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Early results of clubfoot management by ponseti method

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Abstract
Aim: Since long Clubfoot has been an unsolved clinical challenge for the orthopaedic surgeons. It is one of the commonest congenital deformities in children. More than 1,00,000 babies are born worldwide each year with congenital clubfoot. Around 80% of the cases occur in developing nations like India. We wish to study results and effectiveness of ponseti method in treatment of clubfoot because this method has become famous after the author reported successful correction in 85% - 90% cases without need for posteromedial release.
Materials and methods: 96 feet in 65 children were treated by ponseti method from June 2015 to June 2016 (31 of them have bilateral CTEV). A prospective follow up for mean duration of 18.6 months(range 6-24 months) was undertaken. All the patients were clinically evaluated by pirani scoring system at each visit with proper counselling of parents.
Results: The average pirani scoring was 5.3/6. The mean number of casts given before Achilles tenotomy was 6.4. 93.75% patients needed tenotomy for full correction. There were 15(15.6%) cases with residual deformity, while 7(7.29%) feet show relapse after completion of treatment. Almost all of them have non compliance for foot abduction brace.
Conclusion: The treatment of idiopathic congenital clubfoot by ponseti method is very effective and shows reproducible results. It is very cost beneficial in developing countries like India. Proper counselling and adherence to brace is highly recommended to prevent relapse.

Keywords: CTEV (congenital talipes equino varus), FAB (foot abduction brace), ponseti method

1. Introduction
Congenital clubfoot (CCF), also known as congenital talipes equinovarus, is the most common orthopaedic deformity that requires intensive treatment [1] and affects approximately 1:1000 live births [2].
It is a congenital dysplasia of all musculoskeletal structures (muscles, tendons, ligaments, osteoarticular and neurovascular structures) distal to the knee [1]. The foot presents equinus, cavus, varus and adducted positions, and is supinated.
CTEV etiology may be associated with myelodysplasia, arthrogryposis or multiple congenital abnormalities, but the most common presentation is the isolated deformity which is considered to be idiopathic. Many theories have been proposed to explain the etiology of idiopathic CTEV. They are related with vascular impairment, external factors (intrauterine positioning), abnormal muscle insertions, and genetic factors [3]. In normal fetal development of the lower limbs, between the 6th and 8th week of intrauterine life, feet are similar to clubfeet (equinus, cavus, varus, adducted, and supinated) but by the 12th week the feet move to the normal position. This means that the condition may be due to the permanence of the foot position at the beginning of development.
The literature is abound with wealth of information regarding various modalities of treatment ranging from bandages by Hippocrates and plaster casts by Kite to surgical treatment but still there is no single modality till date that can boast of achieving the ultimate goal of treatment i.e. to achieve a functional, pain-free, plantigrade foot with good mobility and without calluses [3]. Nonsurgical management generally led to inadequate correction whereas those children with idiopathic clubfoot who underwent surgery often developed extensive scarring of the soft

tissues and residual pain. But these statements have been frequently sidelined by those people who use Ponseti method of serial manipulation and casting. The Ponseti method is widespread worldwide. It consists of a series of manipulations and immobilizations, as well as Achilles tenotomy to correct CTEV deformities. After tenotomy, an orthosis is used to maintain the correction obtained and prevent recurrence [3, 4, 5, 6].

This study is aimed to study effectiveness of ponseti method of serial casting and tenotomy in all cases of CTEV. To evaluate club feet by pirani scoring and to understand role of foot abduction brace after full correction achieved.

2. Materials and methods

This case study was approved by medical ethics and research committee of the institution.

All the patients of idiopathic CTEV who were presented to OPD of orthopaedic department of SSG hospital, Vadodara, Gujarat, India were included in the study. All cases of secondary clubfoot i.e. arthrogryposis, myelodysplasia, cerebral palsy and all neglected club feet were not included in the study. Cases who were partially treated somewhere else or operated were not included.

On their first visit in OPD, all patients were enrolled and detailed history were taken with counselling done by a designated social worker. Initially there were 70 cases enrolled from which 5 cases were lost to follow up. The study was conducted in 65 children with 96 club feet. 31 patients had bilateral club feet. Each club foot was evaluated clinically by ponseti scoring system followed by manipulation and weekly casting as advised by ponseti.

2.1 Ponseti method

The corrective process utilizing the Ponseti technique can be divided into two phases:

- The treatment phase, during which time the deformity is corrected
- The maintenance phase, during which time a brace is utilized to prevent recurrence.

The treatment phase starts as soon as the skin condition of the child permits the use of plaster casts. Till that time regular corrective manipulation of the foot by the mother is carried out. In newborn patients due to soft nature of their skin in early days of life, the first cast was given at 2 weeks of age.

The casts were given by residents in our orthopaedics department under guidance of experienced senior orthopaedic surgeon. Sequential correction of underlying deformities were done by manipualtion with thumb over talar head followed by groin to toe application of plaster cast with only one soft roll padding. cavus was corrected first, followed by adduction and supination in sequence.

At each weekly visit, old cast was removed in opd, followed by evaluation of skin condition and pirani scoring. Once mid foot score becomes 0 and hind foot score<1, patient is scheduled for achilles tenotomy to correct equinus.

Achilles tenotomies were performed with patients under local anaesthesia in the operation theatre by trained orthopaedic surgeon.

After asepsis and antisepsis of the surgical site, percutaneous Achilles tenotomy was performed with a No. 11 scalpel blade. After dressing and padding, a long leg plaster cast was placed to maintain the correction achieved by surgery.

