MODIFIED PONSETI TECHNIQUE FOR THE MANAGEMENT OF CONGENITAL TALIPES EQUINO VARUS (CTEV) IN NEONATES: OUR EXPERIENCE IN A RURAL TEACHING INSTITUTION

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ABSTRACT: Congenital Talipes Equino Varus (CTEV) or clubfoot is a commonly seen congenital deformity of the foot. By this study, the results of Ponseti method of treatment of CTEV were evaluated in neonatal age group with little modification in the technique of percutaneous Achilles tenotomy. **METHODS:** It is a prospective study, conducted during the period of Dec. 2011 to July 2013 at the Department of orthopedics in the institute's hospital. All the neonates born with CTEV were treated with this modified Ponseti casting technique. Neonates having other congenital deformities were excluded from the study. **RESULTS:** Total 33 CTEV feet of 20 neonates were treated. Thirteen were males and 7 were females. Twenty one (63.6%) feet were of rigid variety and 12(36.4 %) feet were of non-rigid variety. Thirteen patients had bilateral and 7 had unilateral involvement. In this study mean pre-treatment Pirani score was 5.55(± 0.70) and mean number of plaster casts required per CTEV was 4.06 (range: 2-6). Percutaneous tenotomy was done in 19 rigid and 9 non-rigid (total 84.85%) feet. Out of 33 feet 31 (93.94%) were managed successfully. Two (6.06%) patients of rigid variety developed relapse of the deformity due to poor and faulty application of D-B Splint. Post-treatment mean Pirani score in this study group was 0.36(± 0.42). **CONCLUSION:** For the treatment of CTEV deformity, the Ponseti technique is a simple, excellent, minimally invasive, effective, and less expensive and easy to learn procedure which is possible without general anesthesia even in neonates.

KEYWORDS: Neonate, Ponseti technique, Talipes equino-varus.

INTRODUCTION: Clubfoot or Congenital Talipes Equino Varus (CTEV) is a commonly seen complex congenital deformity of the foot. Depending on the race its incidence has been reported varying from 0.39 per 1000 to 6.8 per 1000^{1,2} and about 2.5 times more commonly seen in males.³ Idiopathic CTEV occur in isolation while syndromic CTEV as a part of other congenital anomalies like meningomyelocele, arthrogryposis etc. Various etiologic hypotheses have been reported varying from germplasm defects, intra-uterine molding, and intra-uterine developmental arrest to myogenic, neurogenic and vascular explanations.

The deformity consists of four components: equinus at ankle, varus at hind foot, adductus at forefoot, and cavus deformity at midfoot.⁴ Various clubfoot treatment modalities include manipulations, plaster casts, strapping, splintage, passive motion, surgery (limited and extensive).⁵ Recently there has been shown successful results with Ponseti's method of manipulation and serial casting.⁶⁻⁸

Few studies⁹⁻¹¹ reported good results at short term follow up in infants where treatment could be started during earlier few months of life and who had not taken any other treatment prior to

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the study. Promising results have been shown in a retrospective study¹² with this method even in children up to 2 years of age. All the components of clubfoot deformity have to be corrected to obtain foot which is pliable, painless, plantigrade and acceptable cosmetically and functionally.^{4, 13}

Now this has been nearly universally agreed that the non-operative treatment of clubfoot should be started initially regardless of the severity of the deformity and when no improvement is seen, only then postero-medial release (PMR) of the soft tissues should be performed. High incidence of complications, 13-50% of recurrence and the problems faced while treating recurrences are the main disadvantages of PMR.¹⁴

Ponseti casting technique, over the past two decades has become a standard first choice of treatment worldwide. This technique consists of serial application of corrective plaster casts after manipulation along with limited surgery (percutaneous Achilles tenotomy). Success rate of 90- 96% in short, mid and long-term results have been shown with this method of treatment.¹⁵⁻²⁰ This technique is quite useful in developing countries, where good operative facilities are not available in remote areas and the especially trained health personnel can properly and efficiently treat the clubfoot cases with the plaster casts only.²¹

The aim of this study was to evaluate the results of Ponseti casting technique with little modification in the technique of percutaneous tenotomy, used over last 20 months in the institute (a rural teaching institution) for the management of congenital clubfoot in neonates.

