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Use of Physiotherapeutic Methods to Influence the Position of the Foot

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1. Introduction

Objective of this study was to examine a group of children who repeatedly attended physical therapy for pain in the Achilles tendons, heels, knees and back pain. Children kinesiological analysis we determined the posture and gait.

We focused on type and abrasion of footwear and we observed present deformity in the axis of foot, the whole limb and in the deviation in heel position and the instep difference in loading and unloading.

Measurements were performed on tenzometric mat - FOOTSCAN - static (standing) and dynamic (gait) analysis of selected segments of the load under the foot. With static analysis, we examined the percentage distribution of pressure between the right and left foot and the front and the posterior part of the foot. With the dynamic analysis technique, we observed unwinding of the base legs on the mat, position and movement of the COP, momentum of subtalar joint and timing of loading below the selected segments.

The results led us in pelvic area and showed functional relationships. The resullts offered various possibilities of using physiotherapeutic methods.

2. Issue

The structural function of the foot is enabled by an elaborate system of arches, which cause the foot to behave like an elastic spring, which compresses and flexes as necessary. For the body to be stable it must be supported at three points and the centre of gravity must be between these three points. The foot also has three supporting points: the tuberosity of the heel bone, the head of the 1st metatarsus and the head of the 5th metatarsus. Two systems of arches are formed between these points – the longitudinal and the traverse arches. However, this static tripod model is currently considered surpassed and is only accepted during anatomic description due to tradition and general comprehensibility. From the functional aspect it is more precise to compare the foot arch to a "flexible bow", where the string compressing the bow is formed of the tendons and muscles, which maintain the arches in the foot. They flex and soften the shock of impact with the ground. The arches protect the soft tissues of the sole and enable flexible transfer of the body's weight when standing and enable the foot to strike the ground flexibly when walking and running.

From the aspect of kinesiology the fact that the movements in the foot joints take place in chains is very important. In a closed chain, when the foot is under strain, it is not possible to carry out movement of only one joint. On the contrary in an open chain, when the foot is not under strain, movements can be made in one joint only

Functional relations between the subtalar and transverse tarsal joint

The scope of movement in these joints is significantly affected by the mutual position of the talus and the calcaneus. During supination in the subtalar joint the axes of the joint surfaces of the talus and calcaneus for connection to the os naviculare and the os cuboideum are parallel. On the anterior level they are perpendicular to projection of the diagonal axis of rotation in the transverse tarsal joint, so movement into dorsal and plantar flexion take place in their direction. As a result of their parallelism the maximum possible scope of dorsal flexion is possible in this joint, which is simultaneously less stable. The divergence of the axes of the joint surfaces in the transverse tarsal joint increases along with increasing supination in the subtalar joint, even though stability also increases the overall scope of motion decreases at the same time (Vařeka, Vařeková, 2009).

2.1 Developmental stages

During the new born period, if the baby is suspended under its armpits the child will support itself on its feet, however, this is a spinal reflex mechanism. During the 1st trimenon the supporting reaction of the legs disappears and a baby suspended under its armpits will not press its lower legs against a surface and the weight of its body is not supported by the lower limbs. At the end of the 2nd trimenon and the beginning of the 3rd trimenon the supporting function reappears if the child is vertical, so-called "stright" reflex. This period is typical in that the child begins to become aware of space three-dimensionally. During the 4th trimenon the postural bearing changes, the child becomes vertical and is capable standing by itself, i.e. it becomes bipedal. This concerns innate programs and innate global mobility formulae (Vojta, 1999, Vlach, 1979). The function of the sole changes, it enters a dynamic relationship between human ambulation and the floor and acts as a contact surface subject to the rules of biomechanics and also has the ability to grip, i.e. actively grip onto the floor. Here we must emphasise the great significance of proprioception and exteroception by the sole, which acts as a massive display. These are qualities that must be kept in mind, because these abilities are gradually lost as a result of wearing shoes. Shoes protect the foot, but also act as a splint (Véle, 1997).

Feet that are not sufficiently actively proprioceptive and the posture of a new born have two specifics:

1. The new born's feet are in eversion. The longitudinal axis of the calcaneus withdraws in relation to the position of the talus laterally.
2. The heel is positioned high, because the calcaneus has not yet moved below the talus. The calcaneus only acquires its position below the talus in relation to the change in posture of the whole body and erective functions. The position changes as a result of muscular function. Before being able to walk independently each child has a pes valgus. This position of the arch will only change during the 3rd year, when all foot arches develop on the basis of muscular differentiation.

An untrained adult should be able to stand on one foot for at least 10 seconds. This time is reduced as the age of the subject increases. Children are only able to stand stably on one foot during their 3rd year. Children can remain standing on one foot for around 10 seconds during their 6th year.

If an injury occurs defects may result, which combine with a functional defect. Functional defects of the musculoskeletal system are manifested by pain and increased tension. Muscular imbalance, and also hypermobility are predispositional factors.

2.2 Standing as a postural situation

Standing is the culmination of postural development. When standing still in a balanced position not many muscles appear to be active. The muscles in the feet, m. soleus, the hamstrings, m. rectus femoris, the hip flexors and autochthonous spinal muscles are active. However, during deviation from a stable position a gradually greater number of muscles in the lower limbs and body become involved in order to stabilise the postural situation (Véle, 1997; Nashner, Cordo, 1981).

If balance is lost it is possible to see activity in the calf muscles and the muscles on the frontal side of the lower limb even if the body otherwise remains unmoving, we identify this as "increased play of the toes" (Janda, 1984).

Equipment used for quantifying the posture at rest is a stabilographic platform (posturograph). It measures the body's deviations and their frequency using tensometric sensors, or more precisely it measures changes to the centre of pressure (CoP). The CoP changes and its route is drawn out (Spaepen et al., 1977; Mizrahi et al., 1989).

2.3 Function of the foot

During its development as an acral area of the lower limb the foot has adapted to an erect posture and bipedal locomotion. It is capable of adapting to terrain irregularities and absorbing the shock the foot's of impact against a surface. It also forms a solid base when walking, distributes excessive strain on the lower limb equally and reduces energy demands during movement of the body forwards (Gross, Fetto, Rosen, 2002).

