Ultrasonographic evaluation of Achilles tendons in clubfeet before and after percutaneous tenotomy

Anil Agarwal,1 Nadeem Akhtar Qureshi,1 Pawan Kumar,2 Amit Garg,3 Neeraj Gupta1

1 Department of Orthopaedics, CNBC, Geeta Colony, Delhi, India
2 Department of Orthopaedics, ITBP Hospital, Delhi, India
3 Department of Radiology, CNBC, Geeta Colony, Delhi, India

ABSTRACT

Purpose. To measure the size of the Achilles tendons in congenital clubfeet using ultrasonography before and after percutaneous tenotomy.

Methods. 15 boys and 12 girls (39 feet) aged one to 11 (mean, 5) months with idiopathic clubfeet underwent percutaneous tenotomy (Ponseti method). The size of each Achilles tendon was measured ultrasonographically by a single radiologist before and after surgery. In patients with unilateral clubfoot, the normal foot was used as a referent. Longitudinal scans assessed the echotexture, echogenicity, and continuity of the tendon. Transverse scans assessed the shape, echotexture, echogenicity, thickness, and width of the tendon. The size of the Achilles tendon was estimated as an elliptical area using the formula: \( \pi \times \text{thickness} \times \text{width} / 4 \).

Results. Before tenotomy, homogenous, hyperechoic, and linear continuous shadows were noted in longitudinal scans of both the normal and affected Achilles tendons. In transverse scans, the tendons were elliptical, homogenous, and echogenic in appearance. Four weeks after tenotomy, the tendons appeared as heterogeneous, linear continuous shadows with regular margins irrespective of patient age. There was decreased echogenicity in the treated foot. The transverse section of the tendons was elliptical with a heterogeneous echotexture that was predominantly hypoechoic. There was no significant difference in normal, unilateral, and bilateral tendons before and after tenotomy.

Conclusion. The study reasserts functional continuity of the Achilles tendons 4 weeks after tenotomy using clinical and ultrasonographic methods.

Key words: Achilles tendon; clubfoot; ultrasonography

INTRODUCTION

Ultrasonography is reliable and reproducible in evaluating tendons following Achilles tenotomy (Ponseti method) for congenital clubfeet.1–3 It can be used for assessment of tendon regeneration, quantitative measurement of tendon thickness and
length of reparative tissue. We measured the size of the Achilles tendons in congenital clubfeet using ultrasonography before and after percutaneous tenotomy.

MATERIALS AND METHODS

Between June 2009 and December 2010, 15 boys and 12 girls (39 feet) aged one to 11 (mean, 5) months with idiopathic clubfeet underwent percutaneous tenotomy (Ponseti method). The size of each Achilles tendon was measured ultrasonographically by a single radiologist before and after surgery. Informed consent from the parents of each patient was obtained. Patients with arthrogrypotic, syndromic, and neurogenic clubfeet were excluded.

Patients were placed in a prone position and the feet were dorsiflexed to maximum to make the Achilles tendon taut. Coupling gel was applied as the medium for ultrasound waves between the probe and patient. Achilles tendons of both feet were scanned (longitudinally and transversely) approximately 1 cm above the calcaneal insertion. In patients with unilateral clubfoot, the normal foot was used as a referent. Longitudinal scans assessed the echotexture, echogenicity, and continuity of the tendon. Transverse scans assessed the shape, echotexture, echogenicity, thickness, and width of the tendon.

The medial aspect of the Achilles tendon was incised under general anaesthesia. The extent of tenotomy was assessed by a ‘pop’ sound and giving way, correction of equinus, and appearance of a palpable gap in the tendon. Postoperatively, a cast was applied for 3 weeks, with the foot in abduction and maximum dorsiflexion. The cast was then replaced with Steenbeek shoes. Four weeks after tenotomy, tendon continuity was assessed by palpating along the length of the tendon and stroking the foot while observing active plantar flexion at the ankle.

Tendon thickness and width of the affected foot was measured at the middle of the repair site. The size of the Achilles tendon was estimated as an elliptical area using the formula: \( \pi \times \text{thickness} \times \text{width}/4 \). Comparisons were made using the paired \( t \) test.

RESULTS

There was no major bleeding or complication during percutaneous tenotomy. All tenotomised tendons showed firmness at postoperative week 3. At week 4, all tendons were intact, and active plantar flexion at the ankle was present when the foot was stroked.

Before tenotomy, homogenous, hyperechoic, and linear continuous shadows were noted in longitudinal scans of both the normal and affected Achilles tendons (Fig. a). In transverse scans, the tendons were elliptical, homogenous, and echogenic in appearance (Fig. a). Four weeks after tenotomy, the tendons appeared as heterogeneous, linear continuous shadows with regular margins irrespective of patient age (Fig. b). There was decreased echogenicity in the

Figure (a) Before tenotomy, the longitudinal section of the right Achilles tendon appears as a longitudinal homogenous echogenic band in continuity. The bony landmark (calcaneum) gives a hyperechoic shadow. The transverse section shows a homogenous echogenic elliptical area (++xx). (b) After tenotomy, the tendon appears as a longitudinal continuous hypoechoic shadow. In the transverse section, the tendon appears as an elliptical, hypoechoic shadow with regular margins (++xx).
treated foot. The transverse section of the tendons was elliptical with a heterogeneous echotexture that was predominantly hypoechoic (Fig. b).

There was no significant difference in normal, unilateral, and bilateral tendons before and after tenotomy (Tables 1 and 2). The normal tendons did not differ significantly before and after tenotomy (p=0.86), indicating no intra-operator bias.

**DISCUSSION**

Ultrasonography is a non-invasive and dynamic tool for assessing prenatal clubfoot, severity of clubfoot, clubfoot correction using single or different methods, and Achilles tendon regeneration. It enables quantitative measurement and is readily available, relatively inexpensive, repeatable, and can be performed in an out-patient setting.

Adequate tendon regeneration is important following tenotomy of the Achilles tendon. Ultrasonography enables assessment of tendon regeneration and dimension and correlation of the 3 phases of tendon healing: inflammatory, proliferative, and remodelling. In a study involving 37 tenotomies in 26 patients (mean age, 17 weeks) with congenital clubfeet, the mean thickness of the affected Achilles tendons was 2.52 mm before tenotomy, 3.82 mm at week 3, 3.77 mm at week 6, and 4.03 mm at year 1. The mean length of the repaired tendons was 6.93 mm. At week 3, the tenotomised tendons appeared hypoechoic and disorganised. During months 6 to 12, they were thickened and showed near normal echogenicity and fibrillar texture. In our study, the area of the tendon was measured as an elliptic area; there was no difference in the area of normal, unilateral, and bilateral tendons before and after tenotomy. A near normal size, clinically intact tendon was shown as early as week 4, although qualitative analysis of the tendons was not performed.

A limitation of our study was heterogeneity of patient age (range, 1–11 months); the standard deviation of the patient age and tendon area was high, which differed from other studies with a mean patient age of <18 weeks.

**REFERENCES**

4. Tillett RL, Fisk NM, Murphy K, Hunt DM. Clinical outcome of congenital talipes equinovarus diagnosed antenatally by
74 A Agarwal et al. Journal of Orthopaedic Surgery