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**Original Research Article**

# Management of CTEV with TA Tenotomy Following Ponseti method: Evaluation with Demiglio Score and Footprint angle, prospective cohort study

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**Abstract:-**

**Introduction:-**Congenital Talipes Equinovarus (CTEV) is a common deformity of the foot in all races. Turco advocated open tenotomy of the Achilles tendon at musculotendinous junction under direct vision but Ponseti reported the use of subcutaneous tenotomy in 70-90% cases of club feet treated conservatively and dorsiflexion beyond 15 degrees was not possible at the ankle.

**Aims and objective:** Evaluation of effectiveness of tenotomy in clubfoot by demiglio score and footprint angle.

**Material and method:** Patients with idiopathic CTEV who presented less than 2 year age in the outpatient department were included in the study in the period of 2 years. Study design is prospective cohort study included 35 patients. 5 patients lose to the follow up hince study composed of 30 patients with 47 feet. Quantification of various components of clubfoot deformity was done by using the Dimeglio score.

**Result:** Quantification of various components of clubfoot deformity was done by using the Dimeglio score. Total cases 17 (56.6%) cases have bilateral presentation and 13 (43.4%) cases have unilateral presentation (Right sided 9 cases and left sided 4 cases). Satisfactory outcome was noted in 43 feet.

**Conclusion:** Achieved a successful correction by Ponseti method with tenotomy less than two year age group patients was 91.4% feet according to Dimeglio scoring system.

**Keywords:** Ponseti method, CTEV, Tenotomy, Demiglio Score, Footprint angle.

## 1. INTRODUCTION

Clubfoot or Congenital talipes equinovarus (CTEV) was introduced in the medical literature by Hippocrates around 300 B.C. Congenital Talipes Equinovarus (CTEV) is a common deformity of the foot in all races.[1]

Plaster of Paris casts, introduced by Kite and popularized by Ponseti is the most commonly used method.[2,3] Subcutaneous tenotomy of Tendo-Achilles was a minor procedure, first described by Lorenz (1782) in Frankfurt and Delpech (1823) in France.[4,5]

Turco advocated open tenotomy of the Achilles tendon at musculotendinous junction under direct vision but Ponseti reported the use of subcutaneous tenotomy in 70-90% cases of club feet treated conservatively and dorsiflexion beyond 15 degrees was not possible at the ankle.[6]

In CTEV foot is in equinus, cavus, varus and adducted positions and is supinated. It is generally agreed that initial treatment of clubfoot should be non-operative; regardless of severity of deformity.[7,8]

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Tenotomy of the tendo-achilles is mandatory to correct the equinus deformity to obtain dorsiflexion and required in almost 85% of cases of Congenital Talipes Equinovarus (CTEV) treated with Ponseti technique.[9,10] The technique with needle may possibly have advantages in comparison to others tendon lengthening techniques, due to the minimally invasive approach, the simplicity and very low morbidity.[11]

As described by Ponseti, tenotomy is performed by a tenotomy blade, such as 11 number or 15 number, or other small blade, like an ophthalmic knife. However, complications associated with procedure, such as excessive bleeding, formation of a pseudoaneurysm and neurovascular injuries, were described. To avoid these rare but serious complications, many modifications like mini-open tenotomy and needle tenotomy, have been developed.[12,13,14]

## 2. MATERIAL AND METHODS

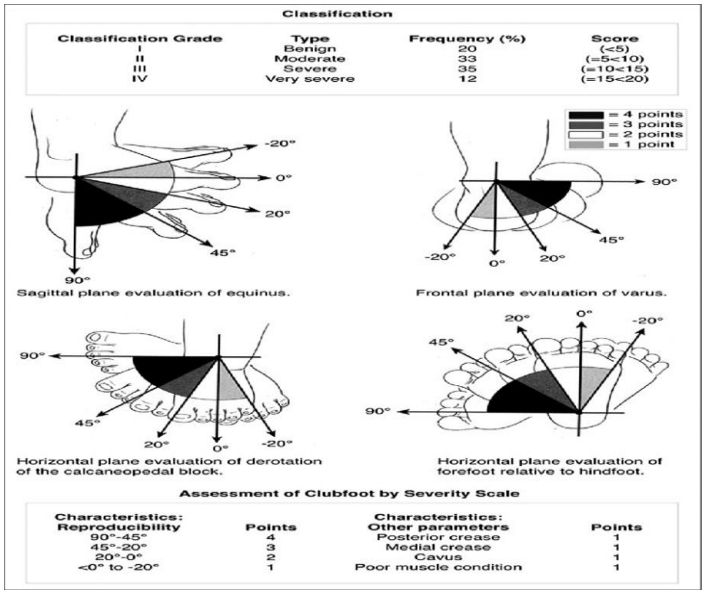
Study was conducted in the Department of Orthopaedics Surgery, Gajara raja medical college amd JA Hospital Madhya Pradesh during the period from August 2018 to August 2020 with informed consent with parents. Patients with idiopathic CTEV who presented less than 2 year age in the outpatient department were included in the study. Study included 35 patients. 5 patients lose to the follow up hence study composed of 30 patients with 47 feet.