Its postural function when standing bipedally consists of maintaining stability, because it transfers the body's and ground's reaction force (Vařeka, Vařeková, 2009). Continuous muscular coordination is necessary for this. We perceive this coordination and stability of the foot as a certainty when standing or walking.

When standing normally there should be no "play of ligaments", which is evidence of increased muscular tension. If standing for extended period the foot arches begin to flatten. Walking is important to maintain the shape and function of arches (Véle, 2006).

And finally the foot serves as a source of proprioceptive and exteroceptive information for the central nervous system (Vařeka, Vařeková, 2009).

2.4 Muscle chains affecting the lower limb

The foot does not touch the ground throughout its whole surface, but only the heel, the lateral edge of the foot and in front along the connecting line of the metatarsal heads. The burden is directed to three points: the heel, the big toe metatarsals and the little toe metatarsals. Their burden corresponds to the size of the bone structure. The medial area mostly has no contact, because the sole arches upwards and forms the main part of the longitudinal arch. The summit of the arch is formed by the sustentaculum tali on the calcaneus.

The burden is not directed towards the centre of the heel, but medially and this creates the tendency for the calcaneus to tilt medially (pronation of the calcaneus). The m. flexor hallucis connecting the fibula with the distal phalange of the toe acts against this force. Its activity lifts the sustentaculum tali and the longitudinal arch; it is active when standing, when the foot lifts from the floor and when standing on tiptoe. When standing, the distance between the heel and the bigtoe metatarsal is shorter then when lying down, because the muscles supporting the foot arch are activated. When the arch falls, if the body weight is excessive, the heel pronates and pes valgus occurs. It is stated that the arch has a developmental connection to climbing trees, where it is required to “grip” onto branches and the trunk (Véle, 2006).

Influence of the axial skeleton on the lower limb

The femur and the tibia form a long vertical lever, opposite which the short talus handle is located. Rotation of the femur when standing is transferred to the position of the foot and inversely the position of the foot is transferred to the pelvis through the calf. According to Kapandji, movements of the pelvic joint affect the function of the foot.

If the femur is rotated towards medially when standing, the patella moves in the direction of the big toe and rotation of the femur is transferred to the foot through the lower limb, which it forces to pronate along with reducing the longitudinal arch of the foot. If the femur is rotated laterally, the patella moves towards the little toe and the foot has a tendency to supinate and the longitudinal foot arch increases (Fig. no. 1).

The ability to lock the position of the joints in the lower limb is necessary to maintain stability when standing, this is achieved in the proximodistal direction by the following methods:

1. reducing the number of axes in the joints distally
2. the shape of the bone fork (ankle fork)
3. reinforcement of the joints by the medial and lateral ligaments

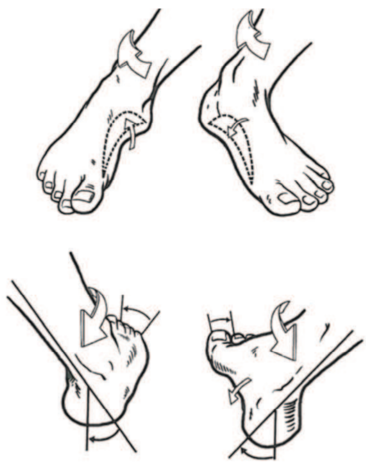


Fig. 1. Effect of femoral rotation on the foot arch.

The foot is connected to the femur through the mm. gastrocnemii, with the tibia and the fibula in the rear through the flexors and in the front through the extensors and mm. peronei. The plantar flexing muscles are important in maintaining the verticals and lifting the foot when walking. M. flexor hallucis longus stretches the longitudinal arch, m. peroneus longus stretches the traverse arch.

The stirrup holding the longitudinal arch of the foot is made up of two loops:

The m. tibialis anterior – m. peroneus longus loop:

fibula - m. peroneus longus – **metatarsus I. – os cuneiform I** – m. tibialis ant. – **tibia**

M. tibialis anterior flexes the foot, it can pronate and supinate it according to the condition of the peronei and therefore this loop has significant effect on the shape of the foot arch.

M. tibialis posterior – m. peroneus brevis loop

fibula - m. peroneus brevis – **calcaneus – os cuboideum** – m. tibialis post. - **tibia**

This loop forms a functional whole and also acts as control from the lateral and medial side on the longitudinal foot arch, which it maintains. M. quadratus plantae, which connects the heel with the front of the foot and is therefore involved in maintaining the longitudinal arch must also be included in the muscles affecting the foot arch..

The lower limb forms a complete muscle chain, the function of which can be affected from above and from below. Consequently it is important, when examining defects in the foot, to consider influence from higher areas, i.e. from the position of the pelvis, hip and knee joints. Similarly the inverse influence from the position of the plantar must also be taken into consideration.

2.5 Effects of stimuli on control of stabilisation

When standing the distribution of the overall burden on the sole fluctuates in relation to internal factors: the shape of the foot arch, the direction of the body's axis in relation to gravity, the projection of the centre of gravity (CoP) onto the supporting surface, the position of the femur head in the hollow of the hip joint and on the position and configuration of the axial skeleton. Distribution of the burden also depends on exterior factors: on the tilt of the supporting platform, on its profile and friction properties of the ground and shoes. Fluctuation of the burden on the soles can be scanned using equipment recording the course of the burden on individual sections of the sole when standing on pressure plates, where the course of artificial destabilisation by impact with the spine can also be seen (Otáhal). The fluctuation of pressure on individual parts of the soles statically and dynamically can be differentiated by colour on the record. Visible deviations of the CoP caused by breathing movement can also be assessed from the aspect of posture. When assessing strain on the front and rear of the foot using a device according to Kohena – Raze.