MATERIALS AND METHODS: This study conducted in a tertiary hospital, is a prospective observational study. The study period was from Dec. 2011 to July 2013. All the neonates with CTEV presenting during this period were treated using the Ponseti casting technique. Only cases with idiopathic CTEV were included in the present study. Cases with associated meningomyelocele, arthrogryposis, spina bifida etc were excluded.

All parents were well informed about the procedure and a written consent was taken. From each participants using pre-designed data sheet, all the relevant data were collected that included patient's complete clinical profile including Pirani's severity scoring score²² (on initial assessment of the severity and on evaluation of the feet at each stage of the treatment and at ultimate final outcome), pre tenotomy total number of the castings done, pre and post treatment complications like plaster sore, skin abrasions, blister formation, excessive bleeding after tenotomy or any other complication.

TREATMENT PROTOCOL: The Ponseti casting technique (Fig. 1-3) with little modification in the technique of doing percutaneous Achilles Tenotomy was followed as a standard protocol. The foot was gently manipulated and the above knee plaster casts were applied serially as described by Ponseti ⁴. We changed the casts at 10 day intervals. Cavus component was improved by lifting the first ray during the first cast application. This is an essential step which exaggerates the deformity to unlock the mid-foot. By using counter-pressure on the head of the talus, the feet were then gradually abducted.

A simple percutaneous Achilles tenotomy was done under local anesthesia after the correction of varus deformity of the heel to correct the residual equinus. For percutaneous Achilles tenotomy we used modified technique in which instead of scalpel blade we used large wide bore (usually 16 gauge- Fig. 3) hypodermic needle's beveled tip. After the tenotomy a last above knee cast,

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was applied keeping knee in 90° of flexion 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 Pirani score ²² which is the main variable of the study to detect the degree of correction. According to it there are 6 scores for clinical signs: 3 scores each for hind-foot and mid-foot. Grading of the amount of deformity is done between 0 and 3 for three signs of hind foot score (HS) and midfoot score (MS). The Pirani score 0 indicated normal foot while the Pirani score 3 and 6 indicated moderately abnormal foot and severely abnormal foot respectively.

Final outcome in our study was categorized as excellent, good and poor. It was graded as excellent when Pirani score became 0. Score of 0.5 to 1, was graded as good and poor if the score became more than 1. So the successful management was obviously reflected by excellent and good outcomes. Further surgical management was advised to patients reflecting poor outcome because of treatment failure.

Detailed analysis of the collected data was done and presented in tables.

RESULTS: Total of 28 patients with 43 clubfeet were treated during the study period and were followed up diligently. Out of these, 8 patients due to one or another reason could not complete the treatment as advised and so they were dropped from the study. So the remaining 20 neonates with 33 CTEV feet were included and analyzed in this study. There were 13(65%) boys and 7(35%) girls with a female to male ratio of 1: 1.86. Fifteen (75%) of these children were born by normal vaginal delivery while 5(25%) were born by Caesarean section. The reason for caesarean section was hypertension in 2 cases, fetal distress in 1, oligohydramnios in 1 and breech presentation in 1.

Of the 33 clubfeet, 21(63.64%) were rigid and 12(36.36%) of non-rigid variety. Of the 7 patients having only unilateral involvement, 4 were right sided while 3 had their left foot involvement. In the study group, mean pre-treatment Pirani score was 5.55(±0.70). Mean Pirani scores of the rigid and the non-rigid varieties (5.69±0.51 vs. 5.29±0.92) (Table1) shows that there was no significant difference between them.

Per CTEV required mean number of plaster casts was 4.06(±0.75). There was no difference in the number of casts required for the rigid feet as compared to non-rigid feet (3.83±1.37 vs. 3.83±0.83) (Fig. 4).

