

Non-positional Leg Defects

Non-positional defects of the leg (the leg cannot be corrected into the correct position) are very serious, their treatment is complex and long, often surgical.

Pes equinovarus congenitus

Pes equinovarus congenitus (*PEC*, *talipes equinovarus*, English *clubfoot*, German *Klumpfuss*) is the most common non-positional congenital defect of the leg (1:1000) and the 2nd most common developmental defect in orthopedics (after DDH).

It can be a postural (fully conservatively correctable) or structural defect.

Famous personalities with this defect included, for example, the Roman Emperor Claudius, the poet George Gordon Byron or the Nazi propaganda minister Joseph Goebbels.

- boys are more often affected (2:1), in $\frac{1}{2}$ cases the defect is bilateral
- in 10% associated with other congenital defects (DDH, hernias, meningomyelocele)
- the main factor in the creation and maintenance of this deformity is the pull of the tibialis posterior muscle, longer medial subluxation in the Chopart joint and shortening of the Achilles tendon



Pes equinovarus

Characteristics

- equinox position in the ankle joint (fall of the tip of the foot plantarly)
- heel varus (the heel is turned inwards when viewed from the back – heel bone supination)
- excavation (arching of the middle part of the foot)
- inversion of the forefoot (caused by a combination of adduction and supination of the forefoot) – i.e. the front part of the foot deviates from the longitudinal axis of the foot in the direction of the thumb and is placed on the outer edge
- medial subluxation in the talonavicular joint
- internal torsion of the tibia (can only be a consequence)

Etiology

It is multifactorial, the etiology is not exactly known, there are several theories:

1. **theory of neuromuscular defect** – striated muscle defect / intrauterine lesion of the peroneus nerve
2. **mechanical theory** – arrest of talus development during arrest of leg rotation during intrauterine development
3. **theory of primary bone dysplasia** – congenitally defective shape of the talus

Structural PEC also occurs in connection with Edwards syndrome, oligohydramnios, congenital constriction band syndrome or spina bifida cystica

Pathogenesis

- due to the predominance of the muscles on the medial side of the foot (main pull of the tibialis posterior muscle), the leg twists into a cone-shaped deformation, the foot steps on the outer edge, calluses or ulcerations form in places of non-physiological stress, as well as early arthrosis of the leg joints
- susceptibility to relapse

Pathological-anatomical findings

- **talus** – head with neck curled plantarly and medially, sinus tarsi laterally,
- **navicular axis** – medially dislocated,
- **calcaneus** – front part curled medially,
- **fibula** – displaced dorsally,
- **Achilles tendon** – shortened.

Clinical picture

- foot in plantar flexion
- heel smaller, varus and pulled up towards the outer ankle, the outer ankle is further back and protrudes
- on the medial side in the area of the heel a deep skin groove

- forefoot in adduction and supination, varus and equinus
- Achilles tendon shortened and strained
- calf hypotrophy, shorter flat leg
- in most cases there is no difference in limb lengths

Classification (Lehman and Tachdjian)

1. **position type PEC**
2. **right - rigid PEC type**
3. **resistant rigid type**, associated with other congenital defects or arthrogryposis
 - positional PEC is quickly corrected after exercise, but untreated it can turn into a rigid form
 - rigid PEC always indicated for operative solution

X-ray examination

In the lateral and dorsoplantar projection, we evaluate 3 angles:

- **Kite's angle** (dorsoplantar TC angle) – the angle between the longitudinal axis of the calcaneus and talus, norm: $> 20^\circ$, PEC: calcaneus and talus axes almost parallel
- **angle between the axis of the talus and the longitudinal axis of the 1st metatarsal** – norm: $< 20^\circ$, PEC: $> 20^\circ$
- **talocalcaneal angle** (lateral TC angle) – evaluated in lateral projection, norm: $> 35^\circ$, increases in dorsiflexion (with eversion of the calcaneus), decreases in plantiflexion (with inversion of the calcaneus), PEC: 15° , decreases in dorsiflexion, in the plantar increases
- **talocalcaneal index** – sum of TC angles in both projections, value less than 40° – incomplete healing

Therapy

- with the aim of creating a shapely and functionally normal leg
- inform parents that the leg will almost always remain shorter and the calf weaker, that healing lasts from birth to adolescence
- treatment must be carried out carefully to avoid bone damage (risk of osteonecrosis)

Conservative therapy

It goes hand in hand with surgical treatment, simple conservative treatment is sufficient for positional PEC therapy. The essence is the release of muscle and ligament contractures and the achievement of dislocation reposition in the talonaviculocuneiform joint (however, this is impossible with the rigid PEC).

