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A PROSPECTIVE STUDY OF TREATMENT OF IDIOPATHIC CLUBFOOT (CTEV) USING PONSETI METHOD

Orthopaedics

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ABSTRACT

Background: Congenital talipes equina varus (CTEV) or clubfoot is one of the commonest orthopedic problems seen in infants. CTEV is the term used to describe as a deformity involving in utero malalignment of the calcaneo-talar-navicular complex of the foot. The incidence is 1 in 1000 live births with male to female ratio is 3:1 and is bilateral in 50% of the infants. Idiopathic congenital talipes equinovarus (clubfoot) is a complex deformity that is difficult to correct. The deformity has four components - cavus, adductus, varus equinus and internal tibial torsion. The goal of treatment is to reduce or eliminate these deformities so that the patient has a functional pain-free foot with good mobility and does not need to wear modified shoes. Most orthopaedic surgeons agree that the initial treatment should be non-surgical and should start as soon as possible after birth. Many methods have been described, most of which involve serial manipulation and casting. If left untreated, clubfoot inevitably leads to significant long-term disability, deformity and pain. Although various surgical techniques are used to correct clubfoot, such as soft tissue releases or bony procedures in older children, currently, conservative management is the preferred option in infants. The technique of gradual and simultaneous correction of all deformities of CTEV using manipulation and casting at weekly interval described by Dr.Ignacio V. Ponseti has gained wide acceptance throughout the world. In this study, we have attempted to analyse the functional outcome of Idiopathic clubfoot using Ponseti's technique in children. **Objectives:** To study the outcome following the use of Ponseti technique for idiopathic clubfoot. To evaluate the efficacy of the Ponseti method in reducing extensive corrective surgery rates for congenital idiopathic clubfoot. **Source Of Data:** Children with congenital idiopathic clubfoot consulted at Basaweshwar teaching and general hospital; attached to Mahadevappa Rampure Medical College, Kalaburagi. **Method Of Collection Of Data:** The study proposes to include patients with congenital clubfoot examined according to the protocol. Associated deformities are noted.The severity of foot deformity was assessed according to Pirani scoring system before and after treatment.Serial toe to groin castings will be applied. The number of casts required to obtain correction and the need for tenotomy was also recorded. Patients will be reviewed at weekly intervals till all deformities except equinus are corrected and once in a month following tenotomy and the use of orthotics. **Results:** Average number of cast applied before equinus correction in 0-6month age group was 6.3 and 7-12month age group was 6.7 average number of final cast used in 0-6months of age was 7.3 and in 7-12months it was 7.7 .Average number of cast increases with increase in age and Pirani severity score 98% of patient had no residual deformity at the time of follow up 2% had relapse at the time of final follow up. There was a significant reduction in the PSS after each cast and these difference in PSS between before equinus correction and after the last cast were significant with the p value of <0.001. **Interpretation / Conclusion:** Ponseti technique of treatment for Clubfoot deformity is very effective, and produces painless, mobile, flexible, plantigrade and cosmetically acceptable foot without need of any major surgical intervention.

KEYWORDS

Clubfoot, CTEV, Ponseti technique, Pirani severity score, Percutaneous Tenotomys

INTRODUCTION

Clubfoot, also called as “Congenital talipes equinovarus” or “CTEV”.It is Idiopathic and one of the commonest congenital condition.It is a severe anomaly of foot that needs to be corrected.Nicolas Andry(1743),described the term “pedis equinal” in his “OrthopedicIa” which means foot of the horse. The term “Talipes Equinovarus” is derived from Latin language, tali means ankle, pes means foot and equinus means horse like (plantar flexed) and varus means adducted and inverted.

Clubfoot was first depicted in ancient Egyptian tomb paintings, and in India, the treatment of the same was described around 1000 B.C .The written description of the condition was described by Hippocrates in 400 B.C. He also mentioned that it can be treated with serial manipulation and strapping and the condition should be treated as early as possible, before the deformities get established[1].