Distribution of pressure on the sole changes markedly during movement of the trunk or limbs. Information about these changes is transferred to the CNS and forms an important component during control of stabilisation of the body's position. When standing symmetrically on two scales we discover a regular difference between the sides, fluctuating between 5 – 15% of the total weight (Véle, 2006). The strain on the sole of the foot appears asymmetrically on three supporting points (figure no. 2): 1st and 5th metatarsal of the little toe and heel. The size of the burden on the supporting point is projected into the structure of the skeleton in the three aforementioned points supporting the foot arch unequally. The foot arch is made up of three arches: the practically flat lateral arch, the low transverse arch and the higher longitudinal foot arch. The shape of the foot arch changes depending on distribution of the burden on the sole in relation to whether the foot is supported on the ground when standing or is lifting when walking or is in the swinging phase of the step. When standing the longitudinal arch increases as a result of muscular activity and the distance between the heel – big toe metatarsal reduces compared to the situation without strain and when lying down. This finding means that the foot arch is maintained when standing through the activities of the postural muscles. The shape of the foot arch is influenced not only by the shape of the foot bones, but also the activity of the muscles, particularly m. peroneus longus, m. tibialis posteriori and m. abductor hallucis brevis. The position of the head of the femur against the hip joint and the position of the pelvis also affect the foot arch (see above - - *effects of the axial skeleton on the lower limb*). Information from the plantar and from the position of the hip joint affect body stabilisation and posture when standing.

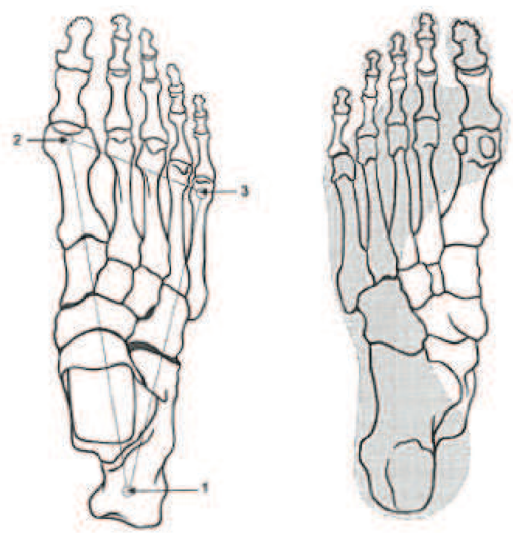


Fig. 2. Brace load distribution on the basis.

2.6 Test for stabilisation defects in early phases

Correction movements when standing take place in the disto-proximal direction. During increased instability plantar flexion occurs in the toes initially, thereby extending the supporting base forward. Later on, activity is expanded to the calf muscles, visible as a "play of ligaments", then the thigh muscles are activated, followed by the muscles in the trunk and finally the muscles of the upper limbs (abduction of the arms). The test for stabilisation defects during their initial phase is based on the disto-proximal direction of correction of erect posture.

The relationship between function of m. flexor digitorum brevis and the function of m. flexor digitorum longus on the lower limbs can be used to assess the beginning of arising instability. During the initial phase of stabilisation defects increased demands are placed on maintenance of stability, which appears as extension of the supporting base forward so that the foot does not contact the ground only at the heads of the metatarsals as it should under normal conditions, but also at the last phalanges of the toes – Véle's test (Fig. no. 3). During perfect stabilisation it is possible to insert a sheet of paper under the terminal phalanges. During the initial phase of a defect the stronger m. flexor digitorum longus overcomes the weaker m. flexor digitorum brevis.

This imbalance causes the distal phalanges of the toes to press into the ground throughout their surface during increased demands for stabilisation, which appears as a change in their configuration and creates a step located between the distal and slightly raised proximal toe phalange. If instability continues to increase the pressure on the end phalanges increases, their proximal ends are raised from the ground because m. flexor digitorum longus exerts a great force on the tip of the end phalange inwards and flexor digitorum brevis is not sufficient to keep the proximal phalanges on the ground, consequently the base of the distal phalanges is raised and they assume a claw like shape.

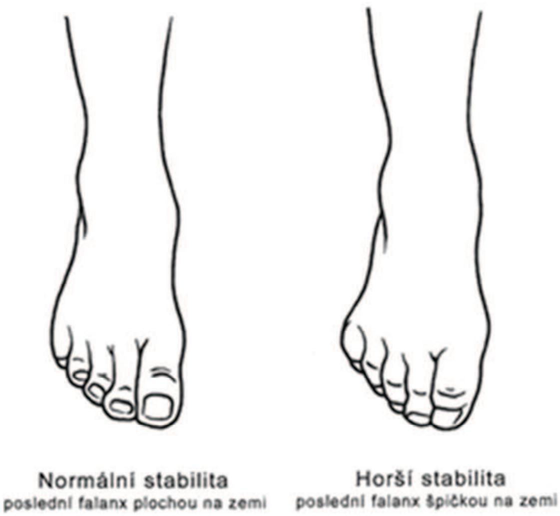


Fig. 3. Stability Test (Véle).

2.7 Examining stabilisation of posture when erect

Stabilisation of erect posture depends on the ability to dynamically keep standing for a long period without significant titubation. Stability of erect posture should not be significantly affected by eliminating visual control. During regularly adjusted stabilisation accompanied by the sensation of certainty when standing, it is practically impossible to see any fluctuations in standing and this finding means a good stabilisation function in all directions. If fluctuation appears when the eyes are closed (titubation), accompanied by an increased "play of ligaments" or expansion of the base, this is a symptom of worsened stabilisation when standing. Stabilisation in the frontal-rear direction is less than side stabilisation. This is given by the method of bipedal locomotion when vertical.

Defects in stabilisation appear as a subjective sense of uncertainty or even dizziness. Extension of the supporting base can be seen when standing still. The scope of the defect can be emphasised by eliminating visual control and also by examination when standing on a narrowed base. The supporting base can be narrowed by standing incorrectly, with feet together, or standing on one limb, or on the toes or heel of one limb. Examination of the ability to stay standing on one foot is necessary because standing in this manner normally appears when walking during the swing phase of the step. An adult untrained individual should remain standing on one foot with visual control for approximately 10 s. This time grows shorter along with the increasing age of the subject. Standing stably on one foot is possible approximately from 3 years of age, when postural stability when walking is guaranteed along with safety and certainty. The level of stabilisation when standing can also be tested by the effects of exterior force perpendicular to the body's axis, for instance by exerting pressure on the chest horizontally.

