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A Prospective Study of Outcome of Percutaneous Needle Tenotomy for Tendo-achilles Release in Congenital Talipes Equino Varus

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ORIGINAL RESEARCH

ABSTRACT

Aim

To study the outcome of percutaneous tenotomy of tendo-achilles using a wide bore needle in Congenital Talipes Equino Varus.

Background

Congenital Talipes Equino Varus is a commonly seen complex congenital foot deformity that can be treated conservatively if the Ponseti technique is followed correctly. Percutaneous tenotomy of tendo-achilles forms an integral part of this technique.

Material Methods

Forty nine feet were prospectively studied in thirty two patients, treated with the Ponseti technique between July 2011 and June 2013, out of which forty feet (81.6%) required percutaneous needle tenotomy of tendo-achilles.

Results

Out of these forty feet, thirty six (90%) feet were managed successfully, without any complication of excessive bleeding, pseudo-aneurysm formation or neuro-vascular compromise, which were reported with the conventional tenotomy by a knife.

Conclusion

Percutaneous tenotomy of tendo-achilles with a needle is a easy to learn, safe and effective method of tenotomy in Ponseti technique.

Key Words

Congenital Talipes Equino Varus, Ponseti, Tendo-achilles, Tenotomy.

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INTRODUCTION

Congenital Talipes Equino Varus (CTEV) is a commonly seen complex congenital deformity of the foot, with an incidence of approximately 1 in 1000 live births. The deformity consists of four components: ankle equinus, hindfoot varus, forefoot adduction, and midfoot cavus. The aim of the treatment is to correct all the components of the deformity to achieve a painless, plantigrade, pliable, and cosmetically and functionally acceptable foot.[1-4]

Over the past two decades, Ponseti management has become accepted throughout the world as the most effective and least expensive treatment of clubfoot. This technique involves serial application of corrective plaster casts after manipulation along with a possible percutaneous tendo-achilles tenotomy. About 85% of the cases treated with the Ponseti technique require percutaneous sectioning of the tendo-achilles for correction of residual equinus deformity.[3-7]

The sectioning of the tendo-achilles is simple, effective and involves low risks. Originally, as described by Ponseti, tenotomy is performed using a tenotomy blade, such as a #11 or #15, or any other small blade, such as an ophthalmic knife. However, complications related to the procedure, such as excessive bleeding[8], formation of a pseudoaneurysm[9] and neurovascular injuries[10], were described. To avoid these rare but serious complications, many modifications such as mini-open tenotomy and needle tenotomy, have been developed according to the requirements of the surgeons and patients.

Use of wide bore needle to perform percutaneous tenotomy of tendo-achilles was first described by Minkowitz et al[11] and has been reported by few other authors[12-15]. Minkowitz et al[11] published a modification for the sectioning of tendo-achilles tendon, performing this procedure percutaneously with a large gauge hypodermic needle. This technique with needle may possibly have advantages when

compared to other tendon lengthening techniques, due to the minimally invasive approach, the simplicity and very low morbidity. Some surgeons perform these procedures in the operative room, thereby raising the cost and exposing the patients to the risk of anaesthesia, whereas the percutaneous needle tenotomy is performed in an outpatient setting, under local anaesthesia and without incising the skin, thereby minimizing complications.

The aim of our study is to present our experiences with percutaneous needle tenotomy for tendo-achilles release in congenital talipes equino-varus.

MATERIAL AND METHOD

This prospective study was performed in the Department of Orthopaedics, Gajra Raja Medical College and Jay Arogya Group of Hospitals, Gwalior (M.P.) from July 2011 to June 2013. All the children with CTEV presenting during this period were treated by the Ponseti casting technique. Only the cases with idiopathic CTEV were included in the present study. Children with other congenital deformities, syndromes or neurological causes of club feet were excluded. Children with incomplete follow up were also excluded from the study.

The study was approved by the Institutional Ethics Committee of Gajra Raja Medical College, Gwalior and the parents or guardians authorized the participation of their children or wards in the study with means of a well informed written consent form. All the relevant data from each case was recorded using a pre-designed data sheet that included patient's complete clinical profile and demographic data including age, sex, and bilaterality. The pre-tenotomy total number of cast applied, pre and post treatment complications like plaster sore, skin abrasions, blister formation, excessive bleeding after tenotomy or any other complication were also recorded. The severity of the foot deformity was classified according to the grading system of Dimeglio et al[16]. All clubfoot deformities were graded on initial assessment of severity and on evaluation of the feet at every change of cast and at ultimate final outcome.

