



Orthopaedics

A STUDY OF ROLE OF MANAGEMENT OF CONGENITAL TALIPES EQUINO VARUS DEFORMITY IN CHILDREN BY PONSETI METHOD

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ABSTRACT **BACKGROUND AND OBJECTIVE:** Idiopathic congenital talipes equino varus is a complex deformity that is difficult to correct. The treatment of clubfoot is controversial and continues to be one of the biggest challenges in pediatric orthopaedics. Most orthopedicians agree that the initial treatment should be non surgical and should be started soon after birth. We aimed to study a short term follow up of 30 patients treated by the Ponseti method at the department of Orthopaedics, S.V.S Medical College, Mahabubnagar to assess the efficacy of the treatment modality. **METHODS:** 30 patients underwent the Ponseti method at Department of Orthopaedics S.V.S. Medical College, during the period of from September 2017 to September 2019, patients were followed up regularly at monthly intervals. The severity of foot deformities were graded as per Pirani's scoring system. **RESULTS :** Good results were obtained in 27 patients. 3 patients developed recurrence of the deformity due to non compliance of the use of orthotics. **INTERPRETATION AND CONCLUSION :** The Ponseti method is a safe and cost effective treatment for congenital idiopathic clubfoot and radically decreases the need for extensive corrective surgery. Non compliance with orthotics has been widely reported to be the main factor causing failure of the technique.

KEYWORDS : URS, UTI**INTRODUCTION**

“Clubfoot”, “Piede torto”, “Pie Zambo”, “Pie Bot”, “PesEquinovaro Congenito”, “Klumpfus” are worldwide synonyms for congenital talipes equinovarus, a complex birth deformity of the foot that is difficult to correct.

Clubfoot occurs in one in 1000 live births and is one of the most common birth defects involving the musculoskeletal system.¹ CTEV results in an equine deformity characterized by ankle plantar flexion, subtalar inversion and adduction of the hind and forefoot. The foot itself is usually short and broad in appearance. The muscles of the lower leg are often small in diameter and do not fully develop. The incidence among different races ranges from 0.39 per 1000 among the Chinese population to 1.2 per 1000 among Caucasian to 6.8 per 1000 among Polynesians.² Lochmiller 1998 reported a male to female ratio of 2.5:1 and 24.4% of the affected individuals have a family history of idiopathic talipes equino varus.³

Treatment of this deformity dates back to fifth century B.C, by Hippocrates and has since undergone tremendous changes largely due to a better understanding of the deformity. Over the years many different forms of treatment ranging from gentle manipulation and strapping, serial plaster corrections, forcible manipulations including the use of mechanical devices to surgical correction have been tried.

Although some success with non surgical treatment has been reported in the literature, results have often been less than optimal, with partial corrections, recurrence, and other complications.⁴ This has led to a trend toward surgical intervention, usually within the first year of life.⁹⁻¹⁰ However, surgical treatment also carries significant risks, and the potential for complications is great. There has been much debate in the past as to whether a conservative or operative treatment was more effective in the treatment of clubfoot. Those feet usually which have had numerous manipulations and operations are stiff, deformed and rigid due to scar tissue formation.

The Ponseti treatment for clubfoot deformity was introduced in North America in the late 1940s and has become a primary treatment option in many countries more recently. Ignacio Ponseti, MD, at the University of Iowa, developed an inexpensive and effective method of treating clubfoot by serial manipulation, a specific technique of cast application, and a possible percutaneous Achilles tenotomy. The clinical correction achieved by using this method has produced a functional, plantigrade foot without requiring posteromedial release in 85% to 90% of cases.⁷⁻⁹ Long-term follow-up studies show that feet treated by Ponseti management are strong, flexible, and pain free. These studies prove that Ponseti management of clubfoot is best for all

countries and cultures.¹

Higher number of patients coming to our center from nearby districts, the unsatisfactory results associated with complete soft tissue releases at ten to fifteen years of follow-up^{9,10} and good to excellent results by Ponseti technique reported by many authors^{3,9-12} encouraged us to study the subject.

Material and Methods

This study includes 30 patients from outpatient section of Department of Orthopaedics, S.V.S medical college and Hospital, Mahabubnagar. The study was done between September 2017 to September 2019.

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

History

A complete and detailed history was taken in every case. Antenatal, natal and postnatal history of mother was taken to find any eventful condition during or after pregnancy. Family history for clubfoot and other congenital diseases was also inquired. Each patient was subjected through general, physical and systemic examination including spine, hip and extremities.

Pretreatment Assessment

After taking complete history, mobility of foot was assessed by applying gentle corrective manipulation. Foot was classified into supple type, if manual reduction was possible; and rigid type, where manual reduction was impossible.

Children were evaluated and graded for severity of clubfoot by Pirani severity scoring system^{20,21}, which registers the deformity of six different components of the clubfoot.

The congenital clubfoot undergoing treatment was assessed at each visit and assigned

- A Midfoot Score (MS) of up to 3 (0=normal, 3= severe deformity)
- A Hindfoot Score (HS) of up to 3 (0=normal, 3= severe deformity)
- A Total Score (TS) of up to 6 (0=normal, 6= severe deformity)

Consequently, the total Score was from 0 to 6 points, with 6 representing the most severe deformity.