**Inclusion criteria:**(1) Children with idiopathic CTEV, treated by the Ponseti technique and submitted for tenotomy of the Achilles tendon for correction of residual equinus. (2) Primary and follow-up treatment done completely at same institution.(3) Age birth to 2 year.

**Exclusion criteria:**(1) > 2 years of age. (2) The non-acceptance of the parents in participation in the study. (3) Operated previously. (4) Non-idiopathic club foot e. g. Secondary congenital talipes equinovarus types (Postural, Neglected, and Relapsed) excluded from our study. (5) Neuromuscular disorder Associated with syndromes.

Quantification of various components of clubfoot deformity was done by using the Dimeglio score.

Dimeglio Score (1994)[15,16]. Essential parameters - the examiner applies a gentle corrective force and records. (i) The equinus deviation in the sagittal plane (0-4 points) (ii) Varus deviation in the frontal plane (0-4 points) (iii) Derotation of the calcaneo-forefoot block (0-4 points) (iv) Forefoot adduction in the horizontal plane (0-4 points).




**Table/Figure 01: Dimeglio scoring system**

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- $90\text{-}45^0$- 4 Points
- 45-20° - 3 points
- 20-0° - 2 points
- 0-(-20°) - 1 point
- >-20 - 0 point

**2. Further additional elements**

- Posterior crease give 1 point, Medial crease give 1 point ,Cavus give 1 point and Poor muscle condition give 1 point. Total of essential parameters is 0-16 points and Total of further additional elements is 0-4 points.Overall total score - 0-20 points.

**3. Grading of feet:**

- Grade I- Benign feet 0-5
- Grade II- Moderate feet 6-10
- Grade III- Severe feet 11-15
- Grade IV- Very severe 16-20

Treatment protocol According to ponseti method (1996,2000):-
According to Ponseti components of clubfoot deformity must
be corrected simultaneously except for the equinus, which takes place
in the ankle joint and must be corrected last.
Cavus is corrected by elevating the 1st metatarsal head and aligning the forefoot with the hindfoot. Correction of the adduction and heel varus deformity by abduction of foot in supination and planter flexion while maintaining the thumb pressure over the lateral aspect of the head of the talus as fulcrum.
Gradual correction should be attempted with the correction maintained for 60 seconds with gentle pressure. After manipulation for 2-3 minutes a thin well moulded toe to groin cast is applied to maintain the correction.

The casts are changed weekly after gentle manipulation. As the foot abducts the calcaneum starts to dorsiflex. The aim is to achieve about 70° of abduction of the foot under the talus. The foot can be maintained in external rotation as long as if talus, ankle, and leg are stabilized in a toe to groin cast, while the knee is in 90° flexion.

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Equinus is corrected by dorsiflexion of the whole foot after adduction and varus are corrected, with the palm under the sole of the foot. The aim is to get minimum of 15° of dorsiflexion at the ankle joint. The heel should be well moulded. 2-3 such casts should be applied. When there acquired dorsiflexion is achieved a final cast is applied for 3 weeks with the foot in 70° of abduction and 15-20° of dorsiflexion.

A percutaneous Achilles tenotomy was performed if the foot could not be dorsiflexed to $15^0$ prior to application of the final cast. Simple percutaneous tenotomy of the Achilles tendon is done without any local anaesthesia on the sedated child, by a 15 number blade under aseptic precaution. Tenotomy is completed a snap was perceived with a click and sudden visible increased correction of dorsiflexion. Immediately after the tenotomy dorsiflexion of about 15-20° is achieved.

