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Review

Sonography as an objective tool for monitoring serial corrections and detecting spurious corrections in clubfoot: A review

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ABSTRACT

Ultrasonography is an emerging tool for monitoring clubfoot correction and for early diagnosis of spurious correction and of deformity recurrence. Sonography is widely available, inexpensive and has dynamic capability and can visualize tarsals in infants accurately.

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1. Introduction

Ponseti method for clubfoot manipulation, which in present decade is the gold standard for treatment of idiopathic clubfoot, is based on realignment of navicular over talus along with derotation of whole calcaneo-forefoot complex [6,9,14,15,19,23]. Monitoring of correction is usually clinical and so a need for objective evaluation and detecting spurious correction is there [10].

Clinical method for evaluation which is widely accepted and practiced is the Pirani scoring system [12]. In Pirani scoring system, the foot is divided in two parts, the mid and hind foot. Scores are given to each part, with each score ranging from 0 to 3. Curvature of the lateral border of the foot, depth of medial crease, and uncovering of the talar head laterally are the three signs related to the mid-foot deformity, whereas those related to the hind-foot deformity are emptiness of the heel, depth of posterior crease of ankle, and rigidity of the equinus (Table 1). The principle of method of scoring is that each of the six signs score from 0 to 1, in which

0: no abnormality
0.5: moderate abnormality
1: severe abnormality

Each foot is assigned a total score, the maximum being 6 points, with a higher score indicating a more severe deformity.

Radiography has its limitation because of the small, unossified, eccentrically, located ossific nuclei giving inaccurate measurement and is hazardous. The role of MRI [6,7,10,11,16,18,28] has been described but is too expansive and not good for serial evaluation [17,22,27].

Abbreviations: TN, talonavicular; MMN, medial malleolus navicular distance; NALm, medial navicular alignment; MSST, medial soft tissue thickness; CC, calcaneo cuboid distance; MS, mid foot score; HS, hind foot score.

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Table 1
Pirani scoring system.

Examination	Score of 0	Score of 0.5	Score of 1
Curvature of the lateral border of the foot	Straight	Mild distal curve	Curve at calcaneocuboid joint
Depth of medial crease	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Uncovering of the talar head laterally	Lateral talar head cannot be felt	Lateral talar head less palpable	Lateral talar head easily felt
Emptiness of the heel	Tuberosity of calcaneus easily palpable	Tuberosity of calcaneus more difficult to palpate	Tuberosity of calcaneus not palpable
Depth of posterior crease of ankle	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Rigidity of the equinus	Normal ankle dorsiflexion-n	Ankle dorsiflexes beyond neutral	Cannot dorsiflex ankle to neutral

Sonography can easily well visualize the cartilaginous bones in small feet more over it has dynamic capability, is easily available, inexpensive, non-invasive and does not require anaesthesia. Though ultrasound has been used in many studies to study clubfoot but these studies have no standard way to perform examination [2–5,8,10,12,13,20,21,24,25,26]. Very few studies are available at present which describe serial ultrasonic measurements for objectively documenting serial club foot correction and detecting any spurious correction. This article is an authors attempt to focus and stress the importance of various sonographical parameters used in these studies in objectively evaluating clubfoot correction.

2. Method

All sonographic measurements in all the studies reviewed were performed with ultrasound machine using 5–10 MHz linear transducer. Both feet were examined, even in patients with unilateral clubfoot. The examiner held the clubfoot in maximally corrected position with one hand and ultrasound probe by the other hand, occasionally with an assistant stabilizing the leg. Generally, the non-ossified cartilage gave a poor echo (black), whereas the ossification center of a bone showed a bright (white) echogenic focus within a cartilage matrix. Each foot was examined through three standard scanning projections (medial, lateral and dorsal), as described by Aurell et al. in all the studies [1–5]. The brief details of which are mentioned herewith.

Of these medial is most important because it provides information about the navicular realignment over the talus. The medial projection on ultrasound simulated as anteroposterior radiographs of the ankle. The talonavicular (TN) articulation was assessed by placing the transducer on medial side of the foot in a slightly oblique or vertical direction (i.e., almost in line with the tibia to match the degree of equinus in patients with severe deformity).