Use of Pirani Score

Every clubfoot under Ponseti management was “Scored” at each week for HS, MS, and TS (Total Score). The Scores were plotted on a graph to know how the foot was recovering on the roadmap of treatment. Tenotomy was indicated when HS > 1, MS < 1, and the head of the talus was covered. After calculating Pirani Severity Score at initial presentation and at weekly interval during follow up, it was noted in proforma specially made for it.

Categorisation of feet

The feet were then classified into three categories with respect to the severity of the deformity on basis of initial Pirani Score.

- Group-I feet with a Pirani Score of 1.5 to 2.5 points
- Group-II feet with a Pirani Score of 3 to 4.5 point
- Group-III feet with a Pirani Score of ≥ 5 points.

Treatment Regimen

The Ponseti technique^{8,24} was used at our institution according to the following regimen.

- Treatment was started as soon as possible after birth and consisted of gentle manipulation of the foot and the serial application of long leg plaster casts without the use of anesthesia, as described by Ponseti. We initiated this same treatment method even in the older children (up to fourteen months of age) who were referred to us for the first time. Order of deformity correction. Cavus, Adduction, Heel varus and Equinus



Figure 1. Initial presentation

Figure 2. Manipulation



Figure 3

Figure 4

Figure 5



Figure 6

Figure 7. After final correction

Figures 3-6....serial casts

A simple percutaneous tenotomy of the Achilles tendon was performed if-

- Residual equinus was observed i.e. after the adduction of the foot and the varus deformity of the heel have been corrected.
- 15° of dorsiflexion has not been obtained with use of casts.
- When HS > 1, MS < 1, and the head of the talus was covered.

Post correction Follow up:

After the last cast was removed and once all deformities were

corrected, the patients were given Denis Browne splint. Patients were evaluated every 15 days until the age of six months, and then every month after initial completion of treatment to encourage parental compliance to bracing and to evaluate maintenance of correction and any early signs of recurrence.

Bracing

After achieving full correction with casts, a custom made DB splint with 70 degree external rotation of the affected foot and 15 degree bend of the connecting bar is given for constant use (at least 23 hrs per day) for the next 3 months or till the child is cruising and then at night for 12 hrs for next 4 yrs. Foot abduction orthosis splint was used to prevent relapse of the deformity the brace was fitted on the same day as the last POP cast was removed. After this the splint was used only for nightwear and CTEV shoes were given for daytime use to facilitate walking.



Figure 8. Dennis Brown Splint

Result assessment:

Final grading of the patient’s results was done into good, fair and poor results.

- Good Results : Patients were labeled as having a good result if Pirani Score is 1.5 points or better or if all deformities get corrected by Ponseti technique alone at final follow up.
- Fair Results: Patients were labeled as having a fair result if additional surgical procedures such as tendon lengthening through an open approach or a posterior release of the ankle and subtalar joint was done to get correction.
- Poor Results: Patients were labeled as having a poor result if Ponseti technique failed to give complete correction of foot even once.

RESULTS

The present study includes treatment and follow up of 30 children with idiopathic clubfoot which were managed by ponseti method of correction and above knee POP cast application after recording the deformity with pirani scoring and if required percutaneous tendoachilles tenotomy between September 2017 to September 2019.

Age distribution :

TABLE 1 : SHOWING AGE DISTRIBUTION

Age (weeks)	Number of cases	Percentage
Less than 6	18	60%
7-12	3	10%
13-18	1	3.3%
19-24	6	20%
25-30	0	0
>31	2	6.6%
Total	30	100%

Most of the children were below 6 weeks of age. The youngest in the series was of 5 days, while oldest was of 9 months. Treatment was initiated at a mean of 10.2 weeks of age (range- 5days to 36 weeks). Treatment was begun at less than three months of age in 21 cases(70%). In only 2 cases, treatment was initiated at more than 6 months of age. Male predominated the series consisting about 57 % of the population. The male to female ratio in the series was 1.3:1. Of the 30 cases, fifteen (50%) had unilateral and fifteen (50%) had bilateral involvement. Right side was found to be more commonly involved (66%) in unilateral cases when compared to left (34%). Four out of thirty cases were having positive family history for similar deformity of foot. Parental involvement was reported in 1 case. While in other three cases, grandparents, uncle and cousin involvement was reported.

Foot was classified into supple type, if manual reduction was possible; and rigid type, where manual reduction was impossible. By this method, 73.3 % feet were rated as supple and 26.6% as rigid, at time of initial presentation.

TABLE – 2: SHOWING PRE-TREATMENT PIRANI SCORES(According to Pirani)

Group	Score	No of feet	Percentage
I	1.5-2.5	6	13.4%
II	3.0-4.5	28	62.2%
III	≥ 5	11	24.4%
Total		45	100%

The deformity was classified, according to the Pirani scoring system into 3 groups. Group-I with a Score of 1.5 to 2.5 points was seen in six feet (13.4%), Group-II the most common category, with a Score of 3 to 4.5 points was seen in Twenty eight feet (62.2%) and group-III with a Score of ≥5 points was seen in 11 feet (24.4%).

