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# Talipes Equinovarus; Overview, Pathological Anatomy and Clinical Features

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## Abstract

**Background**: Idiopathic talipes Equinovarus (clubfoot) belongs to a group of fibroproliferative disorders involving the musculoskeletal system and its origin remains unknown. This defect occurs approximately once per 1000 births. Although the pathological modifications present in clubfeet have been extensively described, and many etiological hypotheses have been proposed, its etiology remains unknown. This complex three-dimensional malformation is characterized by the presence of four deformities: equinus, varus, adductus and cavus. The purpose of any treatment, regardless of its nature, is to achieve a pain-free, functional, plantigrade foot. In the past, surgical treatment was the preferred method, and has been found to achieve good or satisfactory short-term results.

**Keywords**: Talipes Equinovarus

## Background

There are two main types of congenital clubfoot: idiopathic (80% of cases) and secondary clubfoot (20% of cases). The idiopathic congenital clubfoot is a multifactorial condition that includes environmental, vascular, positional, and genetic factors. Clubfoot has a tendency to segregate in families: the risk of developing congenital clubfoot is 25% when a first-degree relative is affected. Several studies and observations suggest the existence of different genes and inheritance patterns involved **(1).** On the other hand, up to 20% of cases of congenital clubfoot is associated to other anomalies (e.g., myelomeningocele) and could be secondary to a specific genetic condition such as Moebius syndrome neurofibromatosis and multiple congenital arthrogryposes **(2).** The congenital clubfoot could also show more complex anatomic features that typically present a shorter and more rigid foot, in which there is a marked curvature of the midfoot (metatarsal equinism) with deep skin folds. In these cases we talk about an "atypical clubfoot" **(3).** Clinical features of clubfoot may already emerge in prenatal diagnostics, but its ultrasonographic diagnosis appears more likely between the 18th and the 24th week of pregnancy **(4).**

***Pathological Anatomy:***

Congenital clubfoot is a variable three-dimensional deformity of complex system of joints and even at birth there are already well established secondary and adaptive structural changes involving skeletal and soft tissues **(5).**

The deformity involves both the fore and hind part of the foot. In the hind part there is equinus, adduction ,inversion and horizontal rotation and in the forefoot there is adduction and inversion**(6). (figure 1).**

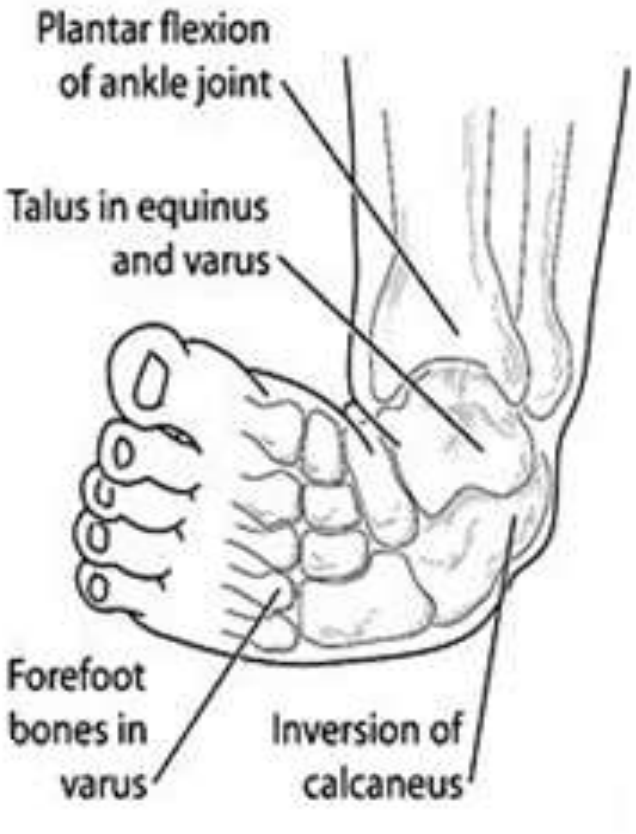


**Figure 1:** Three-part deformity of clubfoot ITEV **(7).**

**The structural abnormalities can be categorized into:**

***(A) Bony Changes:***

Since the study made by Adams in 1851 and later other authors till 1950 the main pathology was thought to be in the talus **(8)**

Newer studies by Bosch, Mckay, Simons and Sarrafin and Smith made a more comprehensive three-dimentional observations **(6).**

These finding can be summarized as following:

1. (The calcaneus is smaller than normal with a hypoplastic sustentaculum tali and is inverted in the coronal plane so that its medial tubrosity approaches the medial malleolus, its posterior end is elevated and displaced posteriorly and laterally to lie close

to the fibular malleolus and its anterior end is deviated medially to lie more in line with the neck of talus than normal) **(6).** In other words, the calcaneus is rotated horizontally through an axis at the interosseous talocalcaneal ligament **(6).**

2. The talus is smaller approximately three-quarters the size of a normal talus. It is planter flexed in the ankle so that its superior articular surface which is shallower and less convex escapes from the tibio-fibular motise **(6**, **8).** (In an untreated case the articular cartilage disappears from the trochlea tali and the lateral aspect of the head of talus) **(6).** The most marked deformity in the clubfoot is in the neck of the talus which is markedly deviated medially and plantar ward on the body.
3. The center of ossification was found to be smaller than normal, and the blood supply of the talus is abnormal in that the vessels are eccentrically placed **(6).** Herzenberg in an analytic study using three-dimensional computer modeling confirmed the medial deviation of the neck of the talus and the lateral rotation of body of talus in the ankle mortise **(6).**
4. The Navicular is rotated such that its long axis becomes nearly vertical instead of horizontal and its tubercle may come into contact with the medial malleolus and may develop a facet at its point of contact. George W Steal noticed that in most dissected specimens in his study (the navicular was about two-thirds of the normal size and its articulation with the talus had a varying degree of inclination or wedging toward the medial and planter surfaces of the foot, thus increasing both the concave curve along the inner border of the foot and the planter flexion of the forefoot which resulted in shortening of the medial border of the foot **(6, 8)**
5. The remaining bones of the foot show very little change in the newborn and if weight bearing was allowed on the deformed foot some wedging of the cuboid and medial angulation of the metatarsals will develop secondarily to this weight bearing **(6,8).**
6. 5. Tibia: Rotational deformity of the tibia was controversial, M Swann et al (1969) denied that medial torsion of the tibia occurs and suggested that the hind foot with the ankle mortise in an uncorrected clubfoot is laterally rotated **(9).**
7. This conclusion was also supported by G W Steal in his anatomical study 1963 in which he found that the tibia was essentially normal except for a small degree of internal tibial torsion in four of the sixteen club-foot specimens that he had studied **(8).**

## ***(B) Joints and Ligaments :***

## **1**. ***Ankle Joints:***

The superior articular surface of the talus is normally narrower posteriorly and this shape is not changed in clubfoot in the newborn. If the equinus remains

uncorrected the anterior part of this particular surface increases in breadth and the posterior part remains poorly developed **(6).**

## 2.***Talo-calcaneal joint:***

normally this joint has three articular facets but in clubfoot these are blended into two in which the anterior part of the joint is grossly abnormal or absent and the posterior part shows inversion and lateral displacement of the calcaneus towards the fibula. The calcaneo-fibular ligament is thick, short and attached closer to the calcaneal tuberosity. The superior peroneal retinaculum, peroneal tendons sheaths and posterior talo-calcaneal ligaments, also hold the calcaneus close to the lateral malleolus. This complex constitutes the postero-lateral tether that restricts dorsiflexion **(6).**

### 3.***Talo-navicular joint:***

Subluxated in an extreme position of medial and planter displacement, (leaving part or most of the head of talus exposed and palpable) under the skin on the dorsum of the foot. This position is maintained by the shortened tibialis posterior tendon and its prolongations. The deltoid ligament, the calcaneo-navicular or spring ligaments and talonavicular capsule, all these structures which are shortened and thick form a medial tether that prevents reduction **(6).**

### 4.***Calcaneo-cuboid joint:***

In this joint the cuboid is abnormally subluxed and displaced medially under the navicular and cuneiform bones and not articulating fully with the calcaneus. As a result of this displacement the plantar calcaneo-cuboid ligament, bifurcate ligament, and the long plantar ligament, all become tight **(6).**

## ***Clinical features classification and differential diagnosis:***

The foot needs to be evaluated in their complexity: general morphology, presence of skin folds, muscular and tendon malleability and flexibility of the deformation. Flexibility is the most relevant element that influences the prognosis the more malleable and easier to move the foot, the better the prognosis. There are several classification systems of the clubfoot, for example Manes-Costa's classification, Pirani's score or Dimeglio classification.

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These scores are valid prognostic tools and can be used in the follow-up process. A high score at presentation may indicate that a longer and more complex treatment will be required. Whenever a congenital clubfoot is detected, a complete examination is mandatory to rule out other neuro-musculoskeletal problems, such as signs of occult spinal dysraphism, developmental dysplasia of the hip (DDH) or congenital torticollis.

