Modified Ponseti manipulation and casting technique for treatment of atypical clubfoot.

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Abstract

Background: Congenital talipes equinovarus (CTEV) or clubfoot is a common and challenging musculoskeletal deformity. Clubfoot is a three-dimensional deformity in adduction, equinus, and supination. Treatment of clubfoot remains as controversial as its etiology. After many years during which surgical methods were used as the treatment of choice, conservative methods like the Ponseti technique have again become popular.

Aim: This work aims to evaluate the efficacy of the modified Ponseti technique in the management of atypical clubfeet in patients aged two years old or younger.

Patients and Methods: The present study is a clinical case series study. The present study included 19 patients. They comprised 14 boys and 5 girls (28 feet) with 9 patients (47.4 %) having bilateral affection. Patients were recruited if they were 2-year old or younger and had atypical clubfoot according to Ponseti criteria including severe equinus and supination, hyperextension, and pronation of the big toe, short and stubby foot, with the adducted metatarsals in plantar flexion and deep creases across the sole and above the heel. Patients who had accompanying congenital anomalies or peripheral vascular disease and those who received any form of surgical treatment for clubfoot or other lower limb abnormalities were excluded from the study.

Before the intervention, all patients were clinically and radiologically assessed. Pirani severity scoring system was used to evaluate our patient's feet.

Results: There was a significant improvement of Pirani score after at the end of manipulation and at the end of follow up when compared with its levels at the start of the study.

At the last follow up, all feet were well corrected with mean ankle dorsiflexion of 15° (range, 10°–20°). There was a minimal cavus deformity in two patients, which was passively corrected.

Conclusions: 100% of our patients with the modified Ponseti method achieved full correction according to the Pirani score, so we recommend doing all those modifications in the management of atypical clubfoot.

Keywords: Atypical clubfoot, Ponsetti technique, Pirani severity scoring system.

Introduction

Atypical clubfeet or complex idiopathic clubfeet are defined by Ponseti as "having rigid equinus, severe plantar flexion of all metatarsals, a deep crease above the heel, a transverse crease in the sole, and a short hyperextended first toe." [(1)] While typical idiopathic clubfeet respond well to the standard method of Ponseti casting and generally correct after 4-6 casts, atypical clubfeet are resistant to correction and standard manipulation and casting may lead to worsened deformity. Turco noted that these feet respond differently to operative and nonoperative treatment and warned that early surgery can result in a grotesquely deformed foot[(1)]. Arthrogrypotic, syndromic, and neuromuscular clubfeet are excluded from the definition of atypical or complex idiopathic clubfeet.

However, some cases of clubfeet do not respond appropriately to the standard Ponseti technique. These atypical cases are characterized by short and cylindrical foot "the short fat foot", often flexed the first metatarsal with the hyperextended big toe, more posteriorly than medially tight foot giving it marked equinus but not so much varus shape, deep transverse crease across the middle of the sole because the foot is flexed across the middle "plantaris deformity" and curved tibia. Using the standard Ponseti technique in the treatment of atypical clubfoot has led to unacceptable results with difficult correction and frequent recurrences; hence, modifications of the Ponseti are suggested to improve results[(2)].

This work aims to evaluate the efficacy of the modified Ponseti technique in the treatment of idiopathic atypical clubfeet in patients aged two years old or younger.

Patients and Methods

The present study was conducted at the Orthopedic Department, El Sahel Teaching Hospital, within a period between August 2017 to September 2018. The mean age at presentation was 10 weeks (2-40 weeks). All patients were followed up for at least 6 months from the time they started brace wearing (6- 10 months) with a mean period of 7.5 months. The study protocol was approved the local ethical committee and

informed consent was obtained from the legal guardians of the included children.

Inclusion criteria were Patients age were 2-year old or younger and had atypical clubfoot according to Ponseti criteria, while exclusion criteria were patients who had accompanying congenital anomalies or peripheral vascular disease and those who received any form of surgical treatment for clubfoot or other lower limb abnormality.

All patients were clinically and radiologically assessed. Pirani severity scoring system was used to evaluate our patients' feet (table 1). Its six clinical signs were recorded before starting treatment and after finishing manipulation. The score can comprehensively inspect all components of the clubfoot deformity in both hind and midfoot. Each of the clinical signs was scored as 0, 0.5, or 1 according to the severity of the deformity, considering 1 is the most severe[(3)].

Table 1: Pirani scoring

Parameters in midfoot	Normal	Moderate	Severe
Curved lateral border	0	0.5	1
Medial crease	0	0.5	1
Talar head coverage	0	0.5	1
Parameters in hind foot		0.5	1
Posterior crease	0	0.5	1
Rigid equinus	0	0.5	1
Empty heel	0	0.5	1

Procedural technique

Start with manipulation and casting. Be aware that treatment will be prolonged, casting interval 2 weeks, and the risk of relapse is increased.