The incidence of congenital talipes equinovarus is 1-2 per thousand live birth totaling around 100000 babies is born with this deformity every year, among which 80% are born in developing nations[2,3]. There are studies mentioning that the incidence of clubfoot is increasing[4], making it a challenge for us to treat it with more specific and accurate methods. Gartland's famous observation of clubfoot in 1964 was “We are still crippling with a problem the cause of which is not known, the pathological anatomy of which is uncertain, the behavior of which is uncertain and the treatment of which remains controversial”[5]. This stands good even today.

There are few theories describing the etiology of congenital talipes eqinovarus which are most acceptable till now, eg.- mechanical factors in utero, neuromuscular defect, primary germ plasma defect, arrested fetal development, hereditary, etc.

All the theories explains certain anatomical changes in foot, which gives it a deformity to be called as CTEV. The changes are mainly in position and shape of talus, calcaneun, navicular and cuboid. The tendon sheath fascia are fibrosed and contracted primarily or secondary to the changes in the normal anatomical position and shape of bones. The deformities are equinus of ankle, calcaneum is in inverted and in equinus below the talus, talar head prominence over the dorsolateral of foot, medial and plantar subluxation of navicular to the talus, cuboid is in front of calcaneum with medial subluxation, medial tilt of anterior part of talus, shortened talar neck, narrow posterior ankle mortise, talar tilt out of ankle mortise[6,7].

The treatment of CTEV started in the ancient times which has been conservative management in form of manipulation with strapping, casting etc[1,6]. Since years it has been treated by different conservative and surgical methods. But it has high tendency to relapse, need for repeat surgeries, extensive soft tissue handling, scarring, which ultimately gives non flexible painful foot with disabilities[3].

The purpose of the treatment of CTEV is to reduce the deformities with painless functional plantigrade foot with good mobility without any modified shoes and within cosmetically acceptable limits. The recent trend for clubfoot treatment includes series manipulation, stretching, immobilization, and for the relapse and resistant cases management includes soft tissue releases, osteotomy and immobilization.

The methods described by J.H. Kite, Ignacio V. Ponseti and French are conservative. Amongst these, the technique described by Ignacio V. Ponseti which includes gradual and sequential correction of all deformities by manipulation and immobilization with cast at about weekly interval gained maximum popularity.

Ignacio V. Ponseti gave different understanding as from others in that he described about the interdependent movements of tarsal bones and considered, the view that tarsal joints move on a fixed axis of motion, to be incorrect. He described the Kite's method of correction in which the abduction of calcaneus under the talus was prevented by applying

counter pressure over the calcaneocuboid joint as "Kite's error". This is very essential in correction of heel varus as the calcaneus cannot be everted unless it is fully abducted under the talus[8]. French functional method of physiotherapy has less reduction of operative procedure compared to Ponseti technique[9].

So the study of correction of clubfoot deformity by Ponseti techique is done to analyze its effectiveness and functional outcome in children below two years of age and without any prior treatment for the same.

METHODOLOGY

Source of data: Children with congenital idiopathic clubfoot consulted at Basaweshwara teaching and general hospital; attached to Mahadevappa Rampure Medical College, Kalaburagi. The study was done from 1st march 2021to 31st August 2022 all cases were selected on OPD basis .The cases were confirmed to be idiopathic clubfoot,by thorough physical examination and ruling out any other congenital anomalies example spinal abnormalities,Arthrogryposis multiplex congenita or history of exposure to radiation or any teratogenic drug intake during pregnancy.