***Table (1): Pirani's scoring system:***

| **Hindfoot contracture** | **Points/ Rating** |
|---|---|
| 1.Posterior crease (PC) | 0, 0.5, 1 |
| 2.Empty heel (EH) | 0, 0.5, 1 |
| 3.Rigidity of equinus (RE) | 0, 0.5, 1 |
| **Midfoot contracture** | |
| 1.Curvature of lateral border of foot (CLB) | 0, 0.5, 1 |
| 2.Medial arch crease (MC) | 0, 0.5, 1 |
| 3.Reduction of lateral talar head (LHT) | 0, 0.5, 1 |
| **Total Points** | Range from 0–6;<br>min = 0; max = 6 |
| | 0 = more normal<br>6 = more problematic/rigid |

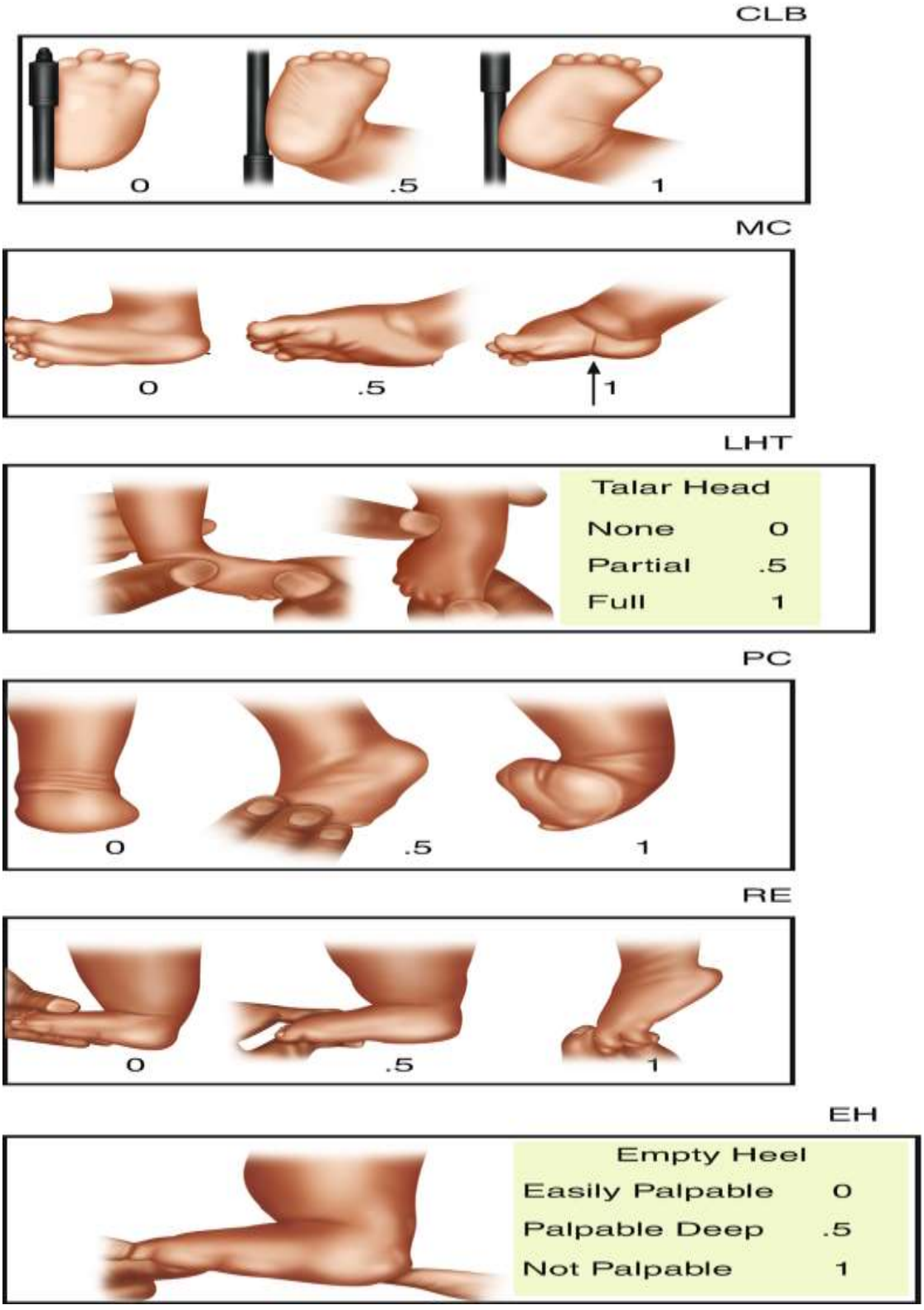
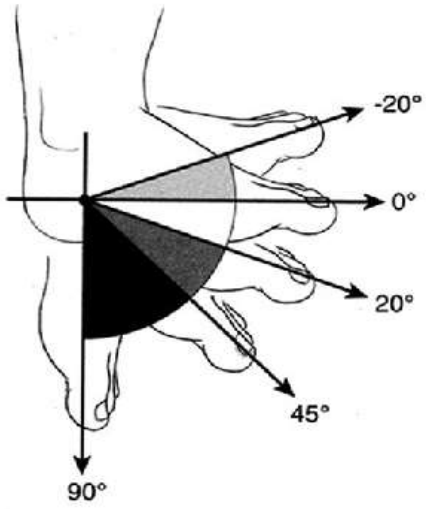