- immediately after detecting the defect: **corrective** exercises, untying, corrective plaster bandages (for small children and rigid forms we change them every week, for older children we leave them for 14 days / we make sensing splints made of plastic, they reach from the toes to the groin in $70-90^\circ$ flexion of the knee joint, we correct all 3 components of the deformity)
- **after the correction part of the treatment, the retention** treatment begins (retention plaster bandages, laminate splints, *Denisov-Brown splints* - shoes without a toe with a connecting rod)
- **Kite's conservative therapy** - corrected each component separately and sequentially (forefoot adduction → heel varus → foot equinus)
- **Ponseti's conservative therapy** (1996) - correction of all components of the deformity at the same time (correction of forefoot adduction, lateral subtalar derotation and inversion correction), achieving correction with less than 10 changes of straightening plaster casts, to overcome equinosity adds subcutaneous Achilles tendon tenotomy, after putting aside Denisov plaster cast -Brown splint up to 6 years of age

Surgical therapy

- it usually starts around 6-8. months of the child's age
- the so-called path of small steps / one-time complete correction
- only the first operation has any hope of success

Surgery on soft parts (tendons, joint capsules, ligaments)

- **We lengthen the tendons** in different ways (Achilles tendon (Z-cut), tibialis post tendon, flexor hallucis lg., flexor digitorum lg.) or transpose (e.g. tibialis ante tendon from attachment to 1. metatarsus on the outside of the dorsum of the foot)
- we cross **joint capsules** (medial and dorsal capsulotomy, e.g. talonavicular joint, naviculocuneiform joint, talocrural joint), plantar aponeurosis or ligaments connecting the individual bones of the tarsus

Skeleton surgery

We operate on the skeleton later (at least after the 3rd year, but more likely after the 6th year of age).

- **calcaneal osteotomy** (to correct varus)

- **forefoot osteotomy** (to correct forefoot adduction)
- **arthrodesis** (e.g. triple subtalar arthrodesis as a definitive solution to residual PEC deformities after treatment) – at least after 12, preferably after 15 years of age

Complete performances

- **operation according to Turco** – posteromedial release of all mentioned joints, lengthening of the Achilles tendon, tendons of the flexors of the fingers and big toe, release / lengthening of the tendon of the tibialis post. feet over the calcaneus, and with the other we fix the navicular bone with the talus and metatarsals, we fix the whole thing with a plaster bandage min. 12 weeks, after 6 weeks we replaster, remove sutures and transfixation, in the 4th month we allow full weight bearing in modeled shoes
- **operation according to McKay** - more radical and complex, suitable for up to 3 years, it is a plantar (complete subtalar) release - from a wide circular surgical approach, after dissection of the suralis nerve and the nerve-vascular bundle behind the inner ankle, we completely release the talus and calcaneus so that they could rotate the talus against the calcaneus and secure it in the correct position with K-wires, the next procedure is the same (plastering and corrective shoes)

Congenital steep talus

Congenital steep talus (*talus verticalis*, *congenital flat foot*) is a relatively rare defect (1:100,000). Its **etiology** is unclear, often associated with other defects.