Manipulation:

Carefully identify the talar head laterally. It is not as prominent as the anterior process of the calcaneus. When manipulating, the index finger should rest over the posterior aspect of the lateral malleolus while the thumb of the same hand applies counter pressure over the lateral aspect of the talar head. Do not abduct more than 30 degrees. After 30 degrees abduction is achieved, change the emphasis to the correction of the cavus and equinus. All metatarsals are extended simultaneously with both thumbs by applying pressure on the 1st and 5th rays. Figure 1

Figure 1. A photograph shows a modification of the manipulation technique for treatment of complex clubfoot. All metatarsals are extended simultaneously with both thumbs while the forefoot is mildly abducted. The heel also is dorsiflexed and slightly abducted.

Casting:

Always apply casts with the above-knee portion in 110 degrees flexion to prevent slippage. Up to 6–8 casts can be needed to correct deformity. Figure 2

Figure 2: Final shape of casting

Tenotomy:

A tendon achilles tenotomy was done in all cases. At least 10 degrees dorsiflexion is necessary. Sometimes changing casts at weekly intervals after the tenotomy to gain more dorsiflexion, if sufficient dorsiflexion is not achieved immediately after the tenotomy.

Bracing:

We used a locally manufactured version of Markell splint. It was applied immediately after the last cast was removed. This brace consists of open toe high-top straight last shoes attached to a bar. For unilateral cases, the brace was set at 60 to 70° of external rotation on the clubfoot side and 30 to 40 ° of external rotation on the normal side. In bilateral cases, it was set at 60 to 70° of external rotation on each side. The bar was of sufficient length so that the heels of the shoes were at shoulder width. The bar was bent 5 to 10 ° with the convexity away from the child to hold the feet in dorsiflexion.

The brace was worn full time (except bathing = 23 hours a day) for the first 3 months after the last cast was removed. After that, the child wore the brace for 12 hours at night and 2 to 4 hours in the middle of the day for a total of 14 to 16 hours of the 24 hours. This protocol continues until the child was 3 to 4 years of age.

Follow up

We asked the parents to attend the follow-up clinic at one, six, and twelve weeks after wearing the brace. Then, we followed up their feet every 3 months till the last recorded follow up period. Figure 3

Figure 3 a: female patient called (M.A), 3 weeks old, RT side casting 5 times before the treatment. **b**: 10 months after the treatment.

Results

The present study included 19 patients. They comprised 14 boys and 5 girls (28 feet) with 9 patients (47.4 %) having bilateral affection. The median (range) age of the studied patients was 5.0 (2.0 - 40.0) weeks. The median time passed between diagnosis and treatment was 1 (0.0 – 3.0) weeks. Other clinical and procedural data were reported in table-2.

Patients required an average of 5.6 casts for full correction (5- 9) excluding relapses. Percutaneous Achilles tenotomy was done for all patients due to persistent equinus deformity after the correction of forefoot adduction and heel varus.

There was a significant improvement of Pirani score after at the end of manipulation [median (range): 2.0 (2.0-2.5)] and at the end of follow up [median (range: 0.0 (0.0-0.5)] when compared with its levels at the start of the study [median (range): 6.0 (6.0 – 6.0)] ($p<0.001$) Figure (4).

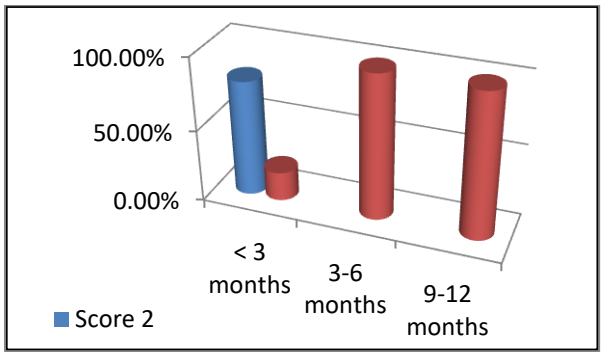

Figure (4): Age groups and final Pirani scoring

At the last follow up, all feet were well corrected with mean ankle dorsiflexion of 15° (range, 10°–20°). There was a minimal cavus deformity in two patients, which was passively corrected.

Four patients (21%) had complications including erythema, slight swelling of the forefoot and toes, mild rocker-bottom deformity, midfoot hyperabduction, or repeated downward cast slippage. Patient no. 5 developed a plaster sore over the talar head after the third cast. Mostly, it happened due to constant pressure over the talar head during casting. We stopped serial casting till ulcer was completely healed and manipulation was done very gently afterward, that is why he needed 9 casts to achieve full correction. No infections or profuse bleeding were observed after the tenotomy.