3. Methodology

Within the scope of this study we examined 24 children aged between 10–13 years, of this 12 were boys (average age = 11.5 ± 1.04 years, height = 155.58 ± 6.14 cm, weight = 48.33 ± 9.16 kg, BMI = 19.93 ± 3.18 kg.m-2) and 12 were girls (average age = 11.5 ± 0.96 years, height = 157.33 ± 4.8 cm, weight = 49.92 ± 6.08 kg, BMI = 20.15 ± 2.26 kg.m-2).

The children visited elementary school in Ústí nad Labem

We assessed incorrect movement stereotype when walking and standing. We focused on the type and wear of shoes and noticed present deformities, the axis of the foot and the whole lower limb, deviation of the heel and differences in foot arch when under strain and not.

Measurements were taken using FOOTSCAN equipment – static (standing) and dynamic (walking) analysis of the strain below selected segments of the sole.

During the static analysis we established the percentage of distribution of pressure between the right and left foot and between the front and rear of the foot. During dynamic analysis we monitored the technique of lifting the sole from the surface, the position and movement of the CoP, mobility of the subtalar joint and the progress of the strain below selected segments.

4. Results

According to Lewit it is known that dysfunction of the foot can be the cause of gross disruption of the movement stereotype and difficulties in the area of the pelvis, the sacral spine and even in the area of the upper cervical spine.

During examination of the position of the pelvis (table no. 1) tilting of the pelvis (lateral tilt) occurred most frequently in boys (50%) and anteversion of the pelvis (tilt forward) in girls (67%). Another indicator is occurrence of shortened muscles in the ischia crural muscles – fknee flexors (67% in boys) , m. quadratus lumborum bilaterally (58% in boys and 50% in girls) – this was established unilaterally in 20% of the children. Reduction in the upper section of m. trapezius occurred most frequently (83% in boys and 50% in boys) (tab. no. 2)

We examined the foot arch roughly by inserting an index finger below the sole from the inside when the child was standing. Flat foot was typical (61% children), toe-out (45% children), toe-in (48%) and hallux valgus (18% of children), in 30% of the children the foot sweated excessively, 15% children underwent repeated treatment for mycosis. 40% children has calluses in the area of the instep or ankle. Insufficient stimulation by movement was clear as well as the consequences of unsuitable ergonomics of the environment and shoes. 44 % children has supination of the position of one foot when standing spontaneously and pronation of the position of the other foot (48%). Children who toed-in complained of pain in the knee joint in the medial area. Stabilisation defects appeared when standing on one lower limb in 45% of children.

We registered the presence of trigger points in the area of m. quadratus plantae in 42% boys and 58% girls and the children stated excessive tiredness and experienced a sensation of heavy feet and static swelling. Trigger points on the Achilles tendon occurred in boys (50%) and an identical proportion of both genders had painful heel spurs (50%)

When examining joint mobility (table no. 3) we recorded occurrence of blocks in boys in both the Chopart joint (92%) and also in the subtalar joint (42%). In girls we found hypermobility in both joints – subtalar (42%) and Chopart (75%). The hypermobility in girls is related to the stability test according to Velé, which was positive in 58% of girls (table no. 5).

Table no. 6 shows examination of standing on two scales when the difference between sides fluctuated in the range of 5-15% of the total weight.

The distribution of the strain on the sole of the foot is described in % in table no. 7. The greatest strain occurred on the front right foot in both genders /(28.1%).

Gait was hard (70%), without shock absorbance when striking the ground the position of the pelvis also changed – it became anteflexive with hyperlordosis of the sacral spine. This was distorted by a weakened abdominal wall and seepage in the area of the sacral character of discs.

Table no. 8 and no. 9 show examination on the FOOTSCAN. The frequency of first contact appeared differently on each foot throughout the whole research group. On the left foot this was initially the lateral edge of the heel, then the medial edge of the heel, followed by the 5th metatarsal, the 4th metatarsal, the 3rd metatarsal, the centre of the foot, the 2nd metatarsal, the 1st metatarsal, the 2nd – 5th toe and finally the big toe.

On the right foot first contact occurred on the medial and then the lateral edge of the sole, this was followed by the 4th and 2nd metatarsal, the centre of the foot, the 5th, 2nd and 1st metatarsal, the 2nd and 5th toe and finally the big toe.

Average max. pressures again differed depending on foot. On the left foot these occurred at the 3rd metatarsal for the whole group; of this girls recorded the highest pressure on the 3rd metatarsal and boys on the lateral edge of the heel. On the right foot the maximum pressure occurred at the medial edge of the foot for the whole group (table no. 10 and a 11).

