# Serial Corrective Cast Manipulation in Idiopathic Club Foot by Ponseti Method. (A Study of 70 Feet with 3 Year Follow Up)

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**Citation**

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**Abstract**

A total number of 70 feet in 50 patients of clubfoot were studied prospectively in Guru Govind Singh Hospital, M.P.Shah Medical College, Jamnagar during period of April 2004 to April 2008. The patients' characteristics at the time of presentation, such as the severity of the initial club foot deformity measured by Pirani Severity Score System, age at the initiation of the treatment, total duration of the treatment, the details of tenotomy, Denis-Browne Splint and CTEV Shoes were studied in relation to the recurrence of the deformity. Parents of 42 infants (84%) were feeling discomfort with the use of the orthosis but when explained properly they co-operate. The outcome has no relation with the severity of the deformity, but the younger the age the less the number of the casts are needed. Total duration of the treatment is about 2 months and we found nearly normal range of the motion at 3 yr follow up. Parents of 46 patients (92%) accept the look of the foot nearly normal or normal.

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## INTRODUCTION

Idiopathic clubfoot is a complex deformity that is difficult to correct. The deformity has four components: Forefoot Equinus, Hindfoot Varus, Forefoot Adductus and Midfoot Cavus. The aim of the treatment is to reduce or eliminate all the components of the CTEV deformity to obtain Painless, Plantigrade, Pliable and Cosmetically and Functionally acceptable foot within the minimum time duration and least interruption of the socio-economical life of the parents and child.

There is nearly universal agreement that the initial treatment of the Clubfoot should be nonoperative regardless of the severity of the deformity. Historically, the treatment consists of Forcible Serial Manipulation by correcting all the deformity simultaneously with fulcrum at the calcaneo-cuboid joint as describe by the Kite[1]. If deformity not responds then most of the surgeons go through Posterio-Medial Release of soft tissue. Although all of these methods have the potential to be successful when applied correctly, most of the authors have reported a success rate of only 15% to 50%[23]. A notable exception is the Ponseti Method[4] which involves serial corrective manipulation, a specific technique of the cast application, and a possible percutaneus TendoAchilis tenotomy. The method has been reported to have short-term success rate approaching 90% and long-term results have been equally impressive[45]. Cooper and Dietz, in a review of the cases of forty-five patients who had been treated by Ponseti and followed for a mean of thirty years, found that, with the use of pain and functional limitation as the outcome criteria, thirty-five patients (78%) had achieved an excellent or good outcome[5].

The unsatisfactory results associated with complete soft

tissue release at ten to fifteen years of follow-up[67] and the long term success reported with the Ponseti method have led to a renewed interest in this method among pediatric orthopedists. Despite this interest, success with the Ponseti Method when it has been used by other orthopedists has not been demonstrated until recently[8].

The purpose of this study was to evaluate the effectiveness of the Ponseti Method[4] with three years follow up of 50 cases with 70 feet managed by single surgeon in prospective manner.

## MATERIALS & METHODS

A total number of 70 feet in 50 patients of clubfoot were studied prospectively at Guru Govind Sinh Hospital, M.P.Shah Medical College, Jamnagar during the period of April 2004 to April 2008 by Ponseti method performed by a single surgeon. The severity of the foot deformity was classified, according to…

1.Pirani Severity Score[9] for Midfoot including …

Curved lateral border,
Medial creases and
Position of the lateral part of the talar head and

2 .Pirani Severity Score[9] for Hindfoot including …

Posterior creases,
Rigid Equinus and
Empty heel.

Each is scored according to the following principle:

0, no abnormality.
0.5, moderate abnormality.
1, severe abnormality.

Thus, each foot can receive a Midfoot score between 0-3 and a hindfoot score between 0-3 and a total score between 0-6.

Age at the beginning of the treatment and its relation with the result, sex distribution, pattern of involvement of the foot, birth order, family history, total number of the cast applied before tenotomy and evaluation of the necessity of tenotomy with age, details of the Denis-Browne Splint and the details of the CTEV shoes, assessment of the passive range of the motion and limitation of the movement and look of the clubfoot is evaluated. A rating system for functional results[4] was designed, with 100 points indicating a normal foot. This include a maximum score of 30 points for amount of pain; of 20 points each for level of activity and patient satisfaction; and of 10 points each for motion of the ankle and foot, position of the heel during stance, and gait. (Table 1)

