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Original Article

Orthopaedics Section

Percutaneous Achilles Tenotomy with a Large Gauge Needle in Ponseti Management of CTEV: A Modified Technique

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ABSTRACT

Introduction: Tenotomy of Tendo-Achilles for clubfoot deformity is routinely done percutaneously with a surgical blade. This method though safe and effective, carries risk of complications such as excessive bleeding and injury to nearby neurovascular structures. Alternatively, sectioning of Achilles tendon can be done safely by a large gauge needle percutaneously.

Aim: To study the safety and effectiveness of modified technique.

Materials and Methods: A total of 37 children with 51 congenital clubfoot were included in this observational study. After successful correction of forefoot adduction and heel varus using the Ponseti technique, Tendo-Achilles was sectioned percutaneously with a 16/18 gauge needle. Any complication occurring during the procedure was noted. Completeness of the tenotomy was checked by Thompson's test and gain in passive dorsiflexion at ankle.

Results: Complete division of tendon was achieved in all 51 feet. No incidence of excessive bleeding, neurovascular injury or formation of pseudoaneurysm was found. However, minor bleeding from the surgical site was noticed in three cases and was managed by applying mild pressure over the involved area.

Conclusion: Percutaneous tenotomy of Tendo-Achilles with a wide gauge needle is simple, safe and effective technique. It causes less morbidity and carries lesser risk of complications when compared to a surgical blade.

Keywords: Clubfoot, Equinus, Tendo-Achilles

INTRODUCTION

Congenital Talipes Equino Varus (CTEV) is a common congenital anomaly with an incidence of one to three per 1000 live birth [1]. Ponseti's technique [2] has become the standard and most effective treatment modality for correction of CTEV in newborn [3,4]. It consists of weekly stretching plaster casts followed by percutaneous tenotomy of tendo-achilles. Achilles tenotomy is needed in 70-80% of cases after successful correction of forefoot adduction and heel varus [4-6]. Earlier, it was done by open method. This practice was later discontinued because of its invasiveness and high rate of complications. Today, as a part of Ponseti's method, it is done percutaneously with a surgical blade (no. 11 and 15 being most commonly used). It is a simple and safe technique. However, with the increasing popularity of this procedure, complications are being reported [7,8]. These usually consist of excessive bleeding, formation of pseudoaneurysm and neurovascular injuries. Several modifications of this technique which includes use of modified surgical blade designs [9] and even mini open methods [10,11] have been reported in an attempt to decrease these complications.

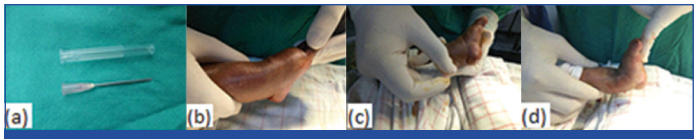
Percutaneous tenotomy with a needle was described earlier in literature to correct trigger finger deformity [12-15]. Minkowitz et al., first described the use of a large gauge hypodermic needle to section the tendo-achilles percutaneously as a modification of Ponseti method [9]. Thereafter, similar studies were published by different authors describing this modified technique [16-19]. When compared to other methods, this technique has the possible advantage of being less invasive, simple and causing lesser morbidity. However, being a new method, and very few publications in its support, this surgical technique needs further validation by more similar studies. We aim to report our experience with this method to correct residual equinus in CTEV after successfully correcting the forefoot and midfoot deformities.

MATERIALS AND METHODS

This observational study was conducted in the Department of Orthopaedics, Christian Medical College & Hospital, Ludhiana, between May 2015 to December 2016. A total of 51 untreated feet with idiopathic CTEV treated by modified method of Ponseti technique were included in the study. Only children below the age of two years were considered for this procedure. Other causes of CTEV like neurological, syndromic and post traumatic were excluded. Children more than two years of age were excluded. Neglected, resistant and relapsed varieties were also kept out of this study. An approval of the Ethics committee was taken and the procedures were in accordance of the standards mentioned in Helsinki declaration of 1975 and revised in 2000. Pirani score [20] was calculated at presentation for every foot included in the study. Correction was started with weekly stretching and plaster casts. Pirani score was then calculated at every follow up to monitor the deformity correction. This consists of six components and each can score 0, 0.5 or 1. Three components contribute to Midfoot Contracture Score (MCS) i.e., Medial crease, Curvature of lateral border and Position of head of Talus. Remaining three components make the Hindfoot Contracture Score (HCS) i.e., Posterior crease, Empty heel and Rigidity of equinus. After successful correction of forefoot adduction and heel varus as per the Pirani recommendation, the children were examined for presence of residual fixed equinus deformity. Those with MCS less than one and HCS more than one were considered for a percutaneous tenotomy of tendo-achilles. Parents were informed about the study and surgical technique used in this study. Only those ready, were included in the study after signing a written consent.