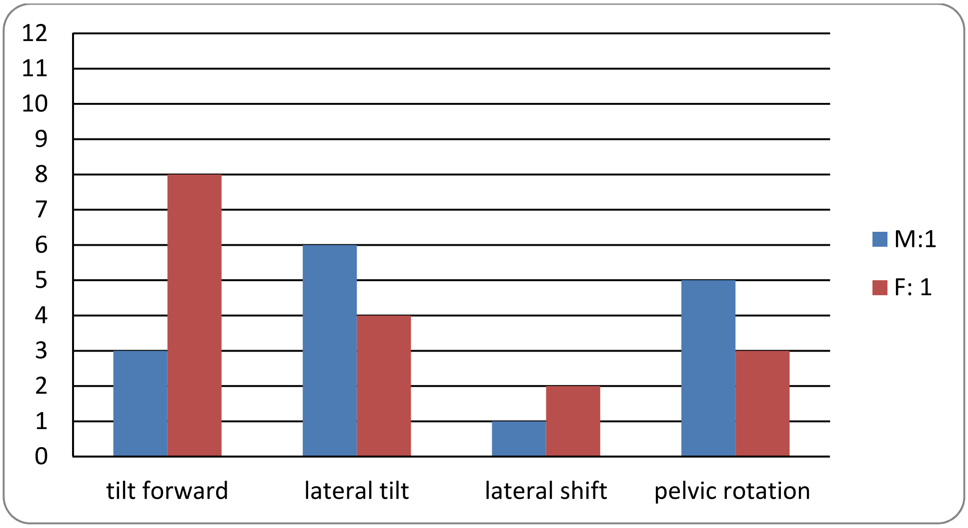
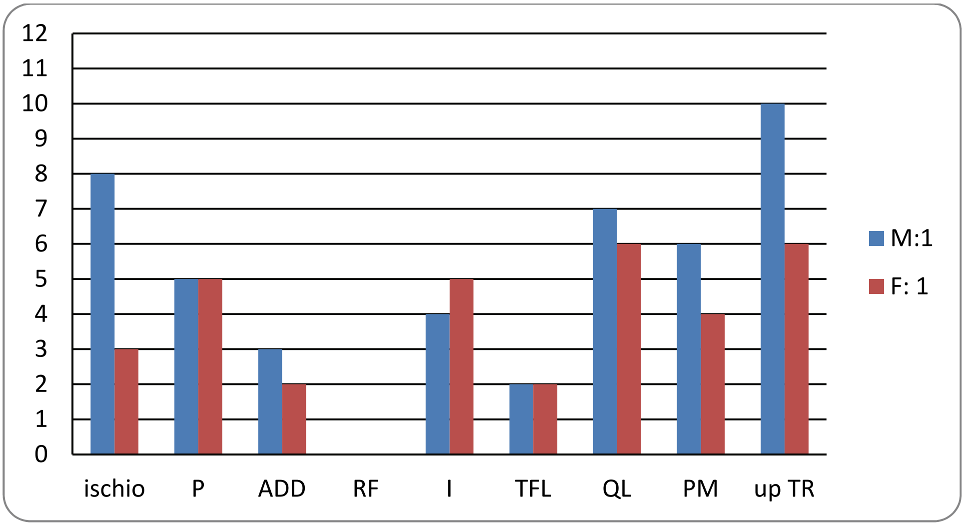
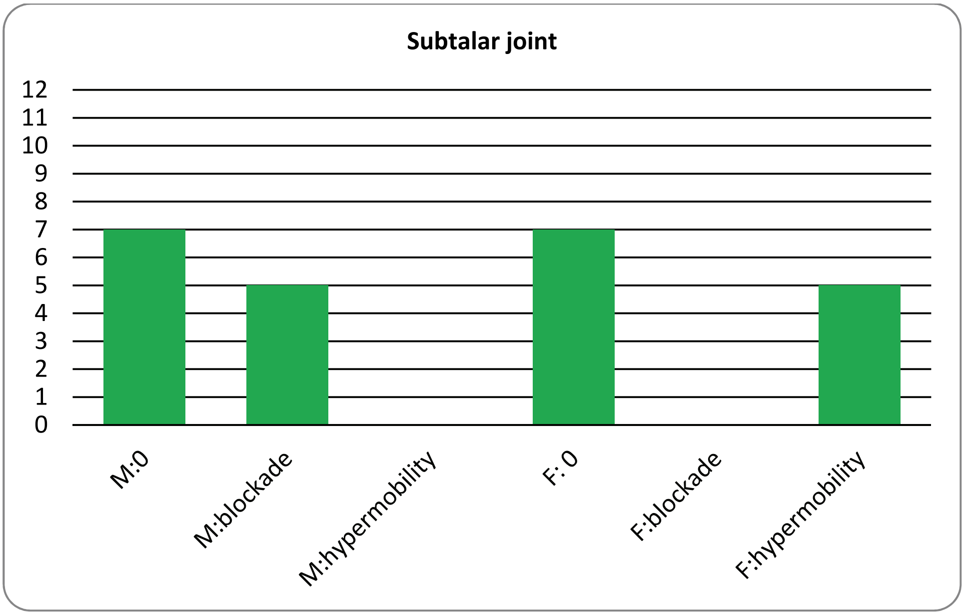


Table 1. Examination of the pelvis (M and F are differentiated in color –:M-male, F -female).



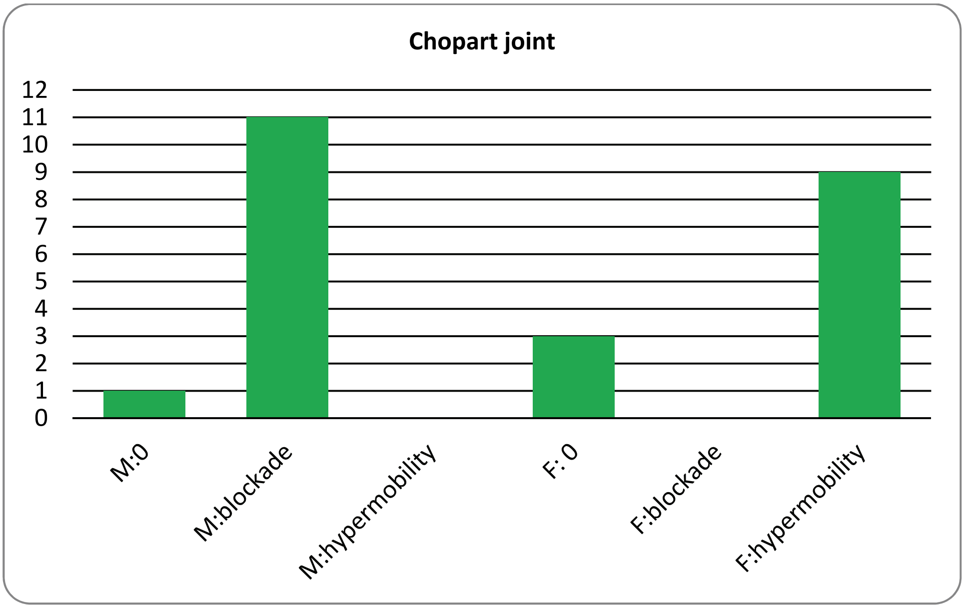
ischio - knee flexors (hamstrings+m.biceps femoris)
P – m.piriformis
ADD - hip adductors
RF – m.rectus femoris
I – m.iliopsoas
TFL –m. tensor fasciae latae
QL – m. quadratus lumborum
PM – m. pectoralis maior
upTR – up trapezius

Table 2. Shortened test structures (M and F are differentiated in color: M-male, F –female).