INCLUSION CRITERIA:

- Children between 7 days to 1 year of age with idiopathic clubfoot

EXCLUSION CRITERIA:

- Patients aged more than 1 year of age
- Clubfoot secondary to syndromic involvement
- Patients that have undergone prior surgical intervention for clubfoot

The study proposes to include 50 patients with total of 66 idiopathic congenital clubfeet as 16 patients had bilateral involvement and were examined according to the protocol. Associated deformities are noted.The severity of foot deformity was assessed according to Pirani scoring system,before and after treatment.Serial toe to groin castings will be applied to hold the stretch.The number of casts required to obtain correction and the need for tenotomy of tendoachilles under local Anesthesia was also recorded. Patient were explained for about 6 to 10 casts at weekly interval, tenotomy and wearing of foot abduction brace till 3 to 4 years of age, and then regular follow up till maturity. Patients were reviewed at weekly intervals till all deformities except equinus are corrected and once in a month following tenotomy and the use of orthotics and specific method of bracing and long term follow up for recurrence all patients were followed until 6 months after last cast radiographs were not taken . The reason for not taking radiograph was, that every time the foot cannot be put in the same position, bones are not well ossified and Pirani scoring system, which is followed here, doesn't need radiographic evaluation.

Routine Blood investigations were done before tenotomy.

Scoring of the foot was done before first casting and then on every visit before applying each cast, and changes were scrutinised.

MANIPULATION AND APPLICATION OF CAST: FIRST CAST:

Correction of Cavus:

Baby was allowed to sleep or bottle fed or breast fed on the mother's lap. Head of the talus palpated in front of the lateral malleolus, lifting the head of first metatarsal by holding it with thumb and index finger of one hand and pressing gently over the head of talus (as fulcrum) with thumb of other hand, cavus was corrected.This corrects the pronated forefoot, aligning it with already supinated hind foot.

Cast Application:

After 1 to 2 minutes of gentle manipulation, cotton soft rolls of 3 inch width was wrapped from toe towards the thigh, while assistant holds the head of first metatarsal gently. Cotton soft rolls were applied covering half of its width in every rotation. It was applied snugly over the foot and the ankle, and loosely over the calf and thigh. Thigh was covered with extra cotton. Plaster bandage (3 inch width) applied from toe towards knee, while assistant holding the toe.Initially 3 to 4 rotations given over the toe covering the assistant's finger then gradually proximated towards knee.

Molding Of Casts:

It was done according to the manipulation. Assistant leaves the foot and surgeon starts molding by lifting head of first metatarsal using head of the talus as fulcrum, making medial longitudinal arch normal. Molding was done over malleoli, talar head, medial arch and heel.

Extending the Cast:

Cast was extended upto thigh keeping knee at 90 of flexion, with more plaster over anterior aspect of knee and less over popliteal fossa. First cast corrects the cavus and forefoot pronation, toes were checked for capillary filling and overcrowding or any excessive cry or leg banging of baby to rule out any abnormal pressure due to cast application. Patients were asked to revisit after 7 days.

Cast Removal:

First cast and all the cast were removed by soaking the whole cast with water and unrolling the so formed soft plaster bandage, by holding end of the plaster bandage which was left for identification.

SECOND TO LAST CAST TO CORRECT ADDUCTION AND VARUS:

After all the preliminary requirement for baby's comfort, manipulation was started within hour of previous cast removal. The casting protocol is same.

Manipulation for Correction of Adductus:

1 to 2 minutes of manipulation is done before cast application. It is done by holding the head of first metatarsal by index finger on the plantar aspect and the thumb on the medial aspect of one hand, and thumb of other hand over the lateral aspect of head of talus. Making talus as fulcrum foot was abducted by the hand which is holding metatarsal head. Lifting of metatarsal head is done at the same time to keep the cavus corrected and keeping foot in supination. Eversion of heel was never tried as it comes gradually along with the correction of adduction.

Cast Application:

Cast applied same way from toe to knee and then extended to the thigh. Cast was molded in the same way as manipulation done, with same pressure points with fingers continuously moving to avoid pressure sores.

CORRECTION OF EQUINUS

After an average of 6.5 cast application, sufficient abduction of 40^0 -50^0 was achieved. If 0^0 - 5^0 of dorsiflexion was possible and tendo achilles was stretchable, then one more casts were applied to achieve a final dorsiflexion of 15^0 to 20^0.

Cast application for equinus correction is done by holding posterior aspect of heel just above the insertion of tendoachilles, pulling it down, and pushing the whole of the sole dorsally at the same time with whole of the palm of another hand.