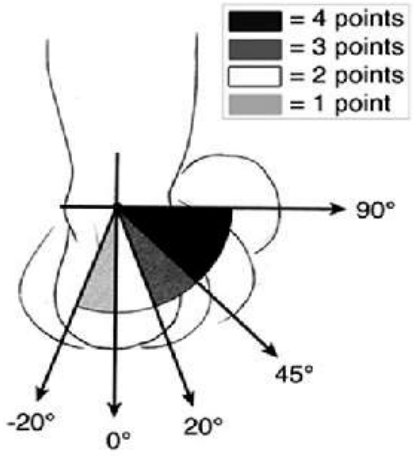

**Figure 2**: Pirani's schematic classification examples **(10).**

**Classification**

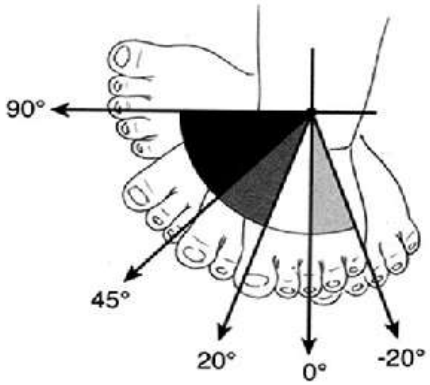
| Classification Grade | Type | Frequency (%) | Score |
|---|---|---|---|
| I | Benign | 20 | (<5) |
| II | Moderate | 33 | (=5<10) |
| III | Severe | 35 | (=10<15) |
| IV | Very severe | 12 | (=15<20) |



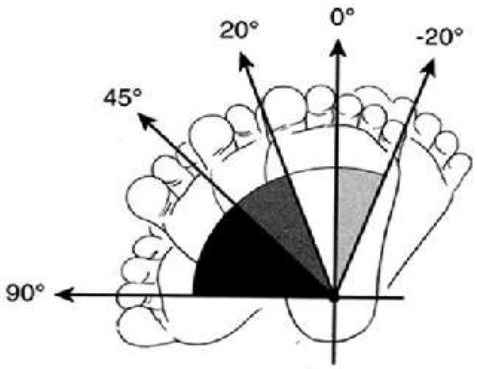

Sagittal plane evaluation of equinus.




Frontal plane evaluation of varus.




Horizontal plane evaluation of derotation of the calcaneopedal block.




Horizontal plane evaluation of forefoot relative to hindfoot.

**Assessment of Clubfoot by Severity Scale**

| Characteristics: Reproducibility | Points | Characteristics: Other parameters | Points |
|---|---|---|---|
| 90°-45° | 4 | Posterior crease | 1 |
| 45°-20° | 3 | Medial crease | 1 |
| 20°-0° | 2 | Cavus | 1 |
| <0° to -20° | 1 | Poor muscle condition | 1 |

**Figure 3:** Dimeglio classification **(11)**

***Radiographic Appearance and Evaluation:***

At birth in the normal foot the cuboid, talus, calcaneus, cuneiforms and metatarsals are visible in the x-ray. In TEV. The centers of ossification appear late and the navicular may not be seen until after the third year and this makes the assessment of the position of this most important structure in clubfoot difficult, but it can be inferred from the position of other visible bones.The standard radiographs in a non-ambulatory child include anteroposterior and lateral in dorsiflexion for both feet. Anteroposterior and Lateral standing radiographs may be obtained for an older child **(12).**

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