Role of percutaneous abductor hallucis tenotomy in treatment of relapsed adduction in clubfoot

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Background
The Ponseti technique of clubfoot has gained popularity for initial correction. However, it can be used for relapses and neglected clubfoot. The effect of abductor hallucis tendon (AHT) release on residual adductus deformity in the surgical treatment of congenital clubfoot had gained good respect.
Revision surgery should address a specific problem or deformity that has become unacceptably symptomatic and is producing functional problems and pain. The aim of this study was to analyze the effect of AHT release on relapsed adductus deformity in clubfoot.
Materials and methods
This multicenter prospective study analyzed the data of 25 patients (30 feet) with relapsed adduction between March 2017 and November 2018. The mean age was 10.3 years (range: 3–36 months). All cases were treated with percutaneous AH tenotomy with or without tendo-Achilles tenotomy.
There were 17 male and eight females. Inclusion criteria were children who had been treated with conventional Ponseti technique and had complete correction of their deformity at the initial treatment. Neurogenic feet, atypical clubfoot, and syndromic deformities were excluded from this study.
Results
All cases were fully corrected after cast removal (4 weeks). A total of two (6.6%) cases (2 feet) had recurrence of adduction after 3 months, detected during the follow-up period (Table 2). According to Pirani score, all cases were improved, except for two cases that needed further intervention.
It was found that both sex and the side affected had no statistical significance effect on the end result. The age was an important factor affecting the results as the cases relapsed were above 2 years. The relationship between bilaterality or unilaterality in relation to final result was statistically insignificant.
Conclusion
Treatment of relapsed adduction component of clubfoot by AHT release is successful. The younger the age of the patient at beginning of treatment, the better were the results. Regular follow-up and cooperative parents are very important to prevent recurrence. AHT shortens the duration of casts required to correct forefoot adduction.

Keywords:
abductor hallucis, clubfoot, relapse

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Introduction

A relapsed clubfoot is defined as recurrence of any component of deformity after a complete correction of clubfoot [1,2]. Regardless of the mode of treatment, the clubfoot has an inherent and stubborn tendency to relapse [1]. Although the Ponseti method has now been established as the treatment of choice for idiopathic clubfoot, even this method has not solved the problem of relapse completely. Relapse following the Ponseti method is very common and has been reported even up to rates of 56% by various authors [3,4]. Not only the etiology of relapsed clubfoot is elusive, the satisfactory treatment of such feet is still obscure. Various methods ranging from recasting to soft-tissue releases and bony osteotomies to external fixators have been described in isolation or combination. None of the methods dealing with relapses are universally acceptable, and each has its own drawbacks [4].

The Ponseti technique of clubfoot has gained popularity for initial correction. However, it can be used for relapses and neglected clubfoot. The effect of abductor hallucis tendon (AHT) release on residual adductus deformity in the surgical treatment of congenital clubfoot had gained good respect [4].

Table 1 Preoperative patient data

No.	Age	Sex	Pirani score	Foot involved	Deformity pattern
1	30 months	Male	3	Right	Adduction
2	36 months	Male	3	Left	Adduction
3	7 months	Female	1	Left	Adduction
4	6 months	Female	1	Right	Adduction
5	8 months	Female	1	Right	Adduction
6	24 months	Female	2	Right	Adduction
7	24 months	Male	1	Right	Adduction
8	7 months	Male	1	Left	Adduction
9	4 months	Male	1.5	Left	Equines adduction
10	6 months	Female	1.5	Left	Equinus adduction
11	12 months	Male	1	Right	Adduction
12	8 months	Male	1	Right	Adduction
13	8 months	Male	1	Right	Adduction
14	7 months	Male	1.5	Both	Adduction
15	3 months	Female	3	Both	Equines adduction
16	6 months	Male	1	Right	Adduction
17	6 months	Male	1	Left	Adduction
18	7 months	Male	1	Right	Adduction
19	4 months	Male	1	Right	Adduction
20	7 months	Female	1	Both	Adduction
21	3 months	Female	3	Left	Equines adduction
22	3 months	Male	1	Both	Adduction
23	5 months	Male	1	Left	Adduction
24	12 months	Male	1	Both	Adduction
25	14 months	Male	2	Right	Equines adduction

Revision surgery should address a specific problem or deformity that has become unacceptably symptomatic and is producing functional problems and pain. Functional problems include poor foot position (such as supination/inversion) or an excessive internal foot progression angle (producing painful lateral ray weight bearing). Revision surgery has a greater likelihood of success if a single problem can be identified and addressed rather than simply taking the patient to the operating room for the nebulous 'repeat clubfoot release' [5].