A light pressure was given over blade insertion site for haemostasis. The circulatory conditions of the toes ware observed by seeing nail blanching. Afterwards, corrective cast is then applied for 3 weeks. The patient observed for circulatory conditions of the ankles, to general state, and signs of bleeding for thirty minutes. After 3 weeks of cast, correction was maintained by foot abduction braces.

**Table/Figure 02: Tenotomy procedure**

Foot abduction braces were applied while maintaining corrected feet in $70^0$ of abduction and $15^0$ of dorsiflexion in bilateral cases. In unilateral cases corrected foot was maintained at $75^0$ while the other in $45^0$ of abduction with both feet in $15^0$ of dorsiflexion.

The brace that we used is Steenbeek foot abduction brace. After removal of the three weeks cast the brace is advised full time except for occasional removal for cleaning purposes. This continues for three months, after which the kid is shifted to nap time bracing in which the brace is worn during the night and during any day time naps. Total time of bracing is 12-16 hrs a day. This is to be followed till the age of 4 yrs. Care is taken to seem for external tibial torsion and heel valgus while the kid is on the brace, and if this happens the rotation of the foot should be decreased to 40° from 70°.

After application of the brace the patient was called up for follow up at 2 weeks to troubleshoot compliance issues and at 3 months to shift to nap and night time bracing and every 4 months to check for relapses and compliance.

Relapse in infants recognized by the loss of abduction, loss of dorsiflexion, recurrence of metatarsus adductus. Relapse in toddler is recognized while the child is walking. From the front one should look for forefoot supination and from behind look for heel varus. Loss of dorsiflexion at ankle should be looked for equinus . Management of relapses requires early recognition and reapplication of corrective cast by the Ponseti technique after which strict bracing is started again. This is sufficient for varus relapse.

The treatment protocol after a repeat tenotomy remains the same as that after the primary procedure. A repeat percutaneous tendo-achilles tenotomy should be done at a site away from the first site. After 8 weeks of bracing a post correction Deformity assessed by Dimeglio scoring.

## 3. RESULTS

Study was conducted at Gajatra raja medical college and JA hospital Bhopal Madhya Pradesh in the department of Orthopaedic surgery. This study included 30 patients (47 feet).

Out of total cases 17 (56.6%) cases have bilateral presentation and 13 (43.4%) cases have unilateral presentation (Right sided 9 cases and left sided 4 cases) The maximum follow-up was 15 months.

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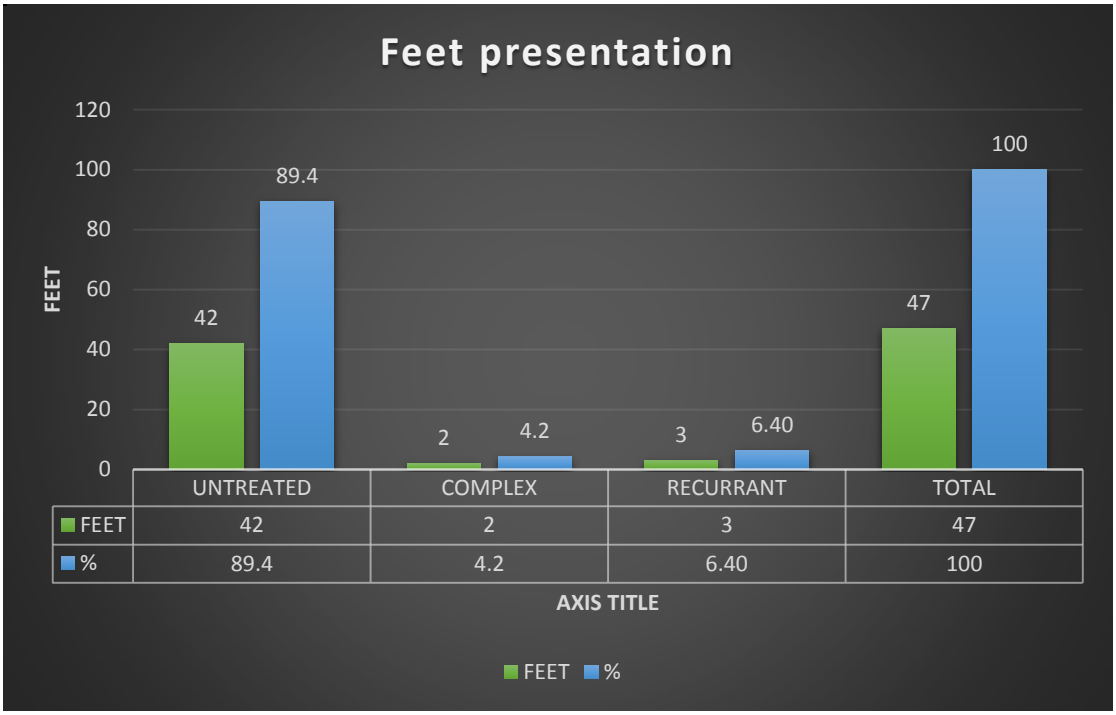