**Figure 1**

Table 1

| Category | Points |
|---|---|
| **Satisfaction (20 points)** | |
| I am… | |
| 1. very satisfied with end results | 20 |
| 2. satisfied with end results | 16 |
| 3. neither satisfied nor unsatisfied with end results | 12 |
| 4. unsatisfied with end results | 08 |
| 5. very unsatisfied with end results | 04 |
| **Function (20 Points)** | |
| In my daily living my club foot… | |
| 1. Does not limit my activities | 20 |
| 2. Occasionally limit my strenuous activities | 16 |
| 3. Usually limits me in strenuous activities | 12 |
| 4. Limits me occasionally in routine activities | 08 |
| 5. Limits me in walking | 04 |
| **Pain (30 points)** | |
| My club foot… | |
| 1. Is never painful | 30 |
| 2. Occasionally causes mild pain during strenuous activities | 24 |
| 3. Usually is painful after strenuous activities only | 18 |
| 4. Is occasionally painful during routine activities | 12 |
| 5. Is painful during walking | 06 |
| **Position of heel when standing (10 points)** | |
| 1. Heel varus 0 degree or some heel valgus | 10 |
| 2. Heel varus 1-5 degree | 5 |
| 3. Heel varus 6-10 degree | 3 |
| 4. Heel varus > 10 degree | 0 |
| **Passive motion (10 Points)** | |
| 1. Dorsiflexion | 1 point per 5 degree (up to 5 points) |
| 2. Total varus-valgus motion of heel | 1 point per 10 degree (up to 3 points) |
| 3. Total inversion-eversion of foot | 1 point per 50 degree (up to 2 points) |
| **Gait (10 Points)** | |
| 1. Normal | 6 |
| 2. Can toe walk | 2 |
| 3. Can heel walk | 2 |
| 4. Limp | -2 |
| 5. No heel strike | -2 |
| 6. Abnormal toe off | -2 |

The results were classified according to the scores, as follows: Excellent 90-100 points, Good 80-89, Fair 70-79 and Poor less than 70 points.[4]

## TREATMENT REGIMEN

The Ponseti method is used at our institution according to the following regimen. Treatment is started as soon as possible after referral, preferably shortly after birth, as soon as the skin permits, and consists of gentle manipulation of the foot and the serial application of long leg plaster cast without the use of anesthesia, as described by Dr. Ponseti[4]. In all patients, the cavus is corrected first by supinating the forefoot and dorsiflexing the first metatarsal. To correct the varus and adduction, the foot in supination is abducted while counterpressure is applied with the thumb against the head of the talus which makes this method differ from that of the Kite where the lever fulcrum is at calcaneo-cuboid joint. Four to eight long leg casts, changed weekly after proper manipulation of the foot, are usually sufficient to obtain good correction[4]. In the last cast, the foot should be markedly abducted up to 70° without Pronation with 15° of dorsiflexion without any forceful manipulation and a long leg cast is applied for the three weeks. (Figure 1)

**Figure 2**

Figure 1 showing the schematic presentation of the weekly interval corrective casts

If dorsiflexion is not obtained up to 15° after achieving the abduction up to 70° and correction of the varus deformity, a simple percutaneus tenotomy of the Achilles tendon is performed. Forty five minutes before the procedure, local anesthetic EMLA cream is applied at tenotomy site. 20 minutes before the procedure Atropine 20ug/Kg with Midazolam 0.5 mg/kg mixed with syrup Paracetamol 10 mg/kg is given orally. Patients are monitored for temperature, pulse, BP, ECG and oxygen saturation till 1 hr of post operative period. So procedure is finished under day case surgery criteria with local anesthetic application and sedation without any anesthesia related complication with better patient compliance. A long leg cast is applied in 70° of abduction and 15° of dorsiflexion[4] immediate after tenotomy under the effect of anesthesia for further 3 weeks to allow for healing of the tendon.[4]

An orthosis is used to prevent relapse of the deformity which is best accomplished with the feet in well-fitted, open-toed, high-top straight-last shoes attached to a Denis-Browne bar of approximately the length between the child's shoulders. The splint maintains the corrected foot in 70° of external rotation to prevent recurrence of the varus deformity of the heel, adduction of the foot and toeing-in. The ankle should be in dorsiflexion in an attempt to prevent equinus, and this is accomplished by bending the bar with the convexity of the bar distally directed. If the deformity is unilateral, the normal foot is placed in 30° of external rotation. The orthosis is worn full-time (twenty three hours a day) till weight bearing age and then at night for 4-6 years with day time CTEV shoes to prevent further relapse. Here we differ from Dr. Ponseti's management as he advised to wear modified Denis-Browne splint to be worn for 24 hours except the time of bathing till 3 months. Then it is removed during the day for gradually increasing periods of time for approximately five months. Finally, the child wears the bar at night only for two to six years.[4]