Five relapse patterns were identified: grade IA, decrease in ankle dorsiflexion from 15° neutral with the knee in extension with passive stretch; grade IB, dynamic supination or adduction; grade IIA, fixed ankle equinus of any degree; grade II B, fixed adduction, which is not correctable by passive abduction of foot; and grade III, combination of fixed hind foot equinus plus forefoot adduction and cavus or complete rigid equinocavovarus foot [6]

The aim of this study was to analyze the effect of AHT release on relapsed adductus deformity in clubfoot.

Materials and methods

This multicenter prospective study analyzed the data of 25 patients (35 feet) with relapsed adduction between March 2017 and November 2018. This prospective study was conducted after approval of the Ethics Committee of the University Hospital. The mean age was 10.3 months (range: 3–36 months).

There were 17 males and eight females (Table 1). Inclusion criteria were children who had been treated with conventional Ponseti technique and had complete correction of their deformity at the initial treatment. Neurogenic feet, atypical clubfoot, and syndromic deformities were excluded from this study.

Pirani score was used to assess all cases [7].

The Pirani Score key features are as follows [3]: six 'signs' are assessed, and the scores depend on severity – 0, 0.5, or 1. Overall, three signs in midfoot and three signs in hindfoot are assessed. Total score varies from 0 to 6 and is the sum of midfoot and hindfoot contracture scores.

Midfoot

(1) Medial crease (MC).
(2) Curved lateral border (CLB).
(3) Lateral head of talus (LHT).

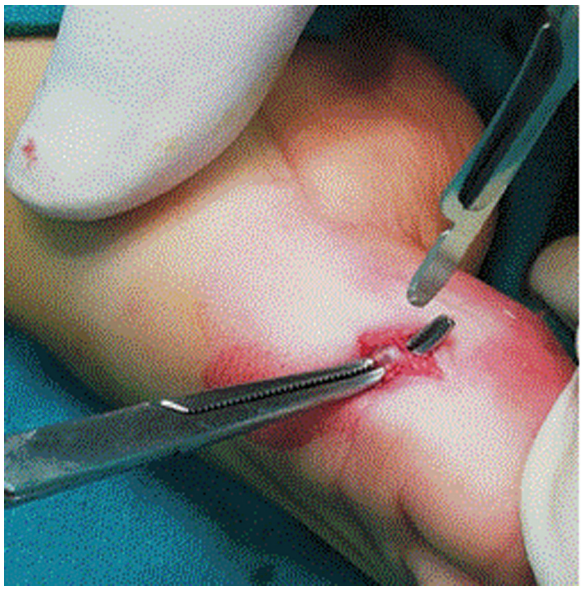
Hindfoot

(1) Posterior crease (PC).

Figure 1

Photograph showing incision site

Figure 2



Photograph showing abductor hallucis tendon

(2) Empty heel (EH).
(3) Rigid equines (RE).

In this study, all cases were admitted as a day-case surgery. A small incision was done opposite to the head of the first metatarsal medially (just distal to first metatarsophalangeal joint) (Fig. 1). Right angle artery was used to explore and hooks the tendon, (Fig. 2) followed by complete tenotomy. Closure was done by a single simple vicryl 2–0 suture.

Five cases had equines (short tendo-Achilles), and percutaneous tendo-Achilles tenotomy was done with AH release.

Postoperative protocol

All patients had above-knee cast with foot in 60° external rotation and full dorsiflexion in the operated limb(s) for 4 weeks (Fig. 3). Patients were seen on the next day for foot edema and then revisited after 2 weeks for integrity of the cast and foot position. Cast was removed after 2 weeks. Children must wear ankle foot orthosis to avoid tendency of recurrence for 3 months all day, and then another 6 months 12 h a day. We followed all patients every 3 months up to 18 months.

Figure 3

Photograph showing postoperative cast

Results

A total of 25 cases were in included in the study (35 feet), comprising 16 male and nine female. The 25 cases (35 feet) had single relapsed adduction deformity of the forefoot (the lateral border of the foot was curved, the heel was in neutral position, and ankle position varied from neutral to varying degrees of dorsiflexion). Overall, five cases had bilateral deformity and 20 cases had unilateral. A total of five children had both equines at the ankle and foot adduction with heel neutral. The mean age at presentation was 10.3 months.

Follow-up period was 18 months with 3 months interval period between each follow-up visit. Follow-up was based on clinical evaluation of the fore foot assessed using Pirani score after surgery. Only one case was in need for change of cast on the second week, as the cast was loose; otherwise, no complication was detected (wound infection or edema).