Management Protocol

The Ponseti[4] technique with little modification in the technique of percutaneous tenotomy of the tendo-achilles was followed as the standard protocol. Treatment was started as soon as possible after referral, preferably shortly after birth, as soon as the skin condition permits Feet were gently manipulated prior to cast application and then placed in long leg toe-to-groin plaster casts with the knee flexed 90^0. The first cast was applied with the forefoot inverted and the first ray elevated to correct the cavus deformity. Subsequent casts were then applied while gently abducting the forefoot, navicular, and cuboid around the talus, allowing simultaneous correction of forefoot adduction as well as the hindfoot varus. Casts were applied at weekly intervals until the adductus and heel varus were corrected. The final cast was applied with the foot in 15^0 of dorsiflexion. The decision of performing percutaneous tenotomy of the tendo-achilles was taken if the foot could not be dorsiflexed to 15^0 prior to application of the final cast.

The percutaneous tenotomy of the tendo-achilles tendon was not performed with a knife, as originally described by Ponseti. Instead, the technique of tenotomy was modified a little, by use of a large wide bore hypodermic needle beveled tip. In a child less than 6 months of age at the time of tenotomy, tenotomy was performed by using a 18 gauge needle, whereas in a child more than 6 months of age, a 16 gauge needle was used. The procedure was performed in an outpatient setting, following the technique as recommended by Minkowitz et al[11].

The patient was placed in supine position, with the knee flexed to 90^0 and the hip abducted to allow access to the posterior portion of the leg and ankle. An assistant maintained the position of the limb. The foot was forced in dorsiflexion causing the tendo-achilles to become tense and easily palpable. With all the aseptic precautions, an appropriate size (16 or 18 gauge) sterile needle was inserted from the medial border of the tendo-achilles about 1 to 2 cm proximal to the insertion of tendo-achilles. The beveled tip of the needle was used as a blade, for sectioning the tendon through lateralization and elevation movements of the cutting end. The completion of tenotomy was perceived with a grating sensation and sudden increase of dorsiflexion, with visible correction of dorsiflexion.

Plaster cast immobilization was performed with the knee flexed 90^0 and the foot positioned in maximum dorsiflexion and abduction of $\sim 70^0$. The same procedure was then performed on the opposite foot, in cases with bilateral involvement. The patient was kept under observation for about an hour, with attention paid to general condition, neuron-vascular status of the limb and signs of bleeding. This cast was left in place for 3 weeks to allow healing of the tendon. To prevent relapse of the deformity, a Denis-Browne bar with shoes (D-B splint) was applied after cast removal. D-B splint was used full time (day and night) during the first 3 months for at least 23 hours each day and then for 2 to 4 hours a day and for 12 hours at night, a total of 14 to 16 hours per 24 hour period.

Follow up of the patients was done every week during the initial stages of treatment and then every month for 3 months after application of D-B splint. Later on follow up was done once every 3 months till the patients were 3 years of age.

The final outcome was measured by using Dimeglio et al[16] scoring system, according to which the following four parameters were measured:

1. Equinus in the sagittal plane.
2. Varus deviation in the frontal plane.
3. Derotation around the talus of the calcaneo-forefoot block.
4. Adduction of the forefoot on the hind foot in the horizontal plane.

The scale includes four additional points for the presence of medial crease, a posterior crease, cavus, and poor calf musculature. From the score, which has a maximum of 20 points, the deformity can be graded as mild (benign), moderate, severe and very severe (Table 1).

Table 1 The grading of idiopathic talipes equinovarus according to the Dimeglio et al[16] scoring system.

GradesType	Score	Reducibility
I Mild	0-5	>90 % soft-soft resolving
II Moderate	6-10	>50% soft stiff, reducible, partly resistant
III Severe	11-15	>50 % stiff-soft, resistant, partly reducible
IV Very Severe	16-20	> 10 % stiff-stiff, resistant

Detailed analysis of the collected data was done. The relationship between the number of casts required to correct the deformity and the respective Dimeglio scores was assessed using the Spearman's rank correlation coefficient with the level of significance set at p = 0.05.

RESULT

Between July 2011 and June 2013, thirty eight patients presented to us in the CTEV clinic. Out of them, thirty-three patients completed the inclusion criteria, with forty-nine feet {seventeen (51.5%) patients with unilateral involvement, sixteen (48.5%) patients with bilateral involvement}. Five patients were excluded from the study, as one patient had syndactyly, one polydactyly, one with urogenital anomaly, one with developmental dysplasia of hip and one with constriction band over both legs (Streeter Syndrome). Out of these thirty-three patients, there were twenty (60.6%) boys and thirteen (39.4%) girls with a female to male ratio of 1: 1.53. Out of the seventeen patients having only unilateral involvement, ten patients had right and seven patients had left sided involvement.