**Table/Figure 03. classification of Feet at presentation:**

Mean precorrection Dimeglio score is 14.17 and maximum precorrection Dimeglio score is 18 and minimum precorrection Dimeglio score is 8.

| Grade | Points | No. of feet | Percentage | Condition of feet |
|---|---|---|---|---|
| I (Benign feet) | O - 5 | 0 | 0 | |
| II (moderate feet) | 6 – 10 | 8 | 17% | Poor |
| III (severe feet) | 11 - 15 | 25 | 53% | |
| IV (very severe feet) | 16 - 20 | 14 | 30% | |
| Total | | 47 | 100% | |

**Table/ figure 04: Dimeglio grade at initial evaluation.**

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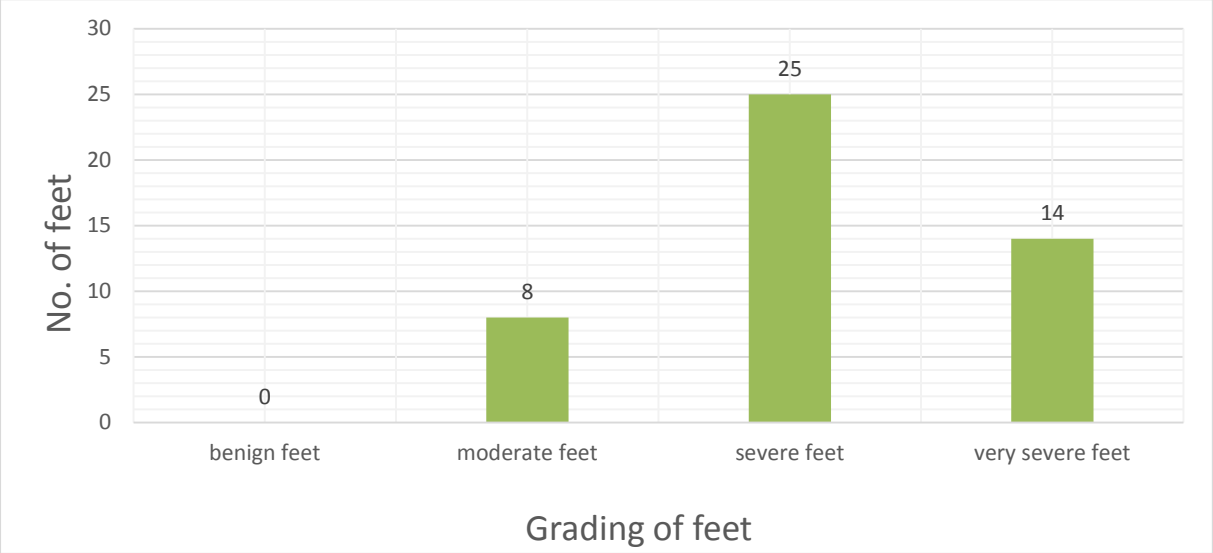


**Table/Figure 05. Grading of Feet by Dimeglio scoring system at initial evaluation.**

According to dimeglio system there were 25 feet in the grade III group, which made more than 50% of total feet included severely deformed feet and 30% feet were in very severely deformed feet.