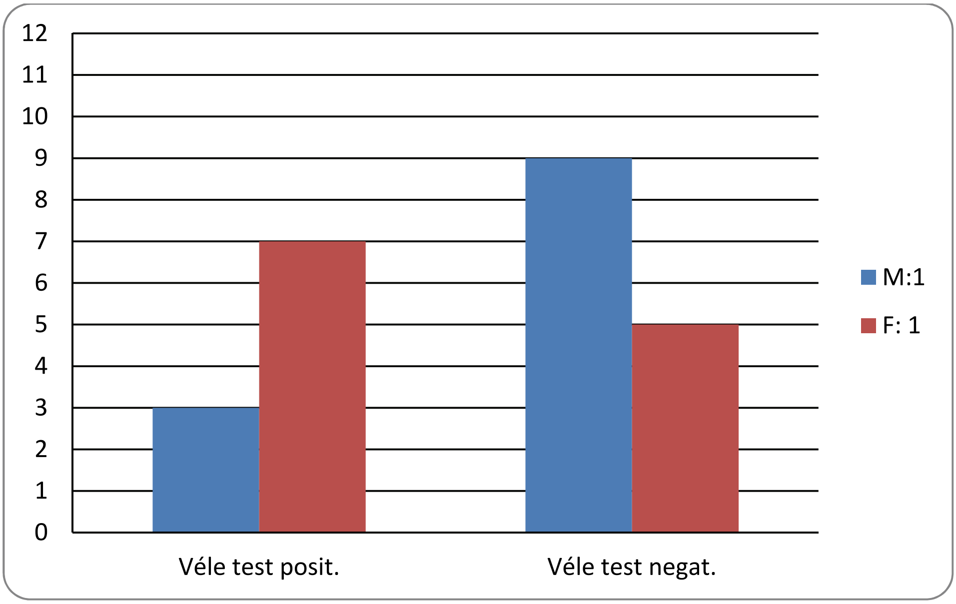
M-male, F - female

Table 3. Examination will articular subtalar joint (here M category on the left, F right).



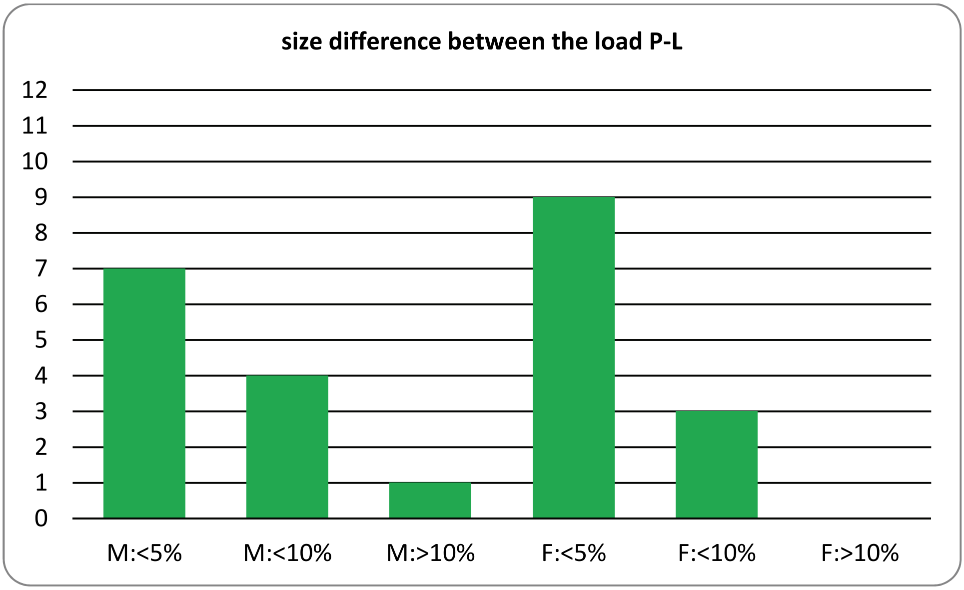
M-male, F - female

Table 4. Examination of joints in the joint will Chopart (here M category on the left, F right).



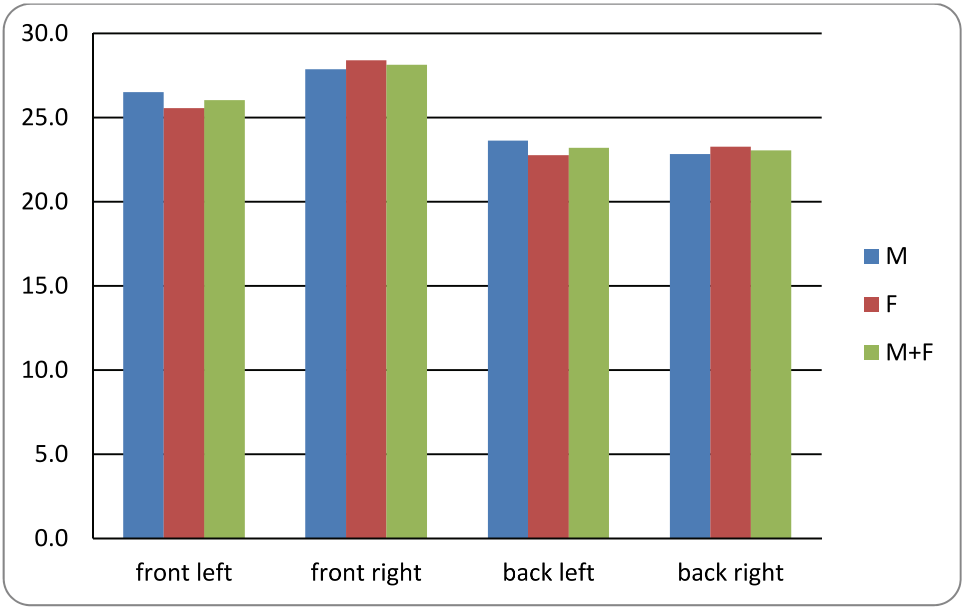
relationship between m.flexor digitorum longus a m. flexor digitorum brevis

Table 5. Stability Test Véle – (M and F are differentiated in color: M-male, F -female).



