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Flatfoot in children

Zoran S. Vukašinović[1,2], Duško V. Spasovski[2], Dragana D. Matanović[1,3],
Zorica M. Živković[4,5], Vladan B. Stevanović[2], Radmila R. Janičić[6]
[1]School of Medicine, University of Belgrade, Belgrade, Serbia
[2]Institute of Orthopedic Surgery "Banjica", Belgrade, Serbia
[3]Clinics of Physical Medicine and Rehabilitation, Clinical Center of Serbia, Belgrade, Serbia
[4]Medical Academy "US Medical School", European University, Belgrade, Serbia
[6]School of Organisational Sciences, University of Belgrade, Belgrade, Serbia
[5]Medical Center "Dr Dragiša Mišović", Belgrade, Serbia
[6]School of Organisational Sciences, University of Belgrade, Belgrade, Serbia

rezime

Foot arches are defined by the position of bones and stabilized by active and passive soft tissue structures. The most significant foot arches are longitudinal, medial and lateral. During lifetime they develop and change, while the most significant disorder represents the flatfoot. During the first two years of life, the flatfoot in full weight bearing position is considered a normal physiological condition, while in later age it represents a deformity requiring additional diagnostics and treatment.
The flexible flatfoot is caused by ligamentous laxity, it is mostly pain-free and is treated symptomatically (prescription of adequate shoes and kinesitherapy). The rigid foot is most often caused by bone changes (tarsal coalition, vertical congenital talus) occurring idiopathically or within neuromuscular pathological conditions, with mostly present pain problems. In such cases treatment is also initiated by non-surgical methods, however, some type of surgical treatment is most frequently necessary to be used.

Keywords: foot arches, flatfoot, treatment

INTRODUCTION

The foot, as the terminal part of the lower extremity, has probably undergone the most extensive evolution changes. From the organ for grip and touch in monkeys, it developed into the organ for locomotion in humans. Compared to the feet of primates, foot joints in humans are considerably less mobile, while bones are positioned so as to form characteristic arches. The functions of human feet are to bear body weight and to push the body during walking and running. Accordingly, the foot must be capable of weight bearing while standing or moving, it must be sufficiently flexible to adjust to any surface; it must be capable of transforming into a firm bar and to oppose to the forces of inertia by creating pressure on the surface.

With the goal of fulfilling these functions, the foot is composed of numerous small bones connected thus to form flexible arches[1,2,3,4].

FOOT ARCHES

In infants and toddlers the plantar fat pad of the foot may appear to be a flatfoot. Soft tissues modify the foot differently at various ages. Nevertheless, the arches are skeletally defined and present since birth. They are dynamic and individually variable in height (particularly the longitudinal medial arch of the midfoot), and in various activity phases.

We differentiate longitudinal and transversal arches of the foot[4,5,6]. The longitudinal arches are medial and lateral. The transversal arches - posterior being complete and anterior-incomplete. The role of the arches is to distribute body weight over the bearing points of the sole, heel and six forefoot bearing points (two seasmoid bones below the head of the first metatarsal bone, and the heads of the remaining metatarsal bones, 2nd, 3rd, 4th and 5th). The flexibility of the arches helps in walking and running, because they function as absorbers of the impulse of forces on weight bearing and leaping; it also makes walking easier on uneven surfaces[5,7,8,9]. On each arch the following architectural parts are described: top, columns, borders and compunds (joints). In addition, when under weight bearing the arch expresses different stability, which is defined by the form of arch elements, alignments, extensor and suspender, all present in the arch of the foot. The medial longitudinal arch, compared to the lateral, is higher and firmer; it absorbs muscular forces, as well as the forces of weight and reaction to the surface in weight bearing position. It has two borders; the anterior composed of the head of the 1st and 3rd metatarsal bones, and the posterior composed of the medial calcaneal tubercle. The arch top is composed of the superior articular surface of the talar body. There are also two columns; the anterior - long and

weak, composed of the talus, navicular bone, three cuneiform bones and the first three metatarsal bones, and the posterior - short and strong composed of the medial half of the calcaneus. The main joint of the medial longitudinal arch is the talocalcaneaonaavicular. The key element of the arch is the talus, which is of special form, alignments representing strong plantar ligaments (short plantar, long plantar and calcaneonavicular ligaments), the extensor - the flexor hallucis longus muscle, and the suspender - the peroneus longus muscle[3,5,10]. To maintain the medial longitudinal arch, the bone factor is of the least significance. Intersegmental alignments serve to connect the adjacent bones, among which the most significant one is the plantar calcaneonavicular ligament as it supports the talar head; however, the dorsal ligaments are also important, because they align the adjacent bones; plantar aponeurosis, flexor digitorum brevis muscle and the tendon of the tibial posterior muscle.

