

Clubfoot

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Abstract

Talipes equinovarus, or clubfoot, represents a spectrum of foot deformities characterized by hindfoot equinus and varus with forefoot adduction and supination. Most cases reflect congenital structural malalignment and are classified as idiopathic, syndromic, or neurogenic, while postural deformities are flexible and nonstructural. Prenatal diagnosis is typically established with US, and postnatal evaluation relies on clinical examination with selective use of radiographs. Weight-bearing or simulated weight-bearing anteroposterior and lateral radiographs allow measurement of the talocalcaneal and tibiocalcaneal angles, which aid in assessing severity and monitoring correction. The Ponseti method of serial casting remains the gold standard treatment, although relapse may occur and can be identified clinically or radiographically.

Keywords: musculoskeletal, foot, congenital

Case Summary

A young child with a known diagnosis of clubfoot presented to the orthopedic clinic for corrective management.

Imaging Findings

Anteroposterior and lateral simulated weight-bearing radiographs of the foot demonstrate findings consistent with clubfoot deformity. On the anteroposterior view, the talus and calcaneus are nearly parallel, reflecting hindfoot varus. On the lateral view, the talocalcaneal angle measures 16°, decreased relative to the normal range of 25-55°. The tibiocalcaneal angle measures 117° increased relative to the normal range of 25-60° in maximum dorsiflexion. These findings are consistent with hindfoot equinus and varus deformity (Figure 1).

Diagnosis

Clubfoot

Discussion

Talipes equinovarus, commonly referred to as clubfoot, describes a spectrum of foot deformities characterized by hindfoot equinus and varus with forefoot adduction and supination. The condition most commonly represents a congenital structural malalignment of the talus and adjacent hindfoot structures, with associated medial and posterior soft-tissue contractures, including shortening of the Achilles tendon and medial ligaments. Clubfoot is one of the most common congenital lower extremity deformities, occurring in approximately 0.5-3 per 1000 live births worldwide, with higher rates reported in

certain populations and a male predominance of approximately 2:1.¹⁻³

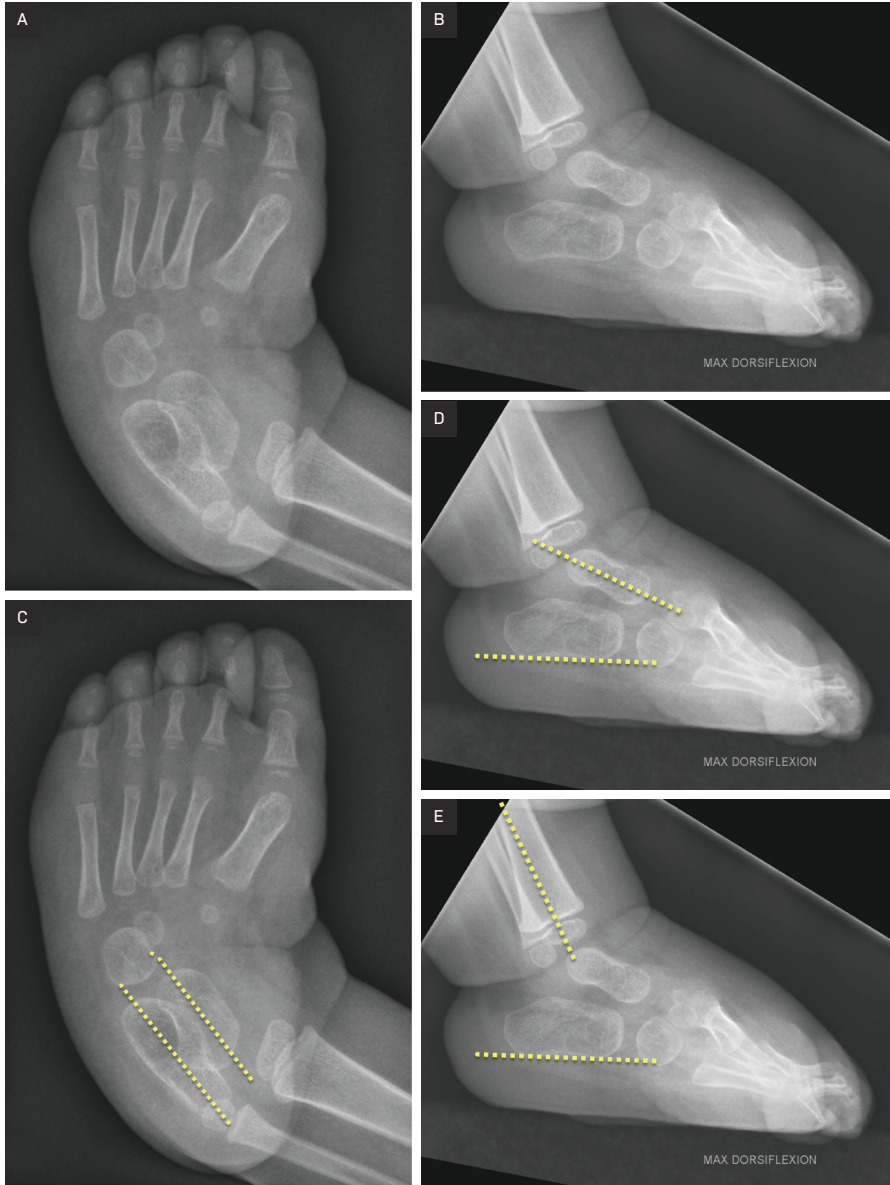
Clubfoot is broadly classified into 4 categories: postural, idiopathic, syndromic, and neurogenic.⁴ Postural clubfoot accounts for approximately 10% of cases and results from intrauterine positioning forces. These deformities are flexible and typically respond to stretching and casting alone.^{1,2} The remaining categories represent structural forms in which the deformity is rigid and not correctable with passive manipulation. Idiopathic clubfoot is the most common form and occurs in the absence of associated anomalies. Syndromic clubfoot is associated with chromosomal abnormalities, genetic syndromes, skeletal dysplasias, and connective tissue disorders. Common associations include arthrogyrosis, Down syndrome, diastrophic dysplasia, and TARP (Talipes equinovarus, Atrial septal defect, Robin sequence, Persistent left superior vena cava) syndrome.^{1,2,5} Neurogenic clubfoot results from disruption of the neuromuscular unit and may be seen in conditions such as myelomeningocele.^{1,2,5}

