

Ultrasonographic Evaluation of Achilles Tendon Healing after Percutaneous Tenotomy for the Correction of Congenital Clubfoot by Ponseti Method

Saurabh Agarwal¹, Ashutosh Kumar¹

Abstract

The Study is attempt to establish the regulation of Achilis tendon after percoetaneous tenotomy in idiopathic clubfoot patient as per ponsenti method of correction clinically and evaluation by ultrasound .

The prospective study was conduct on 21 patients with idiopathic clubfoot deformity admitted in orthopaedic department of M.L.B. Medical College, Jhansi (UP) with reference to age and sex for the period from Aug 2014 to Aug 2016 babies with neurological condition, syndromic condition, recurrent and complex clubfoot case are excluded from the study. Detailed personal history was recorded including age, sex, father and mother name, address and number of cast applied etc.

A mean retraction of 2.26 mm (range 2.3 to 11.0 mm) between tendon stump after tenotomy was observe using ultrasound and in each foot clinical evidence of successful tenotomy was taken as a definitive increase in dorsiflexion at the ankle and lack of a palpabale heel cord. Full leg corrective cast was applied for 3 week after 3 week ultrasound showed tendon healing with the tendon gape filled with irregular hypoechoic tissue and along with transmission of muscle motion to the heel. At 6 month after tenotomy there was structural filling a fibrillar aspect, mild or moderate hypo. Echogenicity and tendon scar thickening when compared with a normal tendon. 1 year after tenotomy USG showed a fibrillar structure and echogenicity at the repair site that was similar to a normal tendon but with persistent tendon scaring thickness.

There is fast reparative process after Achilles tendon percutaneous section after reestablishing conducting between stumps. The reparative tissue evolved to tendon tissue with a normal USG appearance except for mild thickening suggesting a predominating intrinsic repair mechanism.

Keywords : Clubfoot, Achilles tendon healing, Ultrasonography

Introduction

Idiopathic congenital talipes equinovarus is a common condition affecting between 1 per 1,000 live births [1, 2, 3]. The Ponseti technique is well recognized in the management of clubfoot deformity with high success rates. This technique has decreased the need for extensive corrective surgery. Following the serial

application of casts as per Ponseti's original descriptions, a percutaneous Achilles tenotomy is undertaken to enable or improve foot dorsiflexion. The natural history of healing of the tenotomized tendon is not well understood. Several studies have claimed ultrasound to be useful and accurate in assessing the healing phase. In previous studies [4, 5], the reported length of time for tendons to achieve continuity based on ultrasound



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images and clinical assessment varied between 6 weeks to 45 months.

We monitored the post-tenotomy healing process using high-frequency ultrasound to understand the appearances of the healing tendon and the timescale over which the tenotomy healed. We also studied patients that had undergone an Achilles tenotomy several years previously to ascertain the longer-term effect of the Ponseti treatment.

Ponseti recommends the use of a beaver eye blade scalpel to divide the tendon. This procedure is considered safe although excessive bleeding and pseudoaneurysm formation have been reported [6].

We carried out percutaneous tenotomy to correct equinus in patients treated with the Ponseti technique, and found that after 6 months, all cases showed clinical and ultrasonographic connections between the divided stumps in <1 year of age.

Ultrasonography is reliable and reproducible in evaluating tendons following Achilles tenotomy (Ponseti method) for congenital clubfeet [1, 7]. 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

The aim of the present investigation was to prospectively assess and characterize the Achilles tendon healing using ultrasonographic scanning after percutaneous tenotomy in patients with congenital clubfoot treated with the Ponseti technique in the Department of Orthopaedics, MLB Medical College, Jhansi. Approval was obtained from our local ethical committee and informed consent from the parents of each patient was obtained.

Inclusion criteria

1. Children with idiopathic congenital clubfoot treated with the Ponseti method who have undergone percutaneous Achilles tenotomy to correct the residual equinus;
2. The primary and follow-up treatment have both been performed in our institution; and
3. Minimum follow-up of 1 year.

Exclusion criteria

1. Associated malformations
2. Syndromic cases
3. Neurologic sequelae or parental noncompliance.

Material used

Patients were placed in a prone position and the feet were dorsiflexed to maximum to make the Achilles tendon taut. Achilles tendons of both feet were scanned 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,



Figure 1: Soft cotton and plaster rolls.



Figure 2: Tenotomy kit - # 15 blades with handle, xylocaine, syringe.

echogenicity, thickness, and width of the tendon. The medial aspect of the Achilles tendon was incised under general anesthesia. 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 foot abduction braces. Ultrasound scan was done on 3rd week, 6 months, and 1 year followed tenotomy

Results

Between August 2014 and August 2016, 21 patients fulfilled the inclusion criteria, with 30 ft. Mean age at tenotomy was 16.7 weeks, ranging from 6.3 to 40.5 weeks. The mean thickness of the affected Achilles tendon before tenotomy was 2.52 mm, ranging from 1.70 to 4.20 mm. In patients with unilateral deformities, the normal tendon mean thickness in the non-affected foot was 2.50 mm (standard deviation = 0.43), ranging from 2.00 to 3.60 mm. There was no evidence of difference between normal and affected tendons in ultrasonographic appearance Fig. 3 and thickness before the tenotomy ($P = 0.45$).