Tenotomy was done i.e, after about 5-10 cast, provided, 0^0 to 5^0 of dorsiflexion was achieved with an abduction of 40^0-50^0.

PERCUTANEOUS TENOTOMY:

Tenotomy was done under local anaesthesia with 2% lignocaine(lox 2%) plain Parents were explained about the procedure, being a minor one, and basic investigations were done.

Steps For percutaneous tenotomy:

Painting was done from mid of leg to mid foot.Draping was done keeping the ankle exposed.Assistant holds the foot in maximum dorsiflexion while the patient is in supine position, foot rotated externally with knee flexed and thigh externally rotated. Tendoachillis was palpated and identified (bluish in light skin). Scalpel blade no.11 or no.15 was put from medial side of tendon. The point of Insertion of blade is 1.5 cm proximal to the attachment of tendoachilles on calcaneum. Blade is kept parallel to the tendon. It is inserted just anterior and touching to the tendon, to avoid the injury to the neurovascular bundle which is present antero medial to it. Now the sharp edge of blade is rotated posteriorly to cut the tendon using its tip.A "POP or SNAP" is felt after successful tenotomy, which gives an additional 15^0 to 20^0 of dorsiflexion.Wound is dressed. No need of putting stitches most of the time.Oral antibiotic and analgesic are given after procedure for 3 days.

LAST CAST APPLICATION:

It was applied and after gaining 15^0 to 20^0 of dorsiflexion and 40^0 -50^0 of abduction and satisfactory varus correction. This cast was applied

keeping the foot in 40°-50 °of abduction and 15° to 20° of dorsiflexion for 2 weeks . After removal of cast, the outcome is, a painless, plantigrade with good mobility and cosmetically acceptable foot.

BRACING:

After the removal of last cast, the brace was applied. Here we used Denis Browne splint keeping the heel at shoulder width apart with foot in abduction of 60° -70° and dorsiflexion of 15° -20°. Knees are kept free.

Brace was adviced to apply whole day and night for next 3 months. Then brace is applied whole night and 2 to 4 hours in the midday till the age of 4 years. Regular follow up were done after application of Denis Browne splint at 14th day, after 3 month and after every 4 month till the age of 4 years, to look for relapse and wear and tear of splint. At the age of 4 years splint should be removed. Patients are counselled to come every 6 month after the age of 4 years till maturity.

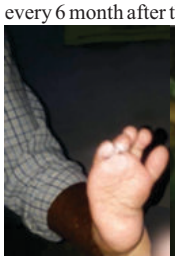


Fig.1 Cavus deformity

Fig.2 Steps of cast application

Fig.3 Adductus deformity

Fig.4 Varus deformity

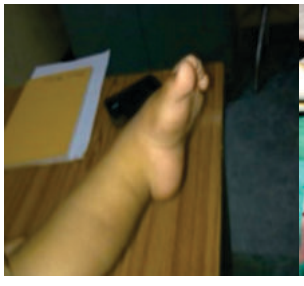


Fig.5 Equinus deformity

Fig.6 Percutaneous tenotomy done

Fig.7 First cast **Fig.8** Third cast

Fig.9 Second cast

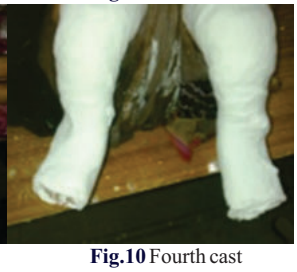


Fig.10 Fourth cast

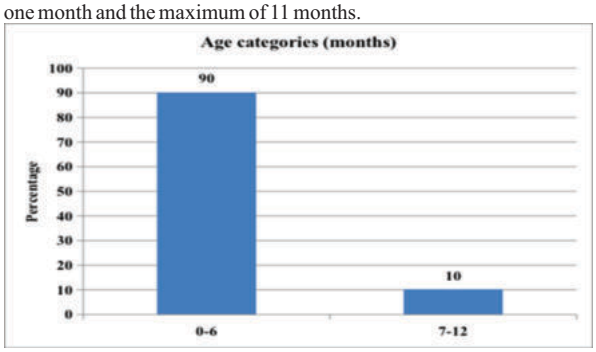
Fig.11 Fifth cast

Fig.12 After treatment (after last cast)