## OBSERVATIONS

A total number of 70 feet in 50 patients of clubfoot were treated. 39 patients (78%) were male, thus the male female ratio is 3.54:1. Of the 50 patients 20 patients (40%) had bilateral involvement, 30 patients (60%) had unilateral involvement out of which 16 (32%) had right foot involvement and 14 (28%) had left foot involvement. No relationship had been found with birth order or with family history. 40 patients (80%) are in between 0-3 months of the age while beginning of the treatment, 8 patients (16%) are in between 3-6 months and 2 patients (4%) are of 9 months. Pirani Severity score for the mid foot had mild curved lateral border in 6 feet (8.58%), moderate in 32 feet (45.71%) and severe in 32 feet (45.71%), mild medial crease in 6 feet (8.58%), moderate medial crease in 30 feet (42.85%) and 34 feet (48.57%) had severe medial crease. 2 foot (2.86%) had adequate talar head coverage while rest of 68 feet (97.14%) had no talar head coverage. Thus most of the Midfoot deformity lies in between moderate to severe according to Pirani Severity Score. Pirani Severity score for the Hindfoot

had mild posterior crease in 6 feet (8.58%), moderate in 20 feet (28.57%) and severe in 44 feet (62.85%), mild rigid equinus in 8 feet (11.43%), moderate rigid equinus in 20 feet (28.57%) and 42 feet (60.00%) had severe rigid equinus. 34 feet (48.57%) had no empty heel while 36 feet (51.43%) had empty heel. Thus most of the Hindfoot deformity lies in between moderate to severe according to Pirani Severity Score. The 6-8 mean number of the cast requires to correct the deformity at weekly interval. 54 feet (80%) requires tenotomy while 16 feet (20%) not require the tenotomy that means achieved correction of the rigid equinus up to 15 degree when abduction is up to 70 degree and no residual varus deformity is there with average age in between 3-6 months. It has been observed that if the treatment is started in the first 3 weeks of the life (16 patients) then we would achieve 15 degree of the dorsiflexion at the end of 4-5 casts and tenotomy is not required. The total duration of the treatment from application of the cast to Denis-Browne Splint is in between 6-8 weeks in 60 feet (85.71%) while in 10 feet (14.29%) it is in between 9-12 weeks. 44 patients (88%) had ankle dorsiflexion in between 11-20 degree and 6 patients (12%) had 21-30 degree. 48 patients (88%) had abduction in between 21-30 degree and 6 patients (12%) had in between 11-20 degree. 48 patients (96%) had plantar flexion in between 21-30 degree. We conclude that the abduction movement which we achieved 60 degree at the end of the cast application would gradually decrease as the age progress and become static between 21-30 degree at the age of one year. Then after no further decrease of the abduction movement is noticed. In our series, we had excellent results when we start the treatment at the age in between 0-6 months of 48 patients (96%). The oldest children in whom we started the treatment were of 9 months and had mild limping and heel varus thus fall into good results. 40 patients (80%) up to 3 years of the age found no limitation of activity like running, playing different outdoor games, squatting and other day to day normal activity while parents of 10 patients (20%) says that patients has occasional problem while running. Parents of 46 patients (92%) accept the look of the clubfoot was normal or near to normal at the end of 3 years of patients' life. Parents of 4 patients (8%) tell that the look is not normal when they keep the foot without shoes for some time and the feet again have the look of the clubfoot.

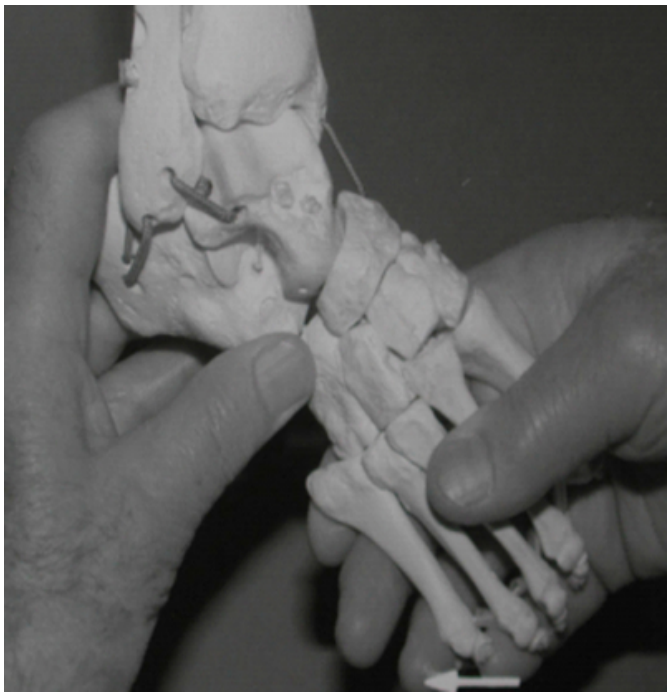
For the purpose of this study, a relapse was defined as a club foot having a recurrent deformity that required further treatment.[4] four patients (6 feet) developed relapse; two feet in the form of cavus and four feet in form of adductus at the mean age of 30 months. All the four patients were defaulters of Denis-Browne splint and CTEV shoes. For cavus feet (2) two corrective cast at weekly interval was required while to correct adductus deformity, 3 feet required three corrective serial manipulative cast at weekly interval and one feet required two corrective manipulative cast at weekly interval.