Prenatal diagnosis of clubfoot is most commonly established during the first or second trimester using US. Reported

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Figure 1. (A) Anteroposterior simulated weight-bearing radiograph of the foot demonstrating parallel alignment of the talus and calcaneus, consistent with hindfoot varus and forefoot adduction. (B) Lateral simulated weight-bearing radiograph demonstrating hindfoot equinus with a decreased lateral talocalcaneal angle and an increased tibiocalcaneal angle. (C) Anteroposterior radiograph demonstrating measurement of the talocalcaneal angle, formed by lines drawn through the longitudinal axes of the talus and calcaneus. (D) Lateral radiograph demonstrating measurement of the lateral talocalcaneal angle using the longitudinal axes of the talus and calcaneus. (E) Lateral radiograph demonstrating measurement of the tibiocalcaneal angle, formed by the longitudinal axes of the tibia and calcaneus.



diagnostic accuracy is approximately 86%.^{1,6} Fetal MRI may be considered when additional skeletal abnormalities are suspected on US. Following delivery, physical examination confirms or excludes the diagnosis. Postural deformities related to intrauterine constraint should be

considered in the differential diagnosis, as these may mimic structural clubfoot on prenatal imaging but are typically reducible on postnatal examination.^{1,2}

Radiographs may be used to assess deformity severity and to evaluate correction during and after intervention.

Standard imaging includes anteroposterior and lateral weight-bearing or simulated weight-bearing views. On the anteroposterior view, the talocalcaneal angle is formed by the intersection of the longitudinal axes of the talus and calcaneus. On the lateral view, the talocalcaneal angle is measured using the same axes in the sagittal plane. The tibiocalcaneal angle, measured on the lateral view, is formed by the intersection of the longitudinal axis of the tibia and the longitudinal axis of the calcaneus (Figure 1).

Reported normal ranges are 15-55° for the anteroposterior talocalcaneal angle, 25-55° for the lateral talocalcaneal angle, and 25-60° for the tibiocalcaneal angle in maximum dorsiflexion.^{7,8} In clubfoot, the lateral talocalcaneal angle is typically decreased and the tibiocalcaneal angle increased, reflecting hindfoot varus and equinus.

The gold standard treatment for clubfoot is the Ponseti method of serial casting, with Achilles tenotomy required in up to 90% of cases.^{2,3,5} Early intervention prior to ambulation and continued bracing through early childhood are associated with improved outcomes. Treatment begins with correction of the cavus deformity by supinating the forefoot and applying pressure beneath the first metatarsal head. Hindfoot varus, forefoot adduction, and hindfoot equinus are then sequentially corrected over several casting sessions. Following tenotomy and application of a final long-leg cast, patients are transitioned to a foot abduction brace to reduce the risk of relapse.

Relapse is defined as the recurrence of any component of the deformity after treatment. It may be identified clinically or radiographically, with lateral radiographs helping assess persistent equinus or varus deformity.⁵⁻⁷ Although initial correction rates approach 92% in patients treated with the Ponseti method, relapse occurs in approximately one-third of patients, with reported long-term recurrence rates ranging from 3% to 62.5%.^{2,5,8} Greater initial deformity

severity and poor brace compliance are associated with increased relapse risk. Recurrent or residual deformity may result in overcorrection, undercorrection, bunion formation, ankle impingement, and degenerative changes, sometimes requiring additional intervention to preserve function and alleviate pain.⁹

Conclusion

Talipes equinovarus, or clubfoot, represents a spectrum of foot deformities characterized by hindfoot equinus and varus with forefoot adduction and supination. Most cases reflect congenital structural malalignment and are classified as idiopathic, syndromic, or neurogenic, while postural deformities are flexible and nonstructural. Prenatal diagnosis is typically established with US, and postnatal evaluation relies on clinical examination with selective use of radiographs. Weight-bearing or

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