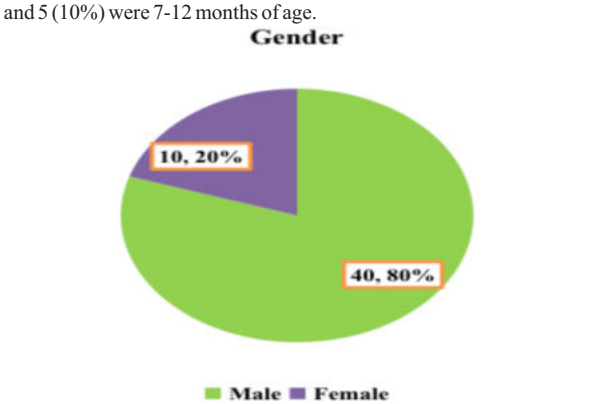
Fig.13 Last cast after tenotomy

RESULTS

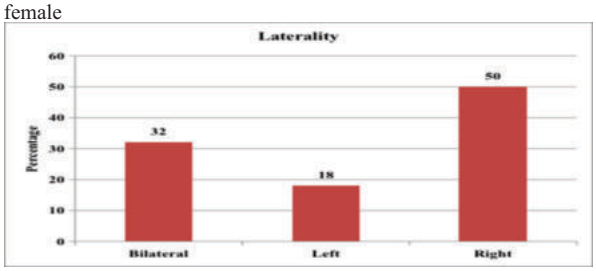
We have recruited 50 children with clubfoot deformity. The mean (SD) age of the participants was 3.72 (2.28) months with the minimum of one month and the maximum of 11 months.



Out of 50 children recruited about 90% of them were 0-6 months of age and 5 (10%) were 7-12 months of age.



Of all the children, 40 (80%) of them were male and 10 (20%) were female



About 16 (32%) of the children had bilateral involvement and the remaining children had unilateral involvement. Out of all children, 9 (18%) had involvement in the left side and 25 (50%) had involvement of right side.

Comparison Of Mean PSS Scoring Before Treatment And Before Equinus Correction

PSS score	Mean	SD	P value
Before treatment	5.27	0.7	<0.001
Before equinus correction	0.58	0.18	

The mean (SD) Pirani severity score before treatment was 5.27 (0.7) and before equinus correction was 0.58 (0.18). There was a significant difference in PSS scores before treatment and before equinus correction with the p value of <0.001.

Comparison Of PSS Scores At Different Stages Of Tenotomy

		Pirani score comparisons				
	PSS score	Number	Mean	SD	Standard error of mean	P value
Pair I	Before treatment	66	5.27	0.74	0.09	<0.001
	After the last cast	66	0.05	0.14	0.02	
Pair II	Before treatment	66	5.27	0.74	0.09	<0.001
	At follow up	66	0.05	0.37	0.05	

There was significant reduction in the Pirani scores before treatment and after last cast and before treatment and at final follow up with a p value of <0.001 making the study significant.

DISCUSSION

Congenital talipes equinovarus is the commonest of all the deformities forming about 80 % of the cases. Its incidence is about 1 in every 1000 live births being more common in India, when compared to western countries.The condition is bilateral in about 66% of cases being more common in males. Idiopathic being the commonest type.

In 1948, Ponseti proposed reducing the deformity with successive casts. Although treatment with cast is a very old method, Ponseti's method is based on strict rules established from anatomic evidence. The goal is not to correct the apparent deformation, but on the contrary, to impose a simultaneous supination and abduction of the foot. Once the calcaneopedal block has been derotated, percutaneous tenotomy of Achilles is performed. Extensive open surgery like posteromedial release is commonly associated with long-term stiffness and weakness, which is avoided by the Ponseti technique.