The extensors involve the medial part of the plantar aponeurosis, the medial part of the flexor digitorum brevis muscle and the abductor hallucis muscle supported by the flexor hallucis brevis muscle. The suspenders serve as the structures supporting the arch from above, with the major role being played by the posterior tibial muscle, the flexor hallucis longus muscle as the strongest one, and are helped by the flexor digitorum longus muscle and the anterior tibial muscle[3,4,5,10].The lateral longitudinal arch is very low, of limited mobility, and formed to transfer loading forces to the surface. Its anterior border is composed of the heads of 4th and 5th metatarsal bones, and the posterior of the lateral tubercle of the calcaneus. The top of the arch is composed of joint facets of the upper calcaneal surface (subtalar joint). There are also two columns; the anterior - long and weak, composed of the cuboid and the 4th and 5th metatarsal bones, and the posterior - short and strong, composed of the lateral half of the calcaneus. The main joint of the lateral longitudinal arch is the calcaneocuboid. The cuboid bone is the key element of the arch, but it should be pointed out that the bone factor is not predominant. The intersegmental alignments involve short plantar ligaments, long plantar ligaments and dorsal ligaments among the calcaneus, cuboid and the corresponding metatarsal bones. The extensors involve the anterior part of the plantar aponeurosis, the anterior part of the flexor digitorum brevis muscle, and are helped by the abductor digiti minimi muscle and the flexor digiti minimi muscle. The role of the suspenders has the peroneus longus muscle and the peroneus brevis muscle[3,4,5,10].

Flatfoot

Flatfoot represents the most frequent condition diagnosed at the orthopedic outpatients unit. It can have a various degree of mobility, and also a variably expressed pain problems[1,2,11]. In this regard we differentiate two basic forms of flat feet:

- Flexible flatfoot - a predominant form, with the arch of the foot present and normal in non-weight bearing, and absent under weight bearing. This is caused by ligamentous laxity, as a part of hypermobility syndrome, so that it is most often bilateral, also with the involvement of other joints, as well as of connective tissues outside the locomotor system.
- Rigid flatfoot - by far the least frequent form of flatfoot, present in only about 1% of flat feet in children, and characterized by the absence of the arch even in the absence of weight bearing. It is caused by congenital anomalies.

Flexible flatfoot

The flexible flatfoot (also termed acquired flatfoot) represents a dynamic deformity present in all neonates. During the first two years of life flat feet are a normal occurrence caused by the presence of fat pads which dis-appear after that period. Thus, at age 18 months the flat-foot is present in 97% of infants, while at age 10 years, when the medial longitudinal arch is expected to develop, it is present in only 5% of children, among whom only a few have problems. Nevertheless, later on the situation changes again, so that about 15-20% of adults have asymptomatic flat feet[4,12,13]. The pathology of the deformity is reflected by the loss of normal medial arch associated with the valgus of the heel, mild subluxation of the subtalar joint and eversion of the calcaneus. It occurs as the result of the tibial posterior muscle dysfunction due to injury, denervation or degeneration. The plantar calcaneal ligament prevents the inferomedial migration of the talar head and the creation of a prominence at the medial aspect of the alignment between the forefoot and the hindfoot.

Treatment of the flexible flatfoot depends on the patient's age. In children aged 3-9 years symptomatic tre-atment is applied by prescribing adequate shoes, shoe inserts and kinesitherapy[3,5,14]. In those aged over 9 years, deformity causes should be considered. In symptomatic patients of this age, the access navicular bone or a partial tarsal coalition should be thought about, with according adjustment of therapy. Adult patients with painful flat feet unresponsive to non-surgical treatment are mostly treated by surgery[3,5,7,12,15,16].

Calcaneovalgus deformity

A special form of the flatfoot is the calcaneovalgus deformity of the foot. It is bilateral in 30-50% of neonates, and occurs as the result of intrauterine position. The foot is in dorsiflexion and the heel in the valgus position. The deformity is flexible and painless, while plantar flexion and inversion are easy to perform. The anatomy of the foot is normal, without bone dislocation, muscular and tendon structures are of normal length, so that the reposition of such a foot is also easy to perform. The diagnosis is clinically passed, and radiography is unnecessary. In differential diagnostics the congenital vertical talus (the hindfoot is in equines and the forefoot is dorsiflexed, with no possibility of correction) has to be taken into consideration. Mostly, treatment is not necessary, exercises and application of corrective casts could be applied[2,3,5].