Ultrasound performed immediately after tenotomy (Fig. 4) showed a hypoechoic area between stumps separated by a mean distance of 5.65 mm (range: 2.3-11.0 mm; initially the gap had a hyperechoic image with reverberating echotexture represented by air penetration, and immediately afterward, the image became hypoechoic due to the hematoma formation. However, the residual connections between stumps persisted in some cases, and these cases required division under ultrasound guidance.

There was one case of unusual bleeding, which was controlled by digital pressure, and this did not compromise foot perfusion or interfere with the treatment.

3 weeks after tenotomy (Fig. 5), the ultrasound scans showed that the tendinous gap was filled with hypoechoic, disorganized repair tissue, with a loss of the fibrillar architecture, ill-defined margins, and scarring with varied characteristics.

6 months after the tenotomy (Fig. 6), a well-formed tendinous structure could be observed, with a fibrillar appearance similar to

normal tendon, but with slight or moderate hypoechogenicity and focal tendon thickening at the tenotomy site.

Tendon tissue regeneration occurred with fibrillar pattern near normal echogenicity.

1 year after tenotomy (Fig. 7), focal tendon thickening persisted in the repaired area although the fibrillar pattern and echogenicity

Table 1: Ultrasonographic finding after percutaneous section of the achilles tendon over time

Stage	Ultrasound appearance (tendotomized area)
Pre-tenotomy	Hypertechoic, defined margins, and fibrillar texture
Immediately post-tenotomy	Hematoma, hypoechoic, and stump separation
Post-tenotomy at 3 week	Hypoechoic, disorganized appearance Ill-defined margins
Post-tenotomy at 6 week	Fibrillar texture, brand hypoechogenicity, defined margins, and thickening
Post-tenotomy at 1 year	Fibrillar texture, near-normal echogenicity, defined margins, and thickening

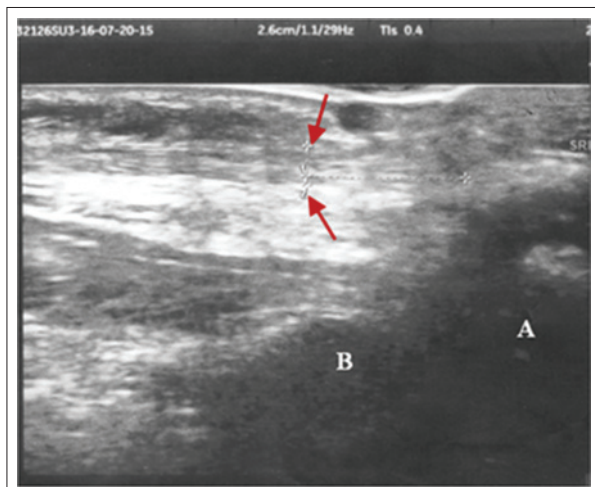


Figure 3: Ultrasound scan before tenotomy it shows homogeneously echoic fibrillar structures arrow. (A) Osseous portion of calcaneum, (B) Tibia.

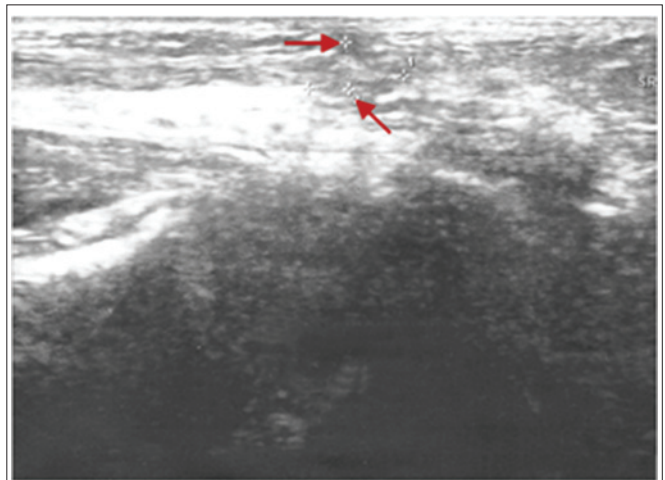


Figure 5: Achilles tendon longitudinal image 3 week after tenotomy. The tenotomy space is filled with hypoechoic tissue displaying disorganized fibrillar pattern.