Mean postcorrection Dimeglio score is 2.70 and Maximum postcorrection Dimeglio score is 8.0 and Minimum postcorrection Dimeglio score is 2.0

**Table/Figure 06: Precorrection And Postcorrection of CTEV foot**

| Grade | Points | No. of feet | Percentage % | Condition of feet |
|---|---|---|---|---|
| I | O - 5 | 43 | 91.4 | Excellent |
| II | 6 – 10 | 4 | 8.6 | poor |

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| | | | | |
|---|---|---|---|---|
| III | 11 - 15 | 0 | 0 | - |
| IV | 15 - 20 | 0 | 0 | - |
| Total | | 47 | 100 | |

**Table/Figure 07: Dimeglio grading of feet at last follow up (Final evaluation)**

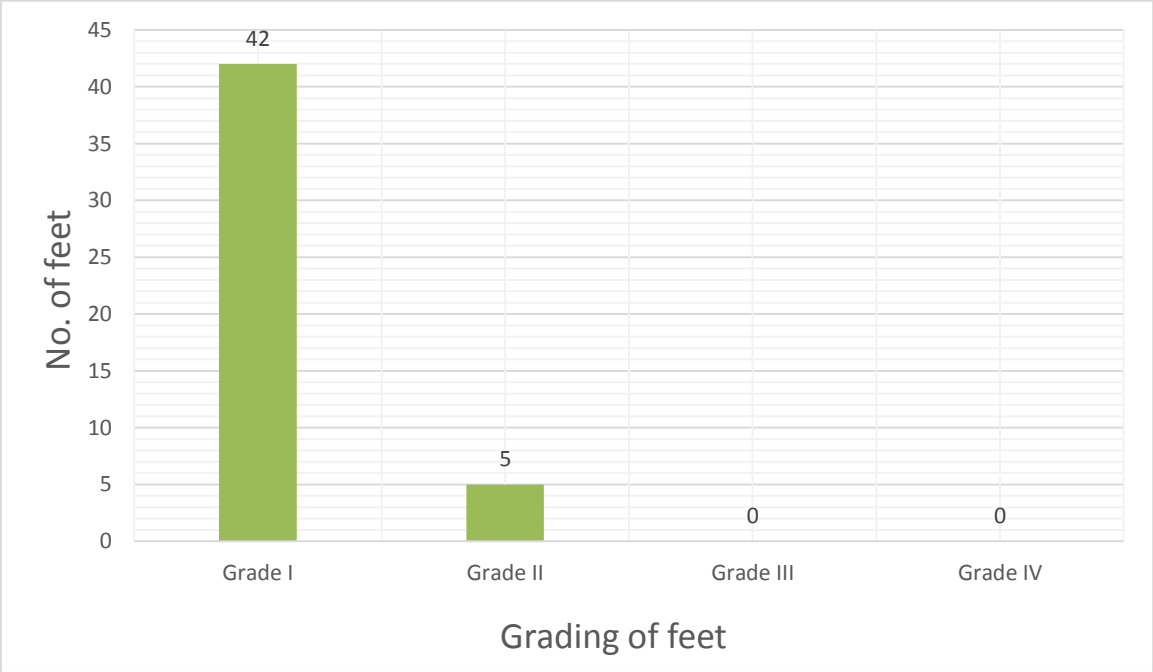


**Figure 08: Grading of Feet by Dimeglio scoring system at Final evaluation (Last follow up)**

Mean Precorrection foot print angle was $14.21^0$ and maximum Precorrection foot print angle was $18^0$ and minimum Precorrection foot print angle was $13^0$.
Mean Postcorrection foot print angle is $9.78^0$ and Maximum Postcorrection foot print angle is $11^0$ and Minimum Postcorrection foot print angle is $8^0$.

**Figure 09: Foot Print Angle Precorrection and postcorrection**

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| FOOT PRINT ANGLE | PRECORRECTION | | POSTCORRECTION | | OUTCOME |
|---|---|---|---|---|---|
| | No. of Feet | Percentage | No. of Feet | Percentage | |
| $\leq 8^0$ | | | 2 | 4.3 % | Excellent |
| $8^0$- $10^0$ | | | 43 | 91.4 % | Good |
| $11^0$ | | | 2 | 4.3 % | Poor |
| $13^0$ | 15 | 32 % | | | |
| $14^0$ | 23 | 49 % | | | |
| $15^0$ | 6 | 12.7 % | | | |
| $16^0$ | 3 | 6.3 % | | | |
| Total | 47 | 100 | 47 | 100 | |

**Table/Figure 10: Comparison precorrection and postcorrection Foot print angle.**

A percutaneous tenotomy of tendon Achillis was performed in all 47 feet in this study. 3 (6.4%) feet out of this required repeated percutaneous tenotomy of tendon Achillis.
Mean Number of casts required for correction of deformity was 5. Maximum number of casts for deformity correction was 16
Complications related to this study is residual equinus in three feet (6.4%) and plaster sore in one foot (2.1%) and residual supination in one foot (2.1%).