(here M category on the left, F right)

Table 6. Examination of standing on two scales the size difference max 5-15% of 5-15% of the total weight.



and the posterior part of the foot (%) - M-male, F -female

Table 7. Static analysis - the percentage distribution of pressure between the right and left foot and the front.

	L-big toe	L-his toes 2-5	L-Meta1	L-Meta2	L-Meta3	L-Meta4	L-Meta5	L-center	L-heel1	L - heel2
M	9	10	8	7	5	4	3	6	2	1
F	10	9	8	7	5	3	4	6	2	1
M+F	9	10	8	7	5	4	3	6	2	1

M- male,F- female
heel 1 medial edge of the heel;
heel 2 – lateral edge of the heel

Table 8. Dynamic analysis - beginning of the contact according to the sum - left leg.

	P-big toe	P-his toes2-5	P-Meta1	P-Meta2	P-Meta3	P-Meta4	P-Meta5	P-center	P-heel1	P-heel2
M	10	9	8	7	4	3	6	5	1	2
F	10	9	8	7	4	3	5	6	1	2
M+F	10	9	8	7	4	3	5,5	5,5	1	2

heel 1 medial edge of the heel;
heel 2 – lateral edge of the heel

Table 9. Dynamic analysis - beginning of the contact according to the sum - right leg.

	L-big toe	L-his toes 2-5	L-Meta1	L-Meta2	L-Meta3	L-Meta4	L-Meta5	L-center	L-heel1	L-heel 2
M	14	7	8	14	17	13	11	2	17	19
F	16	6	6	15	22	18	13	3	18	17
M+F	15	6	7	15	19	16	12	2	17	18

heel 1 medial edge of the heel;
heel 2 – lateral edge of the heel

Table 10. Dynamic analysis - average maximum pressure (N/cm2) – left leg.

	P-big toe	P-his toes2-5	P-Meta1	P-Meta2	P-Meta3	P-Meta4	P-Meta5	P-center	P-heel1	P-heel2
M	8	4	12	17	17	12	4	3	23	11
F	6	6	10	20	20	13	6	5	24	12
M+F	7	5	11	18	19	12	5	4	23	11

heel 1 medial edge of the heel;
heel 2 – lateral edge of the heel

Table 11. Dynamic analysis - average maximum pressure (N/cm2) – right leg.

5. Discussion

In its function the position of the sole of the foot is closely linked to the pelvic floor, the deep stabilisation system of the lumbar spine, the abdominal wall, the diaphragm and the upper thorax apparatus with the floor of the oral cavity. The functional interlinkage between hip stabilisers and the sole is of great importance. The position and function of the sole also influences the function and involvement of muscles in the pelvic floor and vice versa, the pelvic floor influences the function and position of the sole. The muscles of the pelvic floor are significantly involved in the posture of the body, they support the trunk and pelvis together with the muscles of the so-called deep stabilisation system. The position of the diaphragm changes, moving into the horizontal level and beginning to participate strongly on stabilisation of the lower and central thoracic spine. The function of the sole, pelvic girdle and the function of the abdominal wall changes fundamentally in accordance with this.

The deep muscular stabilisation system of the lumbar spine includes the muscles of the pelvic floor (m. levator or m. coccygeus) chiefly the deeper muscles in the abdominal wall (m. transversus abdominis, partially the diagonal abdominal muscles), m. quadratus lumborum, the shorter deep paraxial muscles bridging the individual segments of the spine (mm. intertransversarii, mm. interspinosi), the central muscular layer and mm. multifidi and not least the diaphragm.

During restriction of the Chopart joint through increased tension in m. biceps femoris the block in the foot arch is linked to a defect in the structure of the hip with forward body posture and the inability to relax the m. gluteus maximus when standing (Lewit, 1999). Disruption of the function of the hip flexors leads to disruption of the function of the diaphragm and the circle closes. Mobilisation of the instep and modification of afferentation in the are of the sole results in prompt full correction of the function of the foot and correction of posture in the area of the pelvis with regard to this defect.

Through stretching shortened muscle groups and exercises to adjust involvement of phasic muscles on posture we endeavour to implement higher postural models. The key sites for implementing higher global models are the sole, the pelvic area and the sacroiliac joints and the area of the nape.

There are many methodologies we can use. From yoga positions, through erecting response to Vojta's reflexion locomotion we attempt to achieve a centring of the joints and involvement of the phasic muscles after they have been toned.

A non-functional foot arch is a source of distorted afferentation and on the contrary, after it is stimulated and better adjusted under strain, changes occur to the position of the pelvis and the deeper layers of the pelvic floor are directly activated. This is carried out initially when sitting on a ball, then when standing, after this has been managed and following regular exteroceptive stimulation (from skin receptors) it is possible to exert strain by exercises on unstable surfaces according to Freeman and Janda. The basic aids simplifying sensor-motoric stimulation are round and cylindrical sections, balance sandals, rotana (turntable, twister), mini-trampoline.