A total of 28 (84.85%) feet (19 rigid and 9 non-rigid) required percutaneous tenotomy. Out of 33 feet, 31 (93.94%) were managed successfully (Table 2). Due to poor and faulty application of D-B Splint and irregular follow up, two feet (6.06%) of rigid variety developed relapse of the deformity. Later on these patients were advised surgery i.e. postero-medial release.

Six patients developed cast complications which were mild and all these patients were managed successfully. At the end of overall treatment (with or without tenotomy), the Pirani score was recorded. Post-treatment mean Pirani score in the study group was 0.36±0.42. The non-rigid feet fared better than the rigid feet as per expectations, with their post-treatment scores of 0.17±0.25 and 0.48±0.46 respectively (Table 3).

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Approximate calculation of total cost of treatment per patient was also recorded [Table 5]. In this study mean follow up period was 1year 7 months (range: 1year 11 months to 10 months).

DISCUSSION: Being one of the commonest congenital deformities, CTEV is a complex deformity. All its components i.e. equinus, varus, adductus and cavus, are difficult to correct. Meticulous and dedicated effort on the part of treating physician and parents are required for the correction of the deformity.²³ The ultimate goal of the treatment is to reduce or cure these deformities so that the patient has a functional, plantigrade, pain free foot with good mobility having no calluses and more so that does not require the necessity to wear modified shoes.²⁴

Non-surgical management of clubfoot according to the available literature is the preferred method of initial management of the deformity^{11, 25} world over. Ponseti method of serial manipulation and casting has been reported to be a reliable method for the treatment of CTEV.⁶⁻⁸ The method and its results have been widely reported in children presenting during their early few months of life.^{6-12, 26}

Efficacy of Ponseti method has been evaluated in 20 neonates in this present study. There were 7 females and 13 males and the female to male ratio was 1:1.86. Morcuende et al¹² reported a female: male ratio of 1:2.13 in their study. Ponseti found the incidence to be six times higher among males.²³ In our study group thirteen cases (65%) were bilateral clubfeet and 7(35%) had unilateral deformity.

Among the unilateral cases, 4 had right-sided deformity while 3 had left-sided deformity. In Morcuende et al¹² study, 99 out of 157 (63.1%) were bilateral clubfeet and 58 (36.9%) were unilateral. In Lehman et al²⁷ series, there were equal numbers of unilateral and bilateral cases (15 each).

Mean pre-treatment Pirani score grouping in this series were similar to those reported previously.^{17,24,28} In our series, mean number of plaster casts that was required per feet, was 4.06(±0.75), much less in comparison of the other series.^{21,24} This can be explained by the inclusion and analysis of only neonates in this study.

Percutaneous tenotomy was needed in 84.85% feet (19 rigid and 9 non-rigid) in this study group. Tenotomy was needed in 95% of Gupta's patients²³ and 91% of Dobbs's patients²⁹ and for Tenotomy, a little modified technique which was first reported by Minkowitz B et al,³⁰ was used. This technique was also reported by few other authors.³¹

Tenotomy, according to all the studies, was needed in those patients who were having severe deformity initially. Bor et al quoted, "A foot that requires many casts for the initial correction is more likely to require future additional surgery".¹⁷ Our patients needed tenotomy less frequently because we included only neonates and started treatment early.

The cast complications (Table 4) were mild and were managed successfully. A total of about 136 groin-to-toe casts were applied in the study. As a result of the casting there were 2 cases of skin abrasions over the thigh. This was due to inadequate cast padding at the superior edge of the groin-to-toe cast and can easily be prevented by everting a layer of cast padding over the edge of the cast.

