

## Neglected clubfoot: Patho-anatomy and clinical features

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## Abstract

Neglected clubfoot still remains a great problem in developing countries like India especially in the rural population with limited access to modern healthcare. It is the most common congenital problem leading to locomotor disability, so much so that the government of India has, in recent years added congenital clubfoot in one the eight notifiable conditions at birth with the hope of eliminating the scourge of neglected clubfoot. With the popularity of the Ponseti method, more and more cases of congenital clubfoot are being treated at the time when they should be ideally treated- ie neonatal period and early infancy. However there are still some lacunae in the healthcare delivery system in India, leading to persistence of these neglected cases in rural population. The obstacles of poverty, lack of awareness and lack of medical facilities in accessible locations means that treatment is either not initiated or incompletely performed. Since the deformity in neglected cases is a complex three-dimensional one, it is essential to understand the pathoanatomy of the same before embarking on the treatment. In this article, we deal with the detailed pathoanatomy as well as the clinical features related to neglected clubfeet.

**Keywords:** Congenital talipes equino varus, clubfeet, neglected

## Introduction

Neglected clubfoot still remains a great problem in developing countries like India especially in the rural population with limited access to modern healthcare[1,2]. It is the most common congenital problem leading to locomotor disability, so much so that the government of India has, in recent years added congenital clubfoot in one the eight notifiable conditions at birth with the hope of eliminating the scourge of neglected clubfoot. With the popularity of the Ponseti method, more and more cases of congenital clubfoot are being treated at the time when they should be ideally treated- ie neonatal period and early infancy[1]. However there are still some lacunae in the healthcare delivery system in India, leading to persistence of these neglected cases in rural population. The obstacles of poverty, lack of awareness and lack of medical facilities in accessible locations means that treatment is either not initiated or incompletely

performed[3,4].

Since the deformity in neglected cases is a complex three-dimensional one, it is essential to understand the pathoanatomy of the same before embarking on the treatment. In this article, we deal with the detailed pathoanatomy as well as the clinical features related to neglected clubfeet.

## Pathoanatomy

The pathological anatomy of the neglected clubfoot can be divided into that related to bone and joints and that related to soft tissues (ligaments, muscles and tendons).

## Bones and joints[5,6] [Figures 1,2,3]

The talus is the bone which is most affected in neglected clubfoot [blue arrow]. The talus is severely plantarflexed. The body is small and altered in shape. The talus becomes severely inverted in the ankle mortice. The trochlea is shorter than normal. Only the posterior portion of the

talus articulates with the tibia in the ankle joint while the anterior portion is just covered with thin and stretched out ankle joint capsule.

Normally, the posterior-most portion of the talus is extra-articular. However in neglected clubfeet with severe planter-flexion, the posterior portion of the talus becomes intra-articular and is covered by joint capsule. The neck of the talus develops significant medial angulation and the head becomes wedge shaped. There are two surfaces of the talus- the anterolateral and anteromedial. The anterolateral surface of the talus is left uncovered by the medially displaced navicular and is now covered by just thin joint capsule which is stretched out, and the skin. This is the part which is palpable just underneath the skin. The anteromedial surface now articulates with the navicular which is displaced medially and proximally. The navicular is also very severely affected in neglected clubfeet [white arrow]. It is flattened or wedge-shaped and medially displaced, adducted and inverted. It articulates with the anteromedial surface of the talus and in some severe cases, even has a pseudo-articulation with the medial malleolus. The enlarged tibialis posterior is attached to a wide area on the navicular along with the medial malleolus. The calcaneus also undergoes a significant alteration [black arrow]. The body of the calcaneus is severely plantarflexed and medially bowed. It is adducted and the lateral process of the calcaneus is under the talus, rather than being lateral to it. In severe neglected cases, the body of the calcaneus also undergoes severe changes, leading to it being bean-shaped rather than rectangular