Out of total forty-nine feet, 40 (81.6%) feet required percutaneous tenotomy. Out of these forty feet, thirty six (90%) feet were managed successfully. Due to poor and faulty application of D-B splint and irregular follow up, four feet (10%) developed relapse of the deformity.

The mean age at start of treatment was 5.75 weeks, with standard deviation (SD) of 5.2 weeks and ranged from one day to 26 weeks (median of 4.29 weeks). The mean number of plaster changes required per feet was 5.8 with standard deviation (SD) of 1.71. The mean age at the time of tenotomy was 10.42 weeks, with standard deviation (SD) of 4.97 weeks and ranged from 5 to 22 weeks (Median of 9.28 weeks).

Five cases developed plaster cast complications, which were mild and managed successfully. Four cases had skin abrasions over the thigh, probably due to inadequate cast padding, and one case had plaster sore, probably due to tight cast. There were no cases of blister formation, excessive bleeding, psuedoaneurysm formation or neurovascular compromise.

The distribution of the initial grades, according to the Dimeglio system, is listed in Figure 1. Among the 4 feet that were rated as Dimeglio Grade IV at initial assessment, 100 % required a tenotomy. There were 20 feet in the Grade III group, of which 90 % required a tenotomy, a 27 feet in Grade II, of which 73.3 % required a tenotomy.

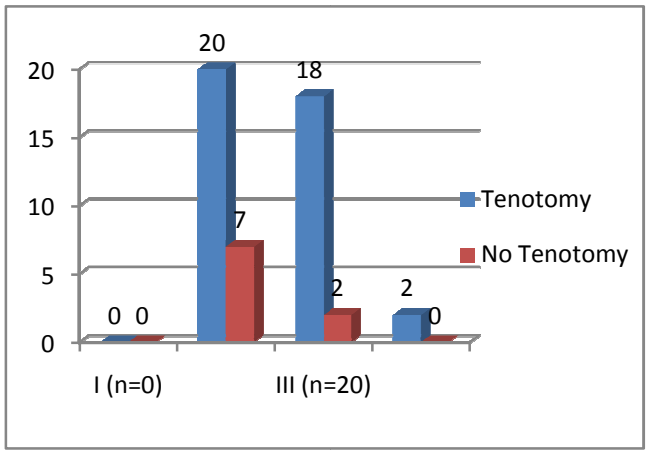

Figure 1. Dimeglio grade at initial evaluation

At the end of overall treatment (with or without tenotomy) i.e. following the final cast, the Dimeglio Grading was again recorded and is depicted in Figure 2, along with the percentages of each grade that required tenotomy.

Of the feet that had a tenotomy, 95 % were ultimately rated as Grade I and 5 % as Grade II (Figure 3).

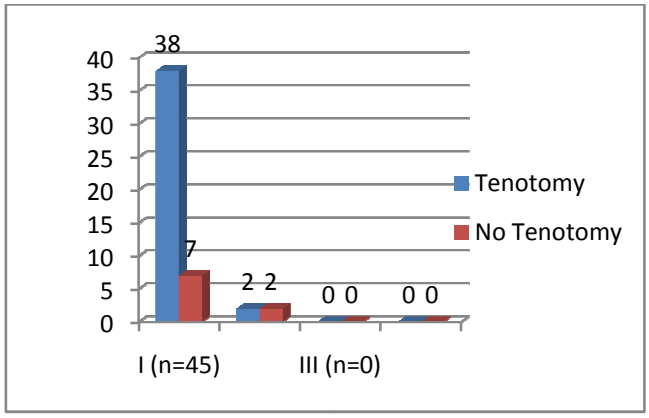

Figure 2. Dimeglio grade following last cast.

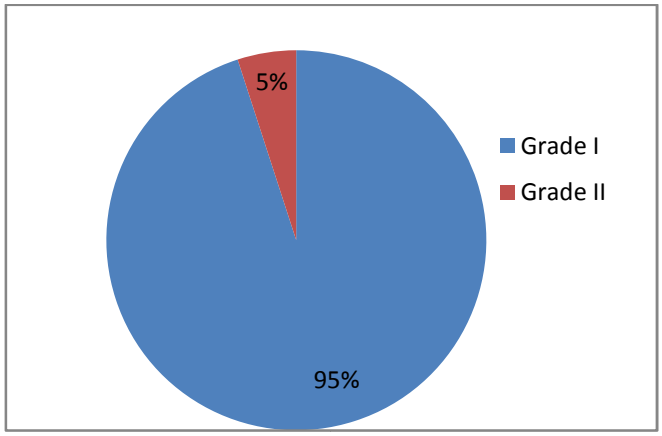

Figure 3. Tenotomy group - final Dimeglio grades

Of the feet that did not have a tenotomy, 77.7 % were ultimately rated as Grade I and 22.2 % as Grade II (Figure 4).