After three weeks of tenotomy, the plaster cast was removed and the use a foot abduction orthosis was initiated with 70° of external rotation for the pathological foot and with 40° for the normal foot. They were advised to be used 23 h/day in the first three months of the treatment thereafter reducing it to use only at night (12-14 h/day) until 3 years of age.

After full correction patients were asked to follow up one monthly interval to evaluate and to change size of braces. At the end of the study the results were graded as good, acceptable or poor.

Result	Ankle dorsiflexion	Heel varus	Adduction of forefoot	Tibial torsion
Good	10	0	0-10	Absent
Acceptable	0-10	0-10	10-20	Moderate
Poor	0	>10	>20	severe

3. Results

There were 65 children (96 feet) in our study with 31 children (47.7%) having bilateral clubfeet. Mean age of presentation was 12.6 weeks (range 2-28 weeks). In two of our cases the earliest presentation was 2 days after birth as delivery was conducted in the same institute. 51 cases (78.46%) of male patients were predominated in our study compared to 14 cases (21.53%) of females. In unilateral club feet, right foot was involved in 19 cases (55.8%) while left foot was involved in 15 cases (44.17%). Positive family history was found in only one patient with sibling involvement.

Mean pirani score at start of treatment was 5.3/6. While average hind foot and average mid foot score was 2.9 and 2.8 respectively. The average number of casts before tenotomy was 6.4 (range 3 to 10 casts). 90 feet out of 96 feet required tenotomy for correction of equinus. The average age for tenotomy was 10.1 months (range 4-15 months). The average duration for follow up was 18.6 months (6-24 months).

At end of the study, 75 feet (78.12%) showed good results while 15 feet (15.62%) showed acceptable results and 6 feet(6.25%) had poor results. There were 30 feet (31.25%) which were showing minor complications such as erythema, blister formation, broken cast etc. None of our patients had any serious complications like vascular compromise or excessive bleeding from tenotomy site. Almost 41 cases (63.07%) showed problems for adherence to brace regimen throughout treatment. 15 feet (15.62%) had residual deformity of forefoot adduction while 6 feet (6.25%) had equinus deformity >20 degrees at the end of treatment.

4. Discussion

Clubfoot is a complex deformity of foot that requires meticulous and dedicated efforts by the treating physician and parents for the correction of the deformity. The Ponseti method [1, 2, 6, 7]. of correction of clubfoot deformity requires serial corrective casts with long-term brace compliance for maintaining correction. The guidelines regarding patient selection and treatment protocol vary between investigators [4, 7, 8]. But in general the treatment needs to be started as soon as possible and should be followed under close supervision.

In this series, the male to female ratio is high (male: female 3.64:1) in comparison to the series of Cowell and Wein[9] and Yamamoto [10] (male: female 3:1). Palmer [11] explained this by suggesting that females require a greater number of predisposing factors than males to produce a clubfoot deformity. Social bias and attention towards males in our region may account for the higher incidence in them in our study.

The mean age of presentation in our study was 12.6 weeks (range 2 -24 weeks), which is comparable to 70 patient study

by laaveg and ponseti [6] with mean age of 6.9 weeks. A mean age of 10.8 weeks was reported by Lehman *et al*. [12] in a series of 30 cases treated by ponseti method. The late presentation may be attributed to religious belief and unawareness in general population.

The number of casts per feet in our study was three to ten (average 6.4). In a series by Ponseti *et al*. [4], the number of cast per feet was five to ten (average 7.6). In another study by Laaveg *et al* [6], the mean number of casts during their treatment was seven. Morcuende [13] reported that 90.0% of the patients required five or fewer casts. Over a period of time, with more experience, people have started changing plaster casts at shorter intervals [14]. Those feet which required a greater number of casts in our study had a Pirani score of 6 at the onset of treatment. The duration of casts for more than 85.0% of feet was ten weeks or less. The duration of treatment in many patients was increased as compared to number of casts given because they were unable to come at strictly weekly intervals. Financial crisis and poor facility for transportation were few of the causes for this failure. 15 cases developed sores or blisters over foot during cast treatment (Figure 1), they were withdrawn from treatment for 1 week until skin becomes normal.

Fig 1: (4 month child with sore after 3rd ctev pop)

In our study, tenotomy was needed in 93.7% of the cases and these patients had initial Pirani score >5. It shows that tenotomy was required in those patients who initially have severe deformity. It is advisable to do tenotomy after achieving forefoot abduction [15]. Pirani carried out tenotomy in over 90.0% of his clubfoot patients. Laaveg *et al*. [6] did tenotomy in 78.0% cases.

In a study by Thacker *et al*. [16], 44 idiopathic clubfeet were treated with cast using the Ponseti method followed by Steenbeek foot abduction brace application. The feet of patients compliant with the brace, remained better corrected than the feet of those patients who were not compliant. We also used a foot abduction brace in our study. All those patients who had less than good results are those with non adherence to the splint. (figure 2).

Fig 2: (11 months old child with residual deformity)

5. Conclusion

Results of the clubfoot treatment by Ponseti technique in our study have been good and rewarding. In our Institution now all the clubfeet are treated by this technique. In a developing country like India and in remote areas, this technique is a very safe, easy, result-oriented and economical method of clubfoot management. However, it is a treatment that requires a major commitment from both the family and the orthopaedic surgeon, from the period of plaster casting to the essential correct use of the orthosis after the tenotomy. Proper motivation and persuading the parents to accept long-term brace treatment helps maintain the correction over a longer period of time and prevents relapse.

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