RIGID FLATFOOT

The rigid flatfoot, which is also termed congenital, is characterized by a valgus position of the calcaneus, the midfoot is pronated, and the talus is directed medially and downward, while the navicular bone is dislocated laterally. The acquired or flexible flatfoot is similar, but the foot is mobile. The etiological spectrum of the rigid foot involves tarsal coalition, congenital vertical talus and other rarer congenital conditions, such as cerebral paralysis, Down syndrome and other[2,5,10,11].

Tarsal coalition

Tarsal coalition, which can be bony, cartilaginous or fib-rous, calcaneonavicular or talocalcaneal joints are mostly affected. The attempt of passive or active hindfoot inversion results in a painful spasm of peroneal muscles, so that this condition is also termed a spastic peroneal flatfoot. Symptomatology includes foot pain, difficulties in walking on uneven ground, feeling of local fatigue and peroneal spasm. Treatment implies 4-6 weeks of immobilization by casting, surgical removal of alignment and soft tissue interposition, subtalar arthrodesis to correct the deformity or triple arthrodesis to resolve pain[9].

CONGENITAL VERTICAL TALUS

Etiology, inheritance and the incidence of congenital vertical talus remain unknown. A marked familial character of development occurs associated with myelomeningocele, arthrogryposis and congenital hip dislocation. Achilles tendon contracture of posterior area and the extensor digitorum longus muscle of anterior area lead to the dislocation of the navicular bone with upward displacement. The talus is rotated along the plantar flexion and may display a hypoplastic neck. The extensor retinaculum can be absent enabling tendon twisting. The sole is rigid, of convex form, with equinovalgus position of the heel, and abduction and dorsiflection of the tarsal midtarsal area[1,9]. Reduction of the deformity is not possible. It should be diagnosed at early neonatal age. Untreated patient have a clumsy gait due to a painful rigid foot and corns below the midarea of the foot. Manipulation and corrective casting fail to give results. The method of choice is surgery; extensive approach, reposition of the navicular bone with talonavicular transfixion, lengthening of soft tissues and tendons that obstruct the reposition (Achilles tendon, dorsiflexors, joint capsule of the midfoot), with a possible later subtalar arthrodesis. Complications of surgical treatment are relatively frequent involving skin problems, recurrence of deformity, loss of mobility and osteonecrosis of the talus[1,9,16].

CONCLUSION

Acquired or flexible flatfoot is most frequent deformity in children. Such feet are usually painless, hypermobile and of normal muscular strength. Congenital or rigid flatfoot is most frequently followed by pains; it is hard and rigid, with abnormal muscular strength (lax or spastic). These two forms can be differentiated by the rising on the toes test[3,10,12,14]. While treatment of the flexible flatfoot by non-surgical methods is relatively efficient, treatment of the rigid flatfoot is difficult. In the latter form of the deformity non-surgical treatment (inserts, corrective shoes and exercises) mostly does not yield good results, so that various surgical procedures of soft tissue and bone are attempted in therapeutic approach.

REZIME

RAVNO STOPALO KOD DECE

Lukovi stopala su definisani položajem kostiju i stabilizovani aktivnim i pasivnim mekotkivnim strukturama. Najznačajniji lukovi stopala su longitudinalni, medijalni i lateralni. Oni se tokom života razvijaju i menjaju, a najčešći poremećaj predstavlja ravno stopalo. U prve dve godine života oslonac punim stopalom se smatra fiziološkom pojavom, a nakon toga predstavlja deformitet koji zahteva dijagnostiku i terapiju.

Fleksibilno ravno stopalo je uzrokovano ligamentarnom labavošću, najčešće je bezbolno i leči se simptomatski (propisivanje odgovarajuće obuće i kineziterapija). Rigidno ravno stopalo najčešće nastaje usled koštanih promena (vertikalni kongenitalni talus, tarzalna koalicija) nastalih idiopatski ili u sklopu neuromuskularnih patoloških stanja, a bolne tegobe su najčešće prisutne. I ovde se lečenje počinje neoperativnim metodama, ali je najčešće neophodno primeniti neku od vrsta operativnog lečenja.

Ključne reči: lukovi stopala, ravno stopalo, lečenje

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