All cases were fully corrected after cast removal (4 weeks). Only two (8%) cases (2 feet) had recurrence

Table 2 Patients' demographics

Case	Age	Sex	Piranis	Foot involved	Deformity pattern
1	30 months	Male	1	Right	adduction
2	36 months	Male	1	Left	adduction
3	7 months	Female	0	Left	No
4	6 months	Female	0	Right	No
5	8 months	Female	0	Right	No
6	20 months	Female	0	Right	No
7	18 months	Male	0	Right	No
8	7 months	Male	0	Left	No
9	4 months	Male	0	Left	No
10	6 months	Female	0	Left	No
11	12 months	Male	0	Right	No
12	8 months	Male	0	Right	No
13	8 months	Male	0	Right	No
14	7 months	Male	0	Both	No
15	3 months	Female	0	Both	No
16	6 months	Male	0	Right	No
17	6 months	Male	0	Left	No
18	7 months	Male	0	Right	No
19	4 months	Male	0	Right	No
20	7 months	Female	0	Both	No
21	3 months	Female	0	Left	No
22	3 months	Male	0	Both	No
23	5 months	Male	0	Left	No
24	6 months	Male	0	Both	No
25	14 months	Male	0	Right	No

of adduction after 3 months, which were detected during the follow-up period (Table 2).

According to Pirani score, all cases were improved, except two cases needed further intervention.

It was found that both sex and the side affected had no significance effect on the final end result. The age was important factor affecting the results, as the cases relapsed were above 2 years. The relationship between bilaterally or unilaterality in relation to final result was statistically insignificant.

Discussion

With a large number of clubfoot cases, there is an obvious load of relapse cases. Long-term studies of surgical procedures have shown poor results with complications like painful feet, arthritis, stiffness of the ankle and subtalar joint, and residual deformity [8,9]. Relapses after soft-tissue releases and osteotomies are further difficult to treat as they result in rigid foot owing to extensive scarring after surgery [10]. The Ponseti method is essentially a conservative method that has shown more than 90% successful long-term results in idiopathic clubfoot [11,12].

Bhaskar and Patni suggested a classification for relapse. They used various surgical procedures, including AH release, posterior release, and osteotomies. Their study shows dynamic forefoot adduction or supination that manifests as intoeing (grade IB), which is the most common type of relapse pattern seen with the Ponseti technique and was seen in 24 children. The heel usually stays in the neutral position or there is flexible hind foot varus. The role of AH in causing adduction deformity and intoeing has received scant attention. AH tenotomy is done during TATT surgery to prevent recurrence. Six cases have undergone this procedure, and we continue to monitor these children. In 24 children, the dynamic intoeing improved after introduction of full-time bracing (22 h/day for 3 months) [6].

Utukuri *et al*. [13] studied patient-based outcomes after Ilizarov surgery in 26 resistant clubfeet (all had previously undergone surgery). Mean age was nine years, with a mean follow-up of 47 months. The total time taken was around 23 weeks. They noted a 65% recurrence rate. They described better functional results despite a poor surgical outcome. All Ilizarov procedures require at least two general anesthesia procedures in each case (adding further to cost of frame).

A painless plantigrade foot was obtained in 33 feet, after cast removal (4 weeks). Only two cases (2 feet) had recurrence of adduction, which were detected during the follow-up period. Children and parents were satisfied with the final results as they were able to wear normal footwear and carry out most of the functions. The results of this technique are better

than surgical and fixator techniques, in terms of very few complications; less management time taken; no capsular release needed, no surgical contracted scar, or osseous procedures needed; with supple feet.

Mahan *et al*. [14] also reported higher recurrence rate at age less than two years. A higher re-relapse rate should be anticipated in a longer follow-up, but these rerelapses after Ponseti treatment are less stiff and can be managed again with the Ponseti protocol. Moreover, prophylactic TATT can be considered in children above 3 years of age. However, further study would be required to validate its role. In this study, there was lower rate of recurrence, with only two case that needed further intervention.

There are a few limitations to this study. A larger study group and longer follow-up from multiple centers are desirable to validate the results of percutaneous AHT in relapsed forefoot adduction.

A total of 25 children with 35 clubfeet included in this study underwent first treatment elsewhere. Final outcome assessment based on functional scoring was detected and shows excellent results.

Conclusion

Treatment of relapsed clubfoot with the Ponseti method combined with AHT release is successful. The younger the age of the patient at beginning of treatment, the better were the results. Regular follow-up and cooperative parents are very important to prevent recurrence. AHT shortens the duration of casts required to correct forefoot adduction and decrease the cost and the risk of leg and foot muscle atrophy.

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Conflicts of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. ICMJE forms for all authors are available online.

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