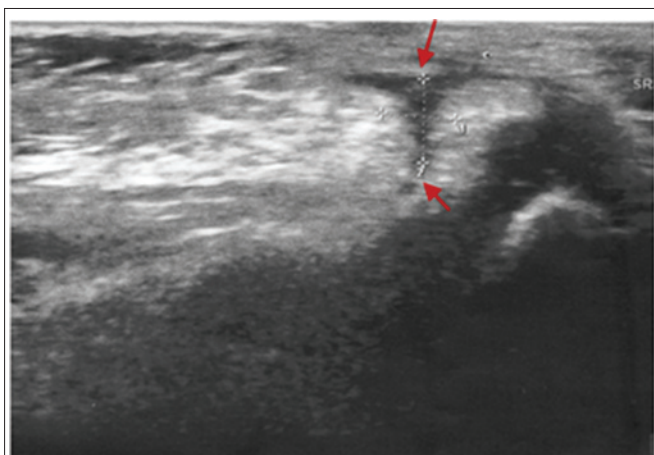


Figure 4: Achilles tendon longitudinal image just after tenotomy showing stump retraction is initially filled by air and soon replaced by hematoma.

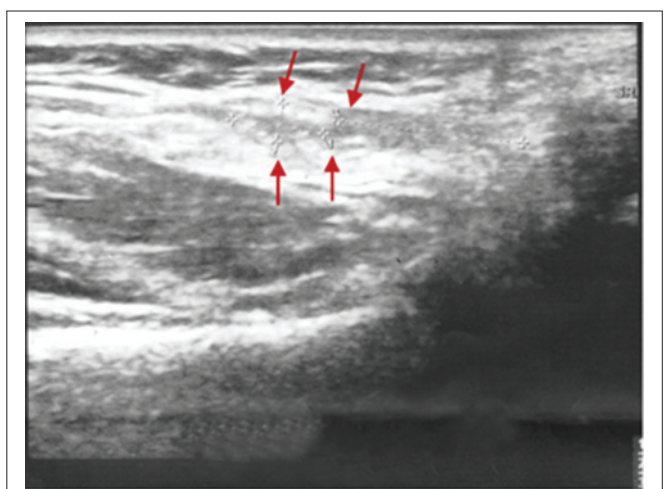
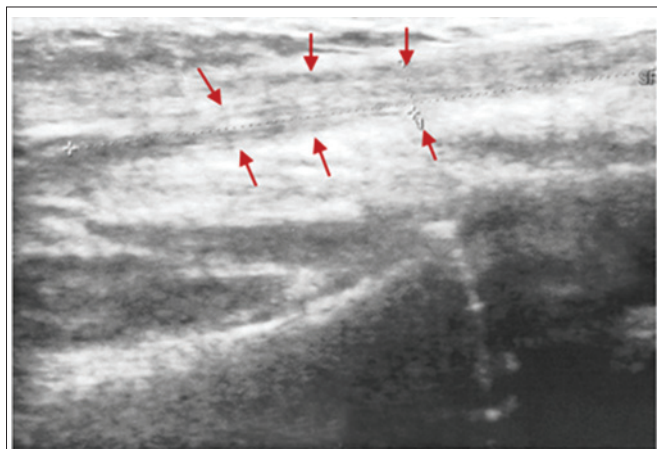


Figure 6: Achilles tendon longitudinal image 6 month after tenotomy.

Table 2: Final findings

Age	Number of patients	Number of tenotomy	Ultrasound variation of length of Achilles tendon (average in mm)				Healed at 6 month	Not healed at 6 months
			Pre tenotomy	Post tenotomy 3 weeks	Post tenotomy 6 months	Post tenotomy 1 year		
<3 months	12	17	2.48	3.82	3.86	4.03	17	0
3 months-1 year	7	9	2.52	3.88	3.92	4.06	7	2
>1 year	2	4	2.60	3.96	4.01	4.08	0	4

**Figure 7:** Achilles tendon longitudinal image 1 year after tenotomy.

were similar to those of normal tendons. The mean thickness in operated tendons at this time was 4.03 mm.

Echotexture similar to a normal tendon with slight thickening at the tenotomy site.

Discussion

Healing of the tendon has classically been described as involving extrinsic or intrinsic factors or a combination of the two. Recent studies [1, 4, 5, 2, 7, 8] has suggested that embryonic mechanism

may responsible for healing in the adult tendon. Thus, the rapid healing in infants aged one to 2 months in whom progenitor cell are abundant, could involve the same mechanism.

Ultrasound tendon examination is accepted as a reliable method for routine tendon assessment providing tendon measurement, morphology and texture, ultrasound scan of 6 months shows maturation of healing tissue evidenced by an increasingly normal echogenicity and a fibrillar aspect of the parallel linear echotexture leading to conclude as predominantly intrinsic mechanism is responsible for the formation of a normal or near normal tendon [1, 4, 5, 2, 7, 8].

Ultrasonography is a non-invasive and dynamic tool for assessing prenatal clubfoot, severity of clubfoot, correction using single and different methods and Achilles tendon regeneration. Ponseti recommended tenotomy in patients up to 1 year age although we extend this age limit for revision in resistant cases it is possible that the prolonged healing seen in children older than 1½ year of age a similar to that seen in adults in whom the gap in the Achilles heals with fibrous tissue rather than tendon fiber.

We conclude that healing in percutaneous Achilles tenotomy follows sequential phases similar to those described in healing of tendons in previous studies [7, 8]. We should be cautious about performing Achilles tenotomies for clubfeet in children over the age of 1½ year as such patients appear to have slower healing with an added potential risk of adhesion formation.

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