Ponseti reported that open surgery is avoided in 89% of cases by this technique of manipulation, casting and limited surgery. Correction of heel varus and increased declination angle of neck of the talus are better in a clubfoot treated by Ponseti method of management as compared to traditional casting methods.

In our study, the most common age range for presentation was 0-6 months. This constitutes 90%. The ratio of male to female in our study was 4:1. This similar male to female ratio was found in Sharma Pulak et.al's study[10].

Patients with isolated right side clubfoot (50%) were more common, more than the bilaterally (32%) affected patients. Least common was isolated left sided clubfoot (18%). In general, studies shows bilateral patients to be more common compared to our study, as in R.A Agrwal et al's 40%[11]. Ankur G. et al's 37.66%[2].

The average number of cast used in 0-6 months of age was 7.3 and the average number of cast used in 7-12 months of age was 7.7 The average number of cast used was slightly less in 0-6 months compared to 7-12 months of age When the age increases, the number of cast requirement also increases similar conclusion was given by RA Agrawal et al[11].

The range for number of cast applied is 6-10 in our study and it is comparable for Ankur Gupta et al's[2] study, whose range was 3-10 and also in study of Ponseti IV and Smoley EN , it is 5-10. Our average number of cast application was 7.5, comparatively higher to Rebecca Kampa et al's[12] and Ankur et al's[2] study.

In our study the number of cast application increases as the pirani severity score of foot increases so we can conclude that the number of cast depends on both age and mean Pirani severity score at presentation (table) we can see a ascending slope in the charts similar conclusion was given by RA Agrawal et al's[11] study we used Percutaneous Tenotomy for equinus correction in all patients in our study as compared to study by Osmania nuri ozyalvac et al. as it increases foot abduction also[13].

The tenotomy required by Ankur et al[2] was 95%. Pirani did 90% tenotomy,and Dobbs did it 91%[2]. So requirement of tenotomy is towards the higher side in our study which is comparable to their studies.

In our study 98% of ctev feet were managed successfully and none of them were referred for PMSTR compared to Ponseti management which had good to excellent result in 78%[14] .

Ankur et al[2] . successful correction without any residual deformity in 6 month of follow up.

Successful initial correction in Ashish et al's[3] study was upto 95%. Recent study of Segev et al. had 94% excellent results[3] .Ponseti IV,Smoley EN[15] had 71% good results.

There was a significant reduction in the PSS before treatment and after the follow up. And, these difference in PSS between before treatment , after the last cast and at follow up were significant with the p value of <0.001 similar results with significant p value was seen in Ayush Kumar Jain et al's study[16].

There were no major complication, like rocker bottom foot or flat foot. Pressure sore, skin blisters were managed by keeping the foot without cast for 1 week or less. Bruise and eczema were managed conservatively only. For cast breakage, we re-enforced or reapplied the cast. For overcrowding we did cast trimming.

The most common cast related complication was pressure sore usually grade 1, and cast breakage.

Tenotomy was done under local anaesthesia. We gave oral antibiotic and analgesic after tenotomy. There was no any infection in any patient at the surgical site.

Clinically the feet were painless, flexible, plantigrade, mobile and cosmetically acceptable.

CONCLUSION

- The incidence in males is four times as compared to females.
- Right sided affection is most common.
- Most commonly clubfoot presents with a Pirani severity score of 5-6
- The results are better if the treatment is started in younger age.
- The number of cast applied in Ponseti method, increases with the increase in age at presentation and Pirani severity score.
- Correction of equinus with Tenotomy is more effective
- Compliance and regular visit to clinic was important.
- Ponseti method of clubfoot treatment has excellent results, with low expenditure and with minimum surgical intervention (percutaneous tenotomy).
- Ponseti technique gives a painless, plantigrade, mobile and cosmetically acceptable foot.
- Use of Ponseti method early reduces the need for extensive corrective surgery for congenital idiopathic clubfoot.
- Ponseti tenchnique can be implemented in rural area after training plaster room attenders also, with caution.

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