Clinical picture

- The Achilles tendon is shortened, the whole leg is in a valgus position, the talus is in a vertical position, the head of the talus protrudes on the inner and plantar surface of the foot (talus in marked plantiflexion) and forms the top of the cradle ("**cradle foot**").
- as a result of the vertical position of the talus and the less pronounced equinosity of the calcaneus with simultaneous dorsal luxation of the os naviculare, a **rigid congenitally** flat foot results
- deep skin furrows in front of the ankle joint and below the outer ankle
- the main sign is rigidity, the front part of the leg is in dorsiflexion and correction to the plantigrade position is not possible
- dg. determined by clinical and x- ray examination

X-ray image

- vertical position of the talus, which is oriented in the extension of the axis of the tibia, with which it forms an angle of 170–180° (hence the steep talus)
- os naviculare lies on the dorsal surface of the neck of the talus

Therapy

- treatment is problematic and almost always **surgical** (it always involves the lengthening of the Achilles tendon), we start with it immediately after the diagnosis is established
- it can be preceded by an effort to reduce the deformity with straightening plaster bandages
- during the operation, we try to reposition the bones in the correct position by loosening the soft tissues, which we fix with Kirschner wires

Digitus V. supraductus

A folded little finger is often of familial occurrence.

Clinical manifestations

- the little finger adducted medially so that it folds over the other fingers
- usually causes difficulties in footwear

Therapy

- at first we try to keep the finger in the right position with strips of plaster
- in case of failure, an operation based on the skin is indicated, possibly tendon plastics

Other (and rarer) birth defects of the foot

- leg deformities in arthrogryposis multiplex congenita (pes equinovarus, talus verticalis)
- coalition of tarsal bones (most often talocalcaneal and calcaneonavicular)
- congenitally varus position of the toes (1 or more small toes curled medially and plantarly, in the distal interphalangeal joint terminal joint curled into supination)
- congenital hallux varus (for a three-jointed thumb, where the middle link is only rudimentarily formed in the form of a wedge, the thumb deviates medially in the metatarsophalangeal joint)
- congenital macrodactyly (due to the accumulation of fibrous-fatty tissue or in neurofibromatosis), microdactyly (isolated or in combination with hypoplasia of the relevant metatarsus – brachymetaphonia, a common finding

- in Streeter's dysplasia), syndactyly or polydactyly (preaxial, postaxial or central) – see Congenital limb defects
- congenital hammer-like fingers (digiti malei, fingers in the basic metatarsophalangeal joint in dorsal flexion, in the first interphalangeal joint in flexion, painful callositis in older children)
- congenital shortening of the metatarsals (common in Japan)
- congenital cleft leg (partial adactyly, lobster claw -shaped)
- supernumerary leg bones

Metatarsus varus

Metatarsus varus (pes adductus, metatarsus adductus) is a non-positional foot defect. Congenitally varus metatarsals can be of three types:

Metatarsus varus congenitus

This is a medial subluxation in the tarsometatarsal joints (Lisfranc joint).

Clinical picture

- all metatarsals in adduction (forefoot curled inward) and inversion
- heel in neutral position / slight valgus
- child walks with toes inward, medial edge of foot concave, outer edge convex

Therapy

- requires intensive treatment
- always **conservative** at first: start with exercise (pressure on medial surface to align foot to correct position), a series of corrective plaster bandages over the knee, modeled so that corrective pressure is directed over metatarsals laterally (duration of individual fixations 1-2 weeks, 6-8 weeks overall, rarely longer)
- if the deformity persists: around the age of 2 years **operations** on soft tissues (tendons and joint capsules), from the age of 3 years osteotomy over the metatarsal bases followed by transfixation with Kirschner wires and plaster fixation for 6 weeks (however, it is better to wait until the child is 5-6 years old, when there is no longer a risk of injury to the growth sprints)



Bots used for treatment

Sickle foot

- synonyms: *dog serpens*, *skewfoot*, *zig-zag fuss*
- rare defect

Clinical picture

- metatarsal varicosity, heel valgus
- talocrural joint in anteroposterior projection on rtg spherical
- toe retracted into adduction most, forefoot creates a bayonet-like deformity (pes serpens)

Therapy

- treatment is initiated conservatively (RHB and cast fixation)
- if unsuccessful, operate (capsulotomy, tendon intersection of m. abductor hallucis, osteotomy of the calcaneus)

Residual deformity

- after treatment PEC
- cases where adduction of the forefoot persists

References

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