affecting not only the foot itself, but also the higher-lying segments of the body [14]. Flatfoot is a common term for complex foot deformities and is characterized by an abduction-

pronation position of the foot [3]. This defect causes that the foot is setting outside the lateral axis of the knee, is excessively stretched from the medial side and shortened on the lateral side and the heel is set in the valgus position [15]. In addition, this defect is characterized by shortening of the rectifiers, ie muscular tibialis, long palpatory rectifier, second finger extensor and fibula muscle [3,15]. Faulty foot placement results in the tendon muscles being dislocated and deepening the defective shape of the foot. The soft tissues in the flatfoot adapt to deformation, the lateral part of the joint capsule is shortened at the level of the lower ankle joint and the lateral - dorsal part at the height of the upper ankle [3].

Three-plane manual therapy in sickle foot, clubfoot and flatfoot

The main goal of the therapy is the mobilization of soft tissues, aimed at the removal of muscle contractures [3]. Soft tissue therapies are performed in starting positions based on three-plane general patterns from the hip to the foot to trigger the inhibitory reflex [3]. In this situation, rotational disturbances of one joint are not transferred to subsequent joints. In addition, traction is performed within the three-plane localized traffic pattern [3]. The basic principle of therapy is to determine the neutral position of the joint before its passive mobilization begins. Passive tractions and mobilizations are performed perpendicularly or parallel to the joint plane, assuming its neutral setting [3]. The purpose of neutral position is to loosen the articular capsule. In this therapy the mobilization towards shortened muscles is used [3]. Because of that, the mechanical function of the joint is restored and the cause of irritation of the deep sensory receptors is removed with the reflex reaction to this irritation [3]. An additional protection for soft tissue therapy is bandaging the foot suitable to the defect.

Therapy in the sickle foot due to very good prognosis in the initial period should be started in the neonatal period [3]. Therapy is performed in the back and frontal position. When lying in back position, the mechanism to pull the muscles on the medial side of the plantar of foot is used [3]. Three other grips have the task of laterally stretching the foot in the case of a strong contraction on the medial side and stretching the toes and forefoot to the width [3]. Thanks to these grips we can get: correction of contracture of the hip and medial arch of the foot in the direction of the abduction and plantar flexion, and functional adjustment of the foot length [3]. Therapy in the frontal lying position is characterized by the correction of contusion of the hip, conversion of the lower leg and adherence of the forefoot [3]. The movement of bending and hip abduction and extension of contracted forefoot are also tested [3]. If we start the therapy in infants, we use the posterior position while the older children in sitting position [3]. Increasing the length of the functional foot is fixed with a bandage. During the bandaging the correction of the functional length of the foot is maintained at the height of the metatarsophalangeal joint [3]. The bandage is designed to maintain the stretch until the next therapy [3].

The therapy in clubfoot consists in stretching the forefoot in the starting position, i.e. in abduction, external rotation at the bent knee, and hip and foot positioned in the supination [16]. The method of clubfoot therapy should be functional and compatible with the genetically designed model of child development [3]. Therapy can be divided into four stages,

the first one being performed in the back lying with the abduction, rotated outside and bent hip. This position is supposed to correct the deformation of the forefoot and the functional length of the foot [3]. During the second stage, which assumes lying in front of abduction, rotated outside and bent hip, we obtain the correction of deformation of the forefoot and varus of the heel [3]. The next, third stage is also performed in the front laying with a slightly abduction hip joint, bent knee joint and leg directed to the ceiling to correct the Chopart joint [3]. The last stage of the therapy in lying on the side or the front assumes the equation of the footfoot [3].

In the first stage, the key is the setting and as a result of stretching the contorted muscles of the plantar side of the foot, its functional length and supination are obtained [3]. By stretching the contorted muscles we obtain corrections of the defective setting [3]. Removal of excessive tension improves the interaction of joint slippage and results in greater freedom of movement [3]. The second stage of therapy is the stage of initial correction, concerns the forefoot and lower and upper ankle [3]. The next stage is to correct the upper ankle and eliminate almost complete flexion and supinative contraction as well as functional shortening of the foot [3]. In the fourth stage, we perform the movements of the dorsal flexion of the foot with its pronation and abduction. The clubfoot heel changes into a crooked position and the freedom of movement is restored in the direction of the dorsiflexion and plantar flexion [3]. At the end of the therapy, to fix the degree of length obtained, we use bandaging allowing natural movements of the child.

Therapy in a flatfoot also involves four stages. The first and the fourth stage are performed in the back lying position and assume the correction of the foot valgus in the reversal and correction of the foot in the near-perineal area in older children [3]. The second stage, lying on the side, is to lift the medial foot [3]. The third stage concerns the correction of the bending of the medial arc performed in reverse and takes place in the front facing position[3]. Therapy in young children should immediately give results because the ligamental apparatus and other connective tissue structures have not yet been contracted and passively stretched. The correction of the foot through the use of therapy as well as the consolidation of functional bandaging in the long term allows to integrate the corrected foot position with the correct movement pattern [3]. Three-plane manual therapy of foot defects is adapted individually to each child, and to give the best results it should be done at least twice a day.

Conclusions

Foot defects in infants and children are a common problem and the examination of the correctness of foot is very important. The foot should be a flexible system providing support function, stable posture and cushioning while walking, running and jumping. Any deviations in the construction of the foot should be recognized as soon as possible to be able to initiate therapy. Three-plane manual therapy of foot defects in children is one of the proposals that can be used in small patients because it brings therapeutic effects.

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