Surgical Technique [Table/Fig-1]:

All children were operated with aseptic precautions under short general anaesthesia by the same surgeon. The limb was cleaned



[Table/Fig-1]: a) 18 gauge needle used for tenotomy: b) Preoperative equinus deformity; c) Surgical technique; d) Deformity correction after tenotomy.

with 5% povidone iodine and draped without a tourniquet. Keeping the knee extended, the foot was dorsiflexed to make the tendo-achilles tight and was palpated as a tight cord posteriorly. A 16/18 gauge needle chosen to cut the tendon was introduced near the medial border of the tendon 1 cm above its insertion over the calcaneum. We preferred 18 gauge for children below 6 months whereas 16 gauge was preferred for those more than 6 months of age. The tendon was cut by the tip of the needle from medial to lateral direction. While doing so, grating sensation could be felt as fibers of the tendon are severed. The dorsiflexion force over the ankle was continuously maintained. The completion of tenotomy was marked by a snap and visible correction of equinus allowing atleast 10 degrees of dorsiflexion. Thompson's test was performed in every case to further confirm the completion of section. A complete tenotomy gives a negative Thompson's test due to absence of transmission of movements from calf to heel. A palpable gap between the two ends of tendon could also be felt. The needle was then removed and passive dorsiflexion rechecked. An above knee cast with knee in 90 degree flexion and foot in maximal abduction and 10 degree dorsiflexion was applied for three weeks. Thereafter, patients were followed on a monthly basis for a minimum of 6 months and then every three months.

RESULTS

The study was conducted on 51 feet with clubfoot deformity in 37 children from May 2015 to December 2016, who satisfied the inclusion criteria. There were 29 males and 8 females with male: female ratio of 3.6:1. Deformity was unilateral in 23 patients whereas in 14 patients, it was bilateral. Those with unilateral deformity, 18 had right and 5 had left sided involvement.

The mean age of patients at the start of treatment was 12.4 weeks (3 days to 16 months). Family history of CTEV was present in one (2.7%) child [Table/Fig-2]. Average Pirani score at the beginning of treatment was 4.75 (2 to 6). TA tenotomy was performed in all 51

Variables		Number	Frequency
Age	0-6 months	35	94.5%
	>6 months	02	5.4%
Gender	Male	29	78.4%
	Female	08	21.6%
Family history	Positive	01	2.7%
	Negative	36	97.3%
Unilateral	Right	18	48.6%
	Left	05	13.5%
Bilateral		14	37.8%
Average Pirani score at presentation		4.75	
Average number of casts before tenotomy.		5.26	
Minimum follow up		6 Months	

[Table/Fig-2]: Demographic profile of the study population.

feet for the correction of equinus deformity. The average number of cast required before the tenotomy was 5.26 (4 to 7) and the mean age at tenotomy was 16.42 weeks (5 weeks to 18 months). The average Pirani score after tenotomy was 0.07 (0-2). Mean follow up period after tenotomy was 6 months. Complete section of the tendon was achieved in all cases and none required an open procedure to complete the tenotomy. At the end of procedure, an increase in dorsiflexion was noted and equinus adequately corrected in all except one patient. This child had bilateral atypical clubfoot and had residual equinus even after complete section of the tendon on both sides. The residual deformity was corrected gradually with serial weekly cast. In one foot, control over the needle was lost intraoperatively causing section of the skin posterior and lateral to the tendon. The wound was sutured primarily and further management was uneventful. There was no incidence of excessive bleeding, pseudoaneurysm or neurovascular injury in any patient. However, three Patients experienced minor bleeding during the procedure which was controlled successfully by applying pressure over the skin puncture site. Five patients (9.8%) developed plaster related complications which were managed successfully. There was no incidence of local infection in any case [Table/Fig-3].

Complication	N (%)
Plaster related complications	5 (9.8%)
Bleeding (Minor)	3 (5.8%)
Pseudo aneurysms	None
Neurovascular injuries	None
Infection	None
Incomplete tenotomy	2 (3.9%)
Loss of control over needle	1 (1.9%)

[Table/Fig-3]: Procedure related complications.

Study/year	Number of feet	Needle used for tenotomy	Average Pirani score (pre/post op)	Average follow up	Complications
Minkowitz B et al., [9]	21	16/18 gauge	----------	----------	None
Daniel Augusto CM et al., [16]	57	16 gauge	----------	----------	Abnormal bleed - 2
Patwardhan S et al., [17]	600	16 gauge	----------	----------	Not mentioned
Rahman MS et al., [19]	70	19 gauge	4.9/0.75	4.5 months	Minor bleed – 2 Difficult procedure – 4 Incomplete correction – 3
Sirsikar A and Kiradiya N [18]	49	16/18 gauge	Used Dimeglio score	7 months	None
Choubey R and Jain A [33]	28	16 gauge	5.58/0.31	12 months	None
Present study	51	18 gauge	4.75/0.5	6 months	Minor bleed – 3 Incomplete correction – 2 Loss of control - 1

[Table/Fig-4]: Results of previous comparative studies.