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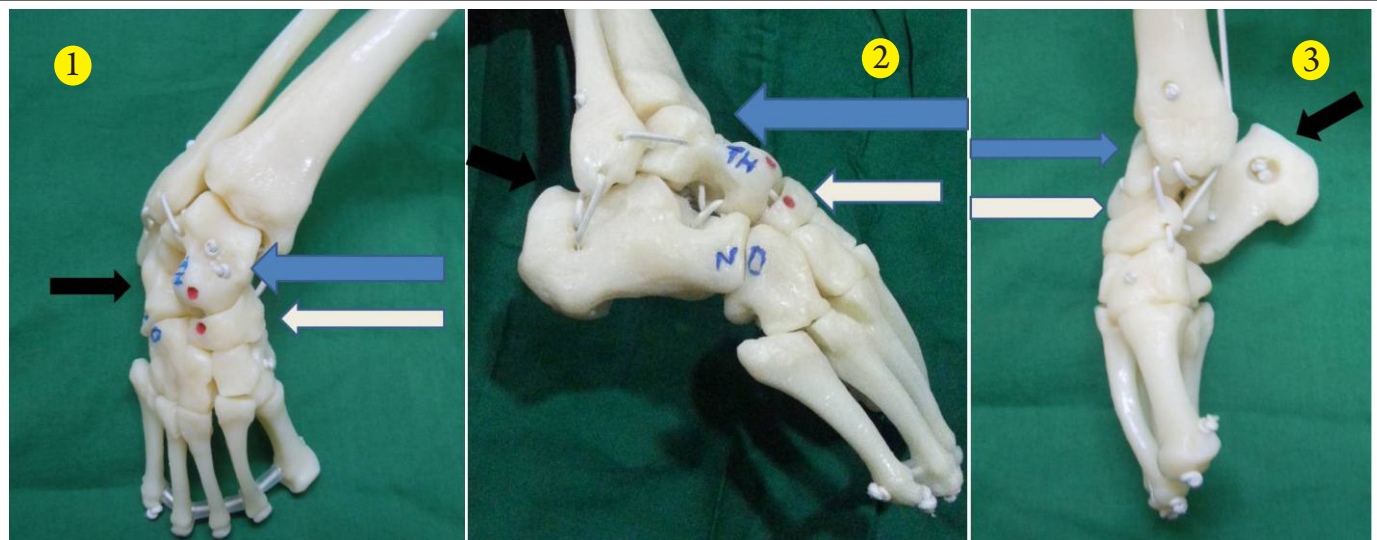
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**Figure 1, 2 & 3:** Bone model of neglected clubfoot in the antero-posterior, lateral and medial views showing the altered alignment of the carpals and metacarpals

on the axial plane. The axes of the calcaneum and talus are parallel to each other. The cuboid is also medially displaced at the calcaneo-cuboid joint so that only the medial surface of the anterior process of the calcaneum articulates with the cuboid. The cuneiforms and metatarsals also undergo secondary changes though to a lesser extent than the talus, calcaneum and navicular. The cuneiforms are medially displaced and have very haphazard articulations with the navicular and the cuboid. The metatarsals are shortened. The talonavicular joint is entirely medially displaced. This articulation is between the anteromedial surface of the talus and the proximal surface of the navicular. There develop pseudoarticulations between the navicular and the tibia (at the medial malleolus) and also between the navicular and the calcaneum. In some cases, there is a fibrous band which is formed between the navicular and the calcaneum, almost like a fibrous calcaneonavicular bar. The three talocalcaneal joints (anterior, middle and posterior) are also very abnormal. The anterior facet remains very narrow while the middle facet is variable. The posterior facet is short. The sustentaculum tali is left uncovered to a large extent. In very severe neglected clubfeet, the talo-calcaneal joints are almost in the weight bearing axis due to the severe inversion so that the talus assumes the weightbearing position. The calcaneocuboid joint orientation is very important for the treatment of neglected clubfeet. The calcaneocuboid joint is very

obliquely placed with the cuboid being subluxed anteriorly and medially while the lateral aspect of the calcaneum is left uncovered. The other joints of the foot (ie the intercuneiforms and intermetatarsals) follow the course of the main joints of the midfoot and hindfoot. The point to remember is that the first two metatarsals are severely pronated while the lateral three metatarsals are supinated. The degree of pronation will determine the cavus, which in turn will determine the fate of the foot in terms of whether the child walks on the lateral border or the dorsal surface.

**Pathoanatomy of soft tissues (ligaments, muscles and tendons)[5-7]**

The soft tissues in clubfeet also undergo a significant amount of secondary changes. They are subclassified as:

1) Changes in muscles:  
The triceps surae and the tendoachilles is the most severely affected amongst all muscle tendon units in neglected clubfeet. The severity of neglected clubfoot depends mainly on the amount of shortening of the tendoachilles. Both the triceps surae and the tendoachilles are foreshortened and the tendon is significantly longer than the muscle. The tendoachilles is inserted medially on the calcaneus and is one of the deforming forces to pull the heel in varus. Amongst the other muscle tendon units affected, the tibialis posterior is very important. The tibialis posterior becomes very broad and hypertrophied and is inserted over a very broad area on the inferomedial surface of the navicular and the

medial cuneiform. This is the most important cause of supination of the foot. In some very severe cases, the tibialis posterior also seems to have an additional thick fibrous band which is attached to the cuboid, which pulls the cuboid medially. This itself leads to the significant displacement of the calcaneocuboid joint, which is seen in some cases.