## DISCUSSION

Although the Ponseti group represented our learning curve with this method, we are very satisfied with the initial results. The major concern in the operative treatment of congenital clubfoot is functional outcome. Open surgical release often leads to scarring and stiffening of the ankle, with resulting limitation of motion and strength.[67] Aronson and Puskarich studied the disability associated with various clubfoot treatment options. Their results showed that patients who underwent casting only and patients who had additional heel cord lengthening had the least deformity and disability.[7] However; patients who had undergone PMR had reduced ankle planter-flexion motion and diminished push off strength. Our patients who were treated with the Ponseti method had much better ankle range of motion, both in dorsi-flexion and planter-flexion. Few authors describe their technique of casting precisely. Kite illustrated his method in 1964 and comprehensively outlined his technique of manipulation. He recommended abducting the forefoot against pressure at the calcaneocuboid joint.[10] Ponseti called this maneuver 'Kite's error' because it blocks the correction of the hindfoot varus and internal rotation. (Figure 2)

**Figure 3**

Figure 2 showing the "Kite's Error"



Zibler reported poor follow-up results for 75 patients (90 feet) who were treated using the Kite method. Only 10% of the patients responded to the conservative treatment, all others required surgery.[11]Another important factor in clubfoot casting is the need to use long leg casts. Kite used below the knee casts in children younger than 12 months.[1012] Ikeda used short leg casts in all of his patients.[13] A below the knee cast is not suitable for holding the foot abduction and should therefore not be used at any age. Percutaneous tenotomy performed during the first few moths of life has been shown by Cooper and Dietz to be a benign procedure, with no negative long term effect on muscle strength.[5] Although Ponseti reports partial relapse in 35% of his patients older than 3 years which required the tibialis anterior tendon transfer; we till three years did not required tibialis anterior transfer and the relapse had been treated by conservative serial casts only.[1415] However, Ponseti's more recent experience suggests a relapse rate closer to 10%, the diminution being attributed to an improved appreciation of the need for careful follow-up treatment with the foot abduction Orthosis protocol. Derotation splinting after the casting period seems to be crucial to avoid relapse of the treated foot and should be administered by any means. Bensahel et al. and others from France have described a method of serial manipulations by well-trained physiotherapists to avoid PMR.[16] However, it has been pointed out that the French treatment involves a very lengthy procedure and a long casting time and has a relatively low success rate compared with Ponseti's method.[17]

One of the chief advantages to using the Ponseti method is the decrease cost, which is important in this age of cost containment. The Ponseti method and traditional casting methods are similar amounts of casting. Thus, there is very little difference in the out-patients costs. However, the traditional casting method invariably leads to an incomplete correction, necessitating an expensive surgical procedure (PMR) with the associated high cost of general anesthesia, operating room time, and hospitalization. The Ponseti treatment usually requires only a relatively inexpensive and quick office procedure (Percutaneous Achilles tenotomy), with the patient under local anesthesia with sedation.

## CONCLUSIONS

A lot has been said and done for correction of clubfoot. From our study of 70 feet, we conclude as following:

1. Ponseti serial corrective cast management is an Easy, Effective and Economical method of CTEV correction when it is applied in idiopathic clubfoot.
2. Result of the method is excellent when it was applied within a Golden period of CTEV that means in the initial three weeks of the newborn
3. If the treatment was started in the late period of life that is after 4-5 months the deformity is more resistant to treatment and requires more number of casts for the correction.
4. After the age of 9 months, in our series the club feet was almost resistant to the Ponseti cast management and required other mode of the treatment in the form of semi-conservative or operative method.
5. We have not given any importance to radiological correction of the deformity and thus not taken any X-ray before or after the correction of the deformity as it has no connection with the functional out come of the result.
6. We followed the functional rating system of Dr. Ignacio Ponseti and got 96% excellent results and 4% good result in our series.
7. All the patients were comfortable with D-B splint

and CTEV shoes and their parents' were fully co-operative for the same for regular follow up examination.

8. All patients in our series started to walk and run as well and have no pain, limp or any other problem in day to day normal activity.

9. Relapse occur in 4 patients (six feet), which was due to default in wearing Denis-Browne splint and CTEV shoes at mean age of 30 months which was correctable with manipulation and applying corrective above knee serial plaster cast with weekly interval.

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