DISCUSSION

Ponseti method of clubfoot treatment corrects all deformities effectively except the equinus. This residual equinus deformity does not improve with further manipulation and casting and requires tenotomy of the tendo-achilles. Ponseti used an ophthalmic scalpel blade for a percutaneous tenotomy. The long and sharp end of this blade has the potential risk of damaging the structures around the tendon especially, those lateral to it. Obviously, thicker the instrument used to perform tenotomy, more is the risk of damaging nearby structures. Since then, constant efforts have been made to find a safer and less invasive method of doing a tenotomy. Dobbs et al., used a shorter ophthalmic blade to minimize this risk [7]. In their study on 219 idiopathic clubfeet, they reported serious bleeding complications following the percutaneous tendo achilles tenotomy in four patients; three due to presumed injury to the peroneal artery and one due to injury to the lesser saphenous vein. Today, a no. 15 surgical blade is most commonly used for

the percutaneous tenotomy. However, Burghardt et al., reported a case of pseudoaneurysm following the use of even no. 15 blade [8]. Some authors have even suggested an open technique instead of percutaneous method to avoid these complications [7,10].

Many studies have reported vascular anatomical variations in the club foot [21-31]. Burghardt et al., described close proximity of the Achilles tendon with the posterior neurovascular bundle [8]. In addition, foot may have a single blood supply through the posterior tibial artery. Insufficiency of anterior tibial artery in clubfoot has been reported in many studies with an incidence up to 85% [7,21,29]. In such circumstances, posterior tibial artery remains the only source of blood supply for the foot and remains at risk during tenotomy. Insufficiency of posterior tibial artery has also been described in clubfoot [25,26,28,30,31]. In these uncommon cases, with deficiency of the blood supply through both anterior and posterior tibial arteries, the fibular artery becomes dominant and should be carefully protected in clubfoot release surgeries, as well as in Achilles tendon sectioning procedures. The injury to this single vascular supply during tenotomy may severely compromise the vascularity of foot leading to partial or complete necrosis of the foot and risk of amputation. Hence, a technique providing more safe precautions is needed to avoid these complications.

In the present study, 51 clubfeet in 37 children were corrected by Ponseti method using serial stretching casts on weekly basis followed by percutaneous sectioning of tendo-achilles. However, tenotomy was done with an 18 gauge needle as recommended by Minkowitz et al., [9]. The technique has already been used for percutaneous release of tendon in trigger finger and has been described to be successful and safe [12-15]. This technique has also been used to release muscle and tendon contracture in adult patients with brain damage [32]. Augusto et al., in their series of 57 feet, reported complication in only two patients in the form of minor bleeding [16]. In a similar study by Rahman et al., complication was seen in nine out of 70 feet [19]. These were in the form of minor bleeding in two, difficult procedure in four and incomplete correction in three feet. Sirsikar et al., used this technique in 49 clubfoot deformities and all were reported as uneventful [18]. Choubey et al., compared the two techniques of doing tenotomy (blade vs needle) and found no significant difference between the two [33]. They did not find any complication associated with percutaneous needle tenotomy technique and reported it as simple, effective and minimally invasive. We didn't find any incidence of excessive bleeding in any patient with this technique. No incidence of pseudoaneurysm was found in our follow up of 12 months after tenotomy. Post tenotomy infections has been reported in earlier studies [34,35]. In current study, no infection was reported in any of the patients in immediate postoperative period. The result of present and similar previous studies has been compared in [Table/Fig-4].

Another concern with the percutaneous tenotomy is the risk of incomplete division of the tendon leading to poor correction of equinus deformity and hence early recurrence. Augusto et al., suggested ultrasound guided tenotomy with a wide bore needle to ensure the completeness of this procedure [16]. In the present study, complete section of the tendon was achieved with good dorsiflexion of foot in all patients. However, in the current study, tenotomy was not done under ultrasound guidance and completeness of tenotomy was ensured only on the basis of clinical findings. Furthermore, this finding can also be surgeon dependent with more incidences of incomplete tenotomy by a less experienced surgeon.

LIMITATION

Our results are from a small patient population (51 feet) with a short follow up period. We recommend further studies in larger population with a longer follow up. In the present study, comparison between the needle and blade techniques was not done and a comparative study between the two techniques is suggested.

CONCLUSION

We consider the technique to be simple and safe with lower morbidity and equally effective as compared to other methods of tenotomy. The method is less invasive and can be done as a day care surgery under local anaesthesia. With the inherent advantages, we recommend this modified technique of tendo-achilles tenotomy for treatment of idiopathic club foot deformity in younger children. With global clubfoot initiative, more and more paramedical staff is being involved in the management of clubfoot. This technique being safe and easier to learn will be useful in these initiatives too.

Conflict of interest: We declare that none of us or any member of our immediate family has any commercial association (e.g., Consultancies, stock ownership, equity interest, patent/licensing arrangements etc.,) that might pose a conflict of interest in connection with the submitted article. Also, no benefits in any form have been received or will be received from any commercial party related directly or indirectly to the subject of this article.

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