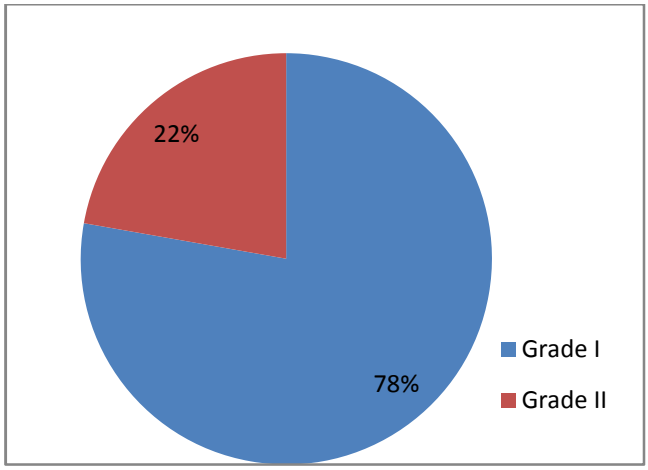

Figure 4. No Tenotomy group -final Dimeglio grades

On applying statistical analysis, Spearman's rank correlation coefficient was found to be highly significant and confirmed a positive correlation between the initial Dimeglio score and number of casts required to correct the deformity ($r=0.72$, $p < 0.0005$). In this study, mean follow up period was 7 months (range 2 months to 18 months).

DISCUSSION

Residual ankle equinus deformity in CTEV treated with the Ponseti technique has been receiving special attention, as it is resistant to manipulations and plaster cast changes. According to Ippolito and Ponseti[17], the retraction of the posterior ligaments of the hindfoot, along with the associated shortening of the triceps surae produces the equinus deformity, which makes its correction by manipulation difficult. Hence, tenotomy of the tendo-achilles is necessary in approximately 85% of patients with CTEV treated with Ponseti technique, in order to achieve a plantigrade foot.

The conventional technique of percutaneous tenotomy with a knife, as originally described by Ponseti, achieves good results, but is associated with complications, such as excessive bleeding[8], formation of a pseudoaneurysm[9] and neurovascular injuries[10]. In order to avoid such complications, Minkowitz et al[11] first described the use of wide bore needle to perform percutaneous tenotomy of tendo-achilles. This modification has been adopted by few other authors[12-15] with lesser complications and better results.

In our study, we followed the casting technique, as originally described by Ponseti. However, we performed the modified technique of tenotomy with a wide bore needle, as described by Minkowitz et al[11], as we consider this technique easy, simple, cost effective, and with fewer complication rates.

Efficacy of this modification has been evaluated in thirty three children in our present study. There were twenty boys and thirteen girls with a female to male ratio of 1: 1.53. Morcuende et al[18] reported a female to male ratio of 1:2.13 in their study, whereas Ponseti found the incidence to be six times higher among males[19].

In our present study, seventeen (51.5%) cases were unilateral and sixteen (48.5%) had bilateral involvement. Among the seventeen unilateral cases, ten had right sided and seven had left sided involvement. In Morcuende et al[18] study, 99 out of 157 (63.1%) had bilateral and 58 (36.9%) had unilateral deformity, whereas there were equal number of unilateral and bilateral cases in Lehman et al[20] series.

Percutaneous needle tenotomy was required in forty (81.6%) out of total forty-nine feet. Out of these forty feet, thirty six (90%) feet were managed successfully. Due to poor and faulty application of D-B splint and irregular follow up, four feet (10%) developed relapse of the deformity. The success rate for this method of treatment with percutaneous knife tenotomy has been reported to vary from 78% to 96.7%. We found this modified technique to yield good results similar to other's experiences.

In our present study, we did not encounter any complication of blister formation, excessive bleeding, psuedoaneurysm formation or neurovascular compromise. However, four cases of skin abrasions over the thigh, probably due to inadequate cast padding, and one case of plaster sore, probably due to tight cast, were encountered.

CONCLUSION

The modified technique of percutaneous tenotomy of the tendo-achilles with a wide bore needle is easy to learn, simple, least invasive, safe, cost effective, ideally can be performed without general anaesthesia at outpatient department and relatively free of complications.

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