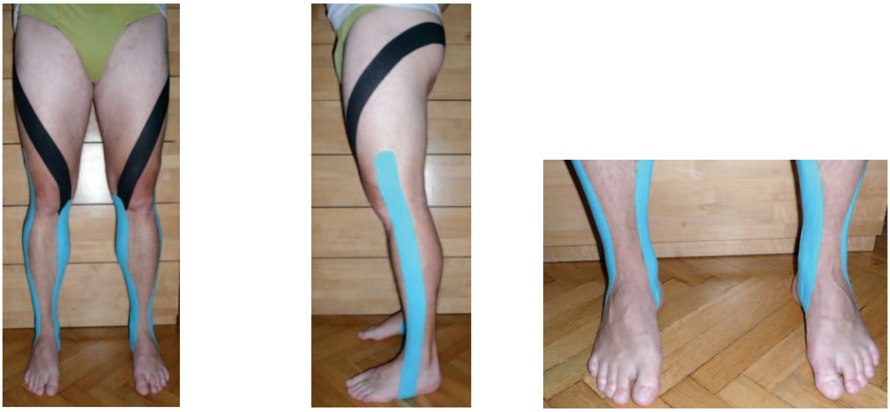
We can also use the Posturomed. The Posturomed means new quality in therapy of proprioceptive afference. (Rašev, 1995).

Opening up of a frequently blocked instep also enable changes to the position of the pelvis.

We place emphasis on re-education of breathing (basal programmes according to Čápová, attitude 3rd month) or on correct positioning of the foot. We burden the foot on four key points – the 1st and 5th metatarsal and the medial and lateral edges of the tuber calcanei. During the initials phase of training it is possible to use tapping of the longitudinal arch (Flandera, 2004) (figure no. 4). It is a good idea to use tapping during correction of the whole lower limb; i.e. the femur is rotated laterally and the lower leg is rotated medially (Fig.no 5 A,B,C).

Fig. 4. Tapping of the longitudinal et transversal arch.

Use of spiral dynamics is a very suitable therapy. This leads towards correct movement – three dimensional, dynamic and systematic. It teaches "anatomically correct movement". It improves flexibility, coordination, the ability to tolerate stress and also increases the individual's performance and stamina. The success of the therapy leads to improved economy of movement. It helps prevent acute damage and chronic over-burdening of the musculoskeletal system.



A B C

Fig. 5. Tapping the entire lower extremity – A - front view; B - side view; C - feet details

Exercising when supported is also very appropriate, where we endeavour to use the supporting phases of the foot; i.e. its maximum extension (fan) with support on the 1st metatarsal. This creates a pillar and we again place strain on the foot at four key points – the 1st and 5th metatarsal and the medial and lateral edges of the tuber calcanei. Support on the 1st metatarsal, when we help ourselves with extended and abducted toes in the MP (metatarse phalangea) toe joints (Fig. no. 6) is considered very important here. This support is projected into the whole body – for example the os tibiale externum dissapears and muscles in the area of the pelvis and thorax are activated.

Fig. 6. Support on the 1st metatarsal, when we help ourselves with extended and abducted toes in the MP.

We can recommend the basic stances used in martial arts (Thai chi, karate), where key attention is paid to precise positioning and centring of joints during movement. The phasic system is also facilitated during these. In combination with precise positioning and the related precise afferentation we can achieve internal coordination in the muscles of the pelvic floor and improvement of the position of the pelvis if repeated often enough.

Control of own posture (kibidachi –Fig. no.7, or ashi dachi – Fig. no.8), which is the pelvis in retroversion, the thorax erect, the head straight and the chin pulled in towards the neck, during which time the energy is maintained in the lower part of the abdomen.

toe joints

Fig. 7. Kibadači

Fig. 8. Neko aši dači

This stance can be found in all traditional martial arts – (the head and the upper part of the body are perpendicular to the ground, the lower limbs are bent with a tendency to push the knees outward, the knees and ankles are fixed, the lower part of the pelvis is pushed slightly in front of the body, a vertical line from the centre of the front part of the knee should fall near the side of the toe, the soles are placed on the ground throughout their surface, the knees face in the direction of the 3rd metatarsal, the distance between the feet is approximately twice the width of the shoulders (Král and coll.,2004).

6. Conclusion

The human foot is an organ, which was formed as the result of the long-term process of adaptation by our ancestors to bipedal locomotion and to erect body posture. A foot fulfilling a static and locomotory function has gradually developed from a foot originally adapted to gripping, jumping and climbing as a result of a more and more erect posture. To assure these functions correctly the structure of the foot changed completely. The tarsus enlarged enormously while the toes and the metatarsal bones regressed. Heavy pressure on the big toe when walking led to its relative enlargement. On the contrary, the other toes underwent various degrees of noticeable reduction. In comparison to primate feet the human foot is a more rigid structure with strong ligamentous support and it formed both longitudinal and transverse arches. A typical characteristic of the human foot is loss of toe opposition and mobility. The foot thereby becomes more a supporting organ than one used for gripping items, even though it has the potential ability to develop the same ability to grip items as the hand, as evidenced by people who have lost the use of their upper limbs.

The fact that six meridians pass through the sole of the foot must also be taken into consideration. Some of these run along the medial, other along the lateral side of the foot. Apart from this the foot itself is one reflexive zone next to another. The meridians of the spleen, pancreas and liver pass along the big toe. However, we are also interested in it because it is the reflexive zone for the head with all its brain glands – the pituitary gland and the hypothalamus. The MP (metatarse phalangea) joint in the big toe is the reflexive zone for the nape. The second and third toe are subject to the meridian for the stomach, the fourth toe is the end point for the meridian of the gall bladder and the meridian of the urinary bladder ends and the meridian of the kidneys begins on the little toe.

Corns, blisters, warts, calluses, abrasions or fissures are among the varied speech of the body and mind.

Dysfunctional strain on the sole and unsuitable ergonomics of the environment and shoes are manifested throughout the body.

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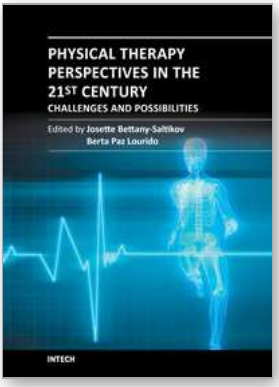
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