The tibialis anterior undergoes some amount of hypertrophy. This is more apparently seen in incompletely treated clubfeet, in which the tibialis anterior causes a dynamic supination deformity during the swing phase of gait. The other muscles of the flexor compartment of the foot also undergo foreshortening with resultant clawing.

2) Changes in ligaments and other soft tissues:

The plantar fascia is very tight and results in the cavus component of the deformity. The amount of tightness of the plantar fascia and the cavus, decide how the child walks in neglected clubfeet[4-6]. If the cavus is moderately severe, the child walks on the lateral border of the foot. However if the cavus is exceedingly severe, the child starts walking on the dorsal surface of the foot, making normal ambulation exceedingly difficult.

In the ligaments, the deep layer of the deltoid ligament is very thick and forms a part of the pseudoarticulation between the medial malleolus and the medially displaced navicular. The tibianavicular and the calcaneonavicular ligaments are thickened and shortened. The ligaments on the



**Figure 4a & 4b:** Bone model of neglected clubfoot in the antero-posterior, lateral and medial views showing the altered alignment of the carpals and metacarpals

medial, plantar and the posterior aspect of the foot undergo severe thickening with shortening and are the main tethers against effective closed manipulative treatment of neglected feet. Amongst them, the medial talo-calcaneal ligament and the plantar calcaneonavicular ligaments are very important. The eponymous “knot of Henry” becomes a thick fibrous band which extends from the undersurface of the navicular till the plantar surface of the medial cuneiform and the talus in neglected clubfoot. Thus to conclude, neglected clubfoot is a three dimensional deformity, with severe secondary changes in bones, muscles, tendons and ligaments, all of whom have to be corrected for effective clinical management.

**Clinical features**

The neglected clubfoot, by definition is a foot which has experienced no or minimal surgical or non-surgical management [6] [figure 4]. In this case, the deformity starts increasing after the child starts weightbearing. This is because the structures which are never meant to bear the weight of the body are now in a weight bearing position, the weightbearing starts happening on the side and dorsum of the foot and secondary contractures start developing on the plantar-medial and posterior side of the foot. There is usually a large bursa or callosity at the lateral aspect of the foot, which on prolonged weight-bearing leads to skin breakdowns, ulcerations and infections. It is often difficult or impossible to wear normal shoes for ambulation.

**Patterns of deformity [6]**

Just like clubfoot deformity in the neonatal and infantile period, there are different patterns of deformity in a neglected clubfoot. Though all the major components of the deformity, ie cavus, forefoot adductus, heel varus and equinus are present in all patients, the exact combination is the main causative factor for a particular type of deformity. As a result, there are various feet with different grades of stiffness, mobility and deformity. This led a few investigators to subclassify the deformities in neglected clubfeet into three patterns of deformity since the treatment modality followed and prognosis depends on each of these patterns.

- 1) Moderately flexible: The foot can be considerably corrected to neutral position
- 2) Moderately stiff: There is some correctability but not to neutral position and with moderate deformity persisting
- 3) Rigid: There is almost no correction of deformity.

The classification can be applied either to the entire foot, or separately to the midfoot and hindfoot. Of course, the standard classifications of Pirani [8] and Dimeglio [9] can still be used additionally.

As explained previously, the degree of cavus determines whether the child walks on the lateral border of the foot or the dorsum of the foot. In lesser degree of cavus, the child walks on the lateral border while in greater degree of cavus the child walks on the dorsal surface itself. In the presence of this severe cavus, it is very difficult to appreciate the amount of equinus actually present. This usually gets unmasked once the cavus and adductus gets corrected.

**Socio-economic factors**

The kids with neglected clubfeet eventually learn to walk with no or some modified footwear [6]. However, it is a condition which is fraught with numerous struggles. This deformity poses a significant disability in young children, preventing access to education and social activity [10]. Many of them are outcast or even deemed as “cursed” with very little social interaction due to the obvious grotesque deformity [6]. Social stigma of having “reverse feet” is also very great, and many girls find it difficult to get married due to this [4]. They are unable to squat for toileting purposes which is an essential function especially in rural population [3,4]. There is significant pain, difficulty in locomotion over long distance, with frequent skin breakdowns, infections and callosities. The skin breakdowns and infections can sometimes be so severe that it may lead to amputations.

**Conclusion**

Congenital clubfoot is a complex problem which requires proper understanding of the anatomy as well as realistic goals for treatment before embarking on attempting to treat it.

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