## 4. DISCUSSION

There was a study to evaluate the effectiveness of Ponseti method with tenotomy in children in Indian setup. Quantification of Deformity assessment was done by using Dimeglio scoring and by taking podogram before the start of treatment, immediately after correction, eight weeks after bracing and at final follow up.
So we conducted the study and compared the observation of current study with the available literature.

Mean precorrection Dimeglio score in this study was 14.17, According to Dimeglio grading criteria it lies in grade 3 (Dimeglio score 10-15). Comparable by Shah Alam Khan et al (2010) in his study. They reported average Dimeglio score at the start of treatment was 14.2 which was also match with the Dimeglio grade-3. Precorrection Dimeglio grade is same in both studies that is grade-3 severe deformity.

Mean postcorrection Dimeglio Score in this study was 2.70. According to Dimeglio grading criteria it lies in grade-1(Dimeglio score (0-5). This observation is supported by Shah Alam Khan et al (2010) in his study. They reported average Dimeglio score at the end of 1 year follow up of treatment was 0.95. Which was also corresponded to Dimeglio grade 1. Postcorrection Dimeglio score in present study was higher than other study. But postcorrection Dimeglio grade is same in both studies that is grade 1 mild deformity.

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In current study 100 % patients subjected to a percutaneous tenotomy of tendon Achilles. This observation is substantiated by literature. Percutaneous tenotomy of tendon Achilles was done in 39 feet out of 45 cases (86.6 %) in study done by Shreyas, Deepak et al (2017). A percutaneous tenotomy of tendo-achillis was performed in 100 % patients in a study done by Aimal sattar, muhd shabbir et al (2019). Tenotomy was effective in 92% patients and was not effective in 8% patients. A percutaneous tenotomy of tendo-achillis was performed in all patients (100%) in a study done by Mushtaq abdul, las jamal et at (2020). Mean age at presentation was higher in their studies this may be the reason for tenotomy in all patients.

In current study a repeat tenotomy was required in 6.4% of the patient. We did repeat tenotomy in those patients who lost some degree of dorsiflexion due to poor brace compliance. We motivated these patients to wear brace after second tenotomy and achieved desired dorsiflexion till latest follow up. Recurrent equinus in 23.4%, required a second percutaneous tenotomy of tendo-achillis in a study done by A.F. Lourenco,J. A. Morcuende A. (2007). Higher rate of second tenotomy in their study may be because they included older patients than our study.

Hegazy Mohameda Nasef (2009) reported that 9.4% of the patients of their study required repeated tenotomy. Percentage of repeated tenotomy higher in the study. This may be because they included patients of age group of 4 months to 13 months. Patient of their study were younger than current study.

In current study the average number of casts used was 5. This is compared with the number of casts used in a study done by kumar Dinesh, Jain Mahendra et al (2020) Their average number of casts was 4.3(range from 3 to 8). Sharma A. Shukla S. et al(2018) reported that the average number of casts used in their study was 5.10. Agrawal R. A., M.S. Suresh et al(2018) average number of casts used in their study was 6.

Mean precorrection foot print angle was 14.21°. Mazhar Abbas et al(2008) measured mean precorrection foot print angle in younger patients. Mean precorrection foot print angle was 14.2°.

Mean postcorrection foot print angle was 9.78°. Mazhar Abbas et al (2008) measured mean postcorrection foot print angle in younger patients. Mean postcorrection foot print angle was 10.1°. Which is comparable to current study.

Complication in the form of superficial plaster sore developed in one patient. This was treated conservatively by avoiding cast for 1 week. Choubey Raghvendra et al (2015) two cases developed plaster cast complications (One with pressure sores over medial aspect of great toe which was in blade tenotomy group and one case had skin abrasions over the thigh) which were managed successfully. Umit tuhanioglu Hasan U. et al (2018) Prolonged bleeding was seen in 2 feet after percutaneous tenotomy and was controlled with local pressure

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Repeat Tenotomy was done for residual equinus in 3 feet (6.4%). One Foot (2.1%) has residual supination where tibialis anterior transfer was done. Shaheen Samir Abdulla Musaab et at (2015) Persistent Equinus deformity after the tenotomy was observed in five feet (3.7%).