The medial malleolus navicular distance (MMN) (Fig. 1), is the shortest distance between the medial malleolus and the medial proximal part of the navicular. It represents the maximally abducted position and indicates the severity of deformity in the TN complex. Medial displacement of the navicular in relation to the head of the talus or medial navicular alignment (NALm) measured. The medial soft tissue thickness (MSST) is also measured and it represents the perpendicular distance from the skin surface to the medial border of the cartilaginous talus at the level of the talar ossification center.

In lateral projection, assessment of the calcaneocuboid articulation is performed by placing the transducer along the lateral border of the foot and parallel to its plantar aspect. The calcaneocuboid alignment is assessed by drawing a tangent along the lateral border of the calcaneus. The perpendicular distance from the tangent to the midpoint of the lateral cartilage border of the cuboid is measured and termed calcaneocuboid distance (CC) (Fig. 2).

The dorsal projection is obtained by placing the transducer on the dorsal aspect and placed more lateral than on a normal foot to follow the main direction of talus. The position of the navicular in relation to the talar head in the sagittal plane and maximum length of talus (Fig. 3) is estimated.

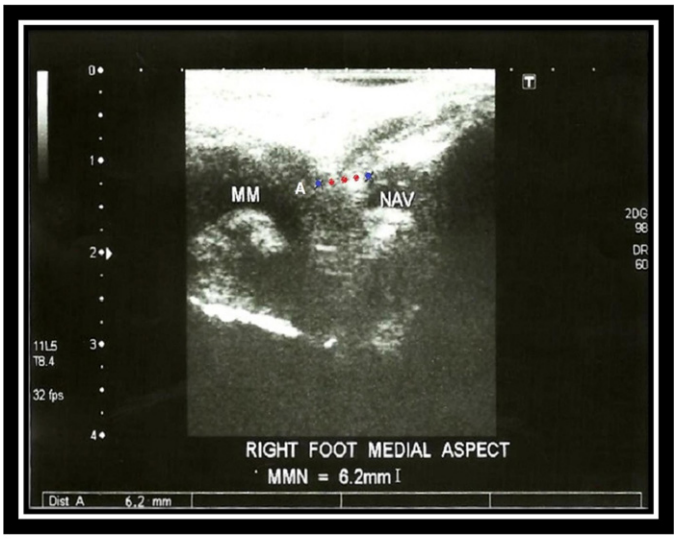

Fig. 1. Sonographical picture showing medial malleolus to navicular distance.

Bhargava et al. [7] besides these projections also evaluated the foot by the posterior projection by placing the transducer vertically on the back of foot in midline to assess the tibiocalcaneal relationship, posterior compartment soft tissue thickness and tendoachilles. According to their study it was helpful to evaluate

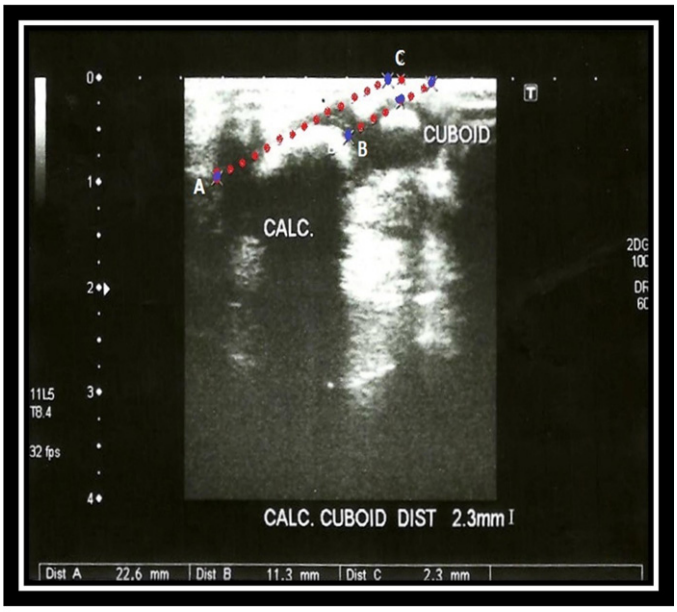

Fig. 2. Sonography showing calcaneocuboid distance.