Table (2): Demographic & clinical data

No.	Name	No. Of casts	Time interval Between diagnosis and treat. (Weeks)	Pirani score at the beginning	Pirani score at end of manipulation.	No. Of tenotomies	Ankle passive DF range	Follow up (Months)	Pirani score after the cast done after tenotomy
1	S.K	6	0	6	2	1	20	7	0
2	F.H	8/7	2	6	2.5	2	15	10	0.5
3	M.A	5	0	6	2	1	20	10	0
4	G.M	6	3	6	2.5	1	15	8	0.5
5	M.A	9	0	6	2	1	15	6	0.5
6	M.H	6	0	6	2	1	20	6	0
7	R.A	7	1	6	2.5	1	10	8	0
8	M.M	5	1	6	2	1	20	6	0
9	R.R	5	2	6	2	1	15	6	0
10	M.M.	5	1	6	2	1	20	7	0
11	M.K	5	0	6	2	1	20	6	0
12	A.N	5	1	6	2	1	15	9	0
13	A.G	5	2	6	2.5	1	15	7	0
14	O.M	6	1	6	2	1	20	7	0
15	M.R	5	1	6	2.5	1	15	6	0.5
16	A.S	6/3/3	0	6	2.5	2	10	10	0.5
17	R.O	6	1	6	2	1	15	7	0
18	S.M	5	1	6	2	1	10	8	0
19	Y.A	6	2	6	2.5	1	15	8	0

Discussion

The most recent reports using the Ponseti method showed excellent corrections in the majority of clubfoot patients[4,5,6,7,8]However, a small percentage of clubfeet are very severe and difficult to treat. Numerous surgeons have performed complete, plantar, lateral, medial, and posterior releases with poor results. [9,10]

Such clubfeet are refractory to the usual corrective manipulation and casting as Turco [11] observed. In 2006, Ponseti et al. [1]found that forefoot adduction in those feet can be corrected easily with one or two plaster casts through the metatarsals remain in severe plantar flexion. Additional attempts to correct the hindfoot varus by abducting the foot deformity push the metatarsals and toes into additional flexion and abduction resulting in a grotesque deformity. They suspected the abnormalities affecting the calf muscles and the posterior ligaments of the ankle extend to the deep intrinsic plantar muscles and ligaments of the foot.

The present study evaluates the efficacy of the modified Ponseti technique in the management of idiopathic atypical clubfeet in patients aged two years old or younger. There was a significant improvement of the Pirani score after at the end of manipulation and at the end of follow up when compared with its levels at the start of the study. At the last follow up, all feet were well corrected with mean ankle dorsiflexion of 15° (range, 10°–20°). There was a minimal cavus deformity in two patients, which was passively corrected.

Ponseti et al. [1] included fifty patients (75 clubfeet) with complex atypical idiopathic clubfoot in their work. The final mean ankle dorsiflexion at the end of the correction in the Ponseti series was 10° (range, 5°–20°). We found that the affected foot in all unilateral cases was (1.5-2 cm) shorter than the normal foot which was very comparable to the results of Ponseti et al. [1]

Current patients required an average of 5.6 casts to achieve correction (range, 5-9), while Ponseti needed an average of five casts (range, 1-10) to get feet corrected. The incidence of the first relapse among our patients was 10.5 % (2 patients) which was lower than in Ponseti paper (14 %). Average time from correction till diagnosis of the first relapse at our study was 2.75 months compared to 1.5 months in the other study. All relapses were related to problems with shoe fit in the foot abduction brace. Ponseti et al. [1]used the pre-molded foot abduction brace to deal with the same issue, known as Mitchell splint. It is a very nice and well-tolerated splint, though; price is not affordable for our patients.

Additional attempts to correct the heel varus by abducting the foot causes hyperabduction of the severely plantar-flexed metatarsals. Because of the rigid flexion of the heel and metatarsals, the plaster cast easily slips off, making the deformity worse and damaging the edematous skin of the dorsum of the foot. As mentioned by Ponseti, to correct heel varus in complex clubfeet, the hindfoot is abducted with counter-pressure applied not only to the talar head but also to the lateral malleolus. The forefoot should not be abducted beyond its normal alignment. Once the heel varus is corrected, the flexed forefoot and the equinus are corrected simultaneously by forceful dorsiflexion the metatarsals with both thumbs while applying a plaster cast.

So we found that in atypical clubfoot elevation of both the 1st and 5th metatarsal give a good result in correction of the hyperflexion of all metatarsal found in those cases, two weeks casting interval allowed enough time to correct this rigid type of deformity, and rigid equinus require tenotomy in all cases. So we recommend doing all those modifications in the management of atypical clubfoot.

Conclusions:

We found that in atypical clubfoot, The modified Ponseti method which is characterized by elevation of both the 1st and 5th metatarsals, two weeks interval between two casts and achieving 40 degrees abduction, rigid equinus require tenotomy in all cases, 100% of our patients achieved full correction according to Pirani score and. So we recommend doing all those modifications in the management of atypical clubfoot.

Disclosures
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