In present study the mean Dorsiflexion possible after correction was 16°. Agrawal Sunny, Suresh B et al (2017), noted that mean dorsiflexion possible after correction was 12.5° (10-15°) in their study. Above mentioned literature post correction dorsiflexion in current study was more than the others. This may be because in other studies patients were older than current study.

The longest duration of follow-up in our study was 15 months. Average follow up was 10 months. We are aware that the follow up in current study is small and further follow up will be necessary to understand fully the limits of this method in older children with club feet. However, the results of study were very encouraging for the treatment of idiopathic clubfoot in older children by a simple, effective, and inexpensive method in developing nations.

**Limitation:** Due to short duration of the follow up, the long-term outcome of Ponseti method in treating clubfoot and the late onset of complication cannot be accessed. Also, objective measure was not used to quantify parents response.

## 5. CONCLUSION

Achieved a successful correction by Ponseti method with tenotomy less than two year age group patients was 91.4% feet according to Dimeglio scoring system. This method is not associated with major complications. Three feet has residual equinus and only one foot developed superficial plaster sore. Only one foot required surgery. Both the patients and their parents were very satisfied with the result of treatment by this method.

## 6. REFERENCE

1. Wynne-Davis R. Family studies and the causes of congenital clubfoot: Talipes equinovarus, talipes calcaneal valgus, and metatarsus varus. J Bone Joint Surg Br 1964;46: 445-63.
2. Ponseti IV, Smoley EN. Congenital club foot: The results of treatment. J Bone Joint Surg Am 1963;45-A: 261-34.
3. Morrissy RT and Weinstein SL. Lovell and Winter's Pediatric Orthopaedics. Baltimore: Lippincott Williams & Wilkins 5th ed, 2000.
4. Kite JH. Congenital metatarsus varus: Report of 300 cases. J. Bone and Joint Surg 1950; 32-A: 500-506.
5. Ponseti IV and Campoz J. Observations on Pathogenesis and Treatment of Congenital Clubfoot. Clin Orthop 1972; 84: 50-59.
6. Helal B and Wilson D editors. The Foot. London: Churchill Livingstone Longman, 1st ed, 1988, pp 219-34.
7. Turco V.J. Resistant congenital clubfoot. AAOS Inst. Course Lect 1975; 24: 104.
8. Ponseti I.V. Clubfoot: Ponseti Management: Global Help Publications; 2003.

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9. Herring JA. Tachdjians Pediatric Orthopaedics: Congenital Talipes Equinovarus. WB Saunders Co; 2002.
10. Saini R, Dhillon MS, Tripathy SK, Goyal T, Sudesh P, Gill SS, et al. Regeneration of the Achilles tendon after percutaneous tenotomy in infants: a clinical and MRI study. J PediatrOrthop B. 2010;19(4):344–7.
11. Bor N, Coplan JA, Herzenberg JE. Ponseti Treatment for idiopathic clubfoot: minimum 5-year follow-up. Clin OrthopRelat Res 2009; 467: 1263-70.
12. Patwardhan S, Shyam AK, Sancheti P. Percutaneous Needle Tenotomy for Tendo-achilles Release in Clubfoot – Technical Note. J Ortho Case Reports. 2012; 2(1): 35-6.
13. Burghardt RD, Herzenberg JE. A. 2008. Ranade Pseudoaneurysm after Ponseti percutaneous Achilles tenotomy: a case report. J PediatrOrthop., 28:366–9.
14. Dobbs MB, Gordon JE, Walton T, Schoenecker PL. 2004. Bleeding Complications Following tendoachilles percutaneous tenotomy in the Treatment of clubfoot deformity. J PediatrOrthop. 24:353–7
15. Dimegilo A. Classification of talipes equinovarus. The Clubfoot. The present and a view of the future. Ed. Simons, G.W. Springer Verlag 1994.
16. Dimeglio A., Bensahel H., Souchet P., Mazeau P., Bonnet F.: Classification of clubfoot. J. Pediatr. Orthp., 4B: 129-36, 1995.
17. Ponseti, I.V.: clubfoot fundamentals of treatment, oxford university press, 1996.
18. Ponseti, I.V. editorial, clubfoot management. J pediatrorthop. .20:699-700: 2000