By leaving the area open clean and dry and application of neomycin powder, healing of these abrasions can be aided considering the proximity to the genitals and perineum. Occurring in 2 cases, cast slippage was seen in those with severe equinus deformity and when the cast was slightly loose or when the flexion at the knee was sub-optimal (<90). By taking proper precautions at the time of

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casting, this can easily be prevented. Probably due to tight cast, blisters developed on the dorsum of the foot in one case which healed after the area was left open for a few days. One incident of cast saw injury was there while cutting the cast which was superficial and on the anterior aspect of mid-leg and healed with antiseptic dressings.

In our study, successful management was achieved in 93.94% of CTEV feet. Only 2 CTEV feet that were rigid at presentation and developed relapse of the deformity due to faulty application of D-B splint and irregular follow up required postero-medial release (PMR) for the correction of deformity later on. All the parents of the patients, who were effectively cured of their deformities, were pleased with the cured feet of their children. The success rates for this method of treatment in children have been reported to vary from 78% to 96.7%.^{15, 17, 19, 20}

Continuation of the bracing protocol is the thorniest part of the Ponseti casting technique.¹⁷ According to the parents of this study group, first two or three days were the crucial period, when children were impatient and tried to get rid of the splint. For which adjustment with the splint was done. Like most of the authors, we also agree that efficient cure of the foot also depends on practice of proper bracing.^{16, 17, 21, 24} By training the parents about the correct use of brace and the complications of incorrect or inadequate bracing, parental observance can be improved.

Another difficult part of the study was follow-up. Serial cast application with or without tenotomy is only a part of the total management of correction of foot. Parents got the wrong idea that the main and complex part of the treatment is over on the initial improvement of the foot and hence they do not come for follow up. The parents and their family members were motivated to overcome this problem. All our patients were regularly followed up but in 2 of the patients follow up were rather irregular and these very patients ultimately needed further surgical treatment.

Similar to other's experience,^{27, 32} we found this treatment technique to be very cost-effective.

CONCLUSION: From the above findings it is very clear that CTEV deformity can be efficiently managed by Ponseti casting technique with admirable results and without any major morbidity. This method is simple, minimally invasive, effective and inexpensive and ideally can be performed without general anesthesia, even in neonatal period at outpatient department.

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Pirani score	Rigid type No. =21(%)	Non-rigid type No. =12 (%)	Total feet No. =33 (%)
06	13(61.90)	4 (33.33)	17 (51.51)
5.5	5(23.80)	5 (41.67)	10 (30.30)
05	2(9.52)	1 (8.33)	3 (9.09)
4.5	--	--	--
04	1(4.76)	1(8.33)	2 (6.06)
3.5	--	--	--
3.0	--	--	1 (3.03)

Table 1: Initial Pirani score

Result	Rigid No. =21(%)	Non-rigid No. =12(%)	Total No.= 33(%)
Successful:	19	12	31 (93.94)
- Excellent: (Pirani score 0)	7 (21.21)	8 (24.24)	15 (45.45)
- Good: (Pirani score 0.5 -1)	12 (36.36)	4 (12.12)	16 (48.48)
Unsuccessful:	2 (6.06)	--	2 (6.06)
- Poor: (Pirani score>1)			

Table 2: Final result

Pirani score	Rigid type No. (%) (n=21)	Non-rigid type No. (%) (n=12)	Total No.=33 (%)
1.5	2 (9.52)	--	2 (6.06)
1.0	2 (9.52)	--	2 (6.06)
0.5	10 (47.62)	4 (33.33)	14 (42.42)
0	7 (33.33)	8 (66.67)	15 (45.45)

Table 3: Pirani score at last follow-up

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Complication	No. of cases
Skin abrasions	2
Cast saw injury	1
Skin blisters	1
Slippage of casts	2
Table 4: Cast complications	

Items	Indian Rupees
Plaster & other Hospital Expenses	1600
Tenotomy	1000
D-B bar shoes	850
Total cost	3450
Table 5: Total Cost of treatment per patient	

No. of CTEV Feet:

Figure 1: Bilateral CTEV

Figure 2: Manipulation and cast application

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Figure 3: Percutaneous Tenotomy

Figure 4: Number of plaster cast needed for Correction

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