TABLE – 3: SHOWING MEAN PIRANI SCORES AT INITIAL PRESENTATION

Group	Score	No. of feet	Mean Score
I	1.5-2.5	6	2.41
II	3.0-4.5	28	3.625
III	≥ 5	11	5.35
Total		45	3.81

In feet classified in Group I mean Pirani Score was 2.41, while in feet classified in Group II and Group III mean Pirani Score was 3.625 and 5.35 respectively. Overall mean Pirani Score for all feet was 3.81.

TABLE-4: AGE VERSUS NUMBER OF CASTS REQUIRED

AGE IN WEEKS	CASTS REQUIRED				TOTAL
	<3	4-6	7-9	>10	
<6	1	16	1	0	18
7-12	0	2	1	0	3
13-18	0	1	0	0	2
19-24	0	1	3	2	8
25-30	0	0	0	0	0
>31	0	1	1	0	2
TOTAL	1	21	6	2	30

Patients presenting early after birth required lesser number of casts compared to those who presented late.

TABLE-5 : INITIAL PIRANI SCORE VERSUS NO. OF CASTS REQUIRED

Group	Score	NO OF CASTS			
		<3	4-6	7-9	>10
I	1.5-2.5	1	3	0	0
II	3.0-4.5	0	15	3	1
III	≥ 5	0	3	3	1

TABLE – 6 : NEED FOR TENOTOMY AMONG DIFFERENT GROUPS

Group	Tenotomy done		Tenotomy not done		Total no of feet	
	Foot	%	Foot	%	Foot	%
I	0	0%	6	100%	6	100%
II	4	14%	24	86%	28	100%
III	7	63.6%	4	36.4%	11	100%
Total	11	18%	36	82%	45	100%

In group-II with Score of 3 to 4.5 points, 4 feet (14%) underwent percutaneous tenotomy, while in group-III with Score of ≥ 5 points, seven feet (63.6%) required the tenotomy. It was also found that Mean Pirani Score of tenotomy feet (4.9) was higher than non-tenotomy feet (3.26).

The mean number of casts that were applied to obtain correction was 5.84 (range- three to ten casts). The more severe the initial deformity (Higher Pirani Score), the more casts were required to obtain correction. Minimum duration of plaster cast application was five weeks, maximum being thirteen weeks and 64.4% of the patients were kept in cast for six to eight weeks. Average duration of plaster cast application was 8.15 weeks. In the present study, twenty five patients

(83.3%) under treatment showed good compliance while five patients (6%) were noncompliant with Denis Browne splint.

TABLE – 7: SHOWING RELAPSE OF TREATED FOOT

RELAPSE	NO OF PATIENTS	PERCENTAGE
YES	3	10%
NO	27	90%

Three patients were shown to have recurrence of the deformity, once it gets corrected successfully with Ponseti technique. All of the patients were noncompliant with FAB. Relapses were treated with a second series of manipulation and casting, followed by the use of the Denis Browne splint. All the patients with recurrence of the deformity were non-compliant with Denis Browne splint. While in two patients, relapse was not seen inspite of noncompliance.

TABLE-8 : COMPLICATIONS

Complications	No of feet	Percentage
Cast saw injury	1	8.3%
Abrasions	9	75%
Slippage of cast	1	8.3%
Blister	1	8.3%

There were 12 complications among all the castings performed, constituting 26.7% of total feet. Majority of complications were minor abrasions (75%) seen in young neonates that may be due to soft skin. In one patient having marked equinus, downward slippage of the cast was noticed. No infections, skin necrosis, neurovascular compromise, or bleeding were observed even in post tenotomy period.

TABLE – 9: RESULTS OF TREATMENT AT FINAL FOLLOW-UP

Result	Number	Percentage
Good	27	90%
Fair	1	3.3%
Poor	2	6.6%

Patients were labeled as having a good result if Pirani Score is 1.5 points or better or if all deformities get corrected by Ponseti technique alone at final follow up. If additional surgical procedures such as tendon lengthening through an open approach or a posterior release of the ankle and subtalar joint was done to get correction it was classified as Fair result. However if Ponseti technique failed to give complete correction of foot even once, such patients were kept under Poor result. In present study about 90% of patients showed good results and about 3.3% had Fair results and 6.6% of patients had Poor results showing failure with Ponseti technique. Overall 93.3% of the patients showed satisfactory results.

DISCUSSION

A clinical study on one of the most common congenital deformity of foot, i.e; Congenital talipes equinovarus was carried out in Department of Orthopaedics, SVS Medical College, Mahabubnagar to evaluate the early results of the conservative treatment using Ponseti technique. In total, there were thirty children (forty-five feet) treated by Ponseti technique.

Age

When the feet were divided on the basis of the age at first reporting, it was seen that a large proportion of patients were seen very early in life. The youngest patient who was included in this study was less than 7 days old. The mean age at initial presentation of 10.2 weeks is in agreement with age incidence observed by Dobbs et al [21] who reported clubfeet in 51 patients at mean age of 12 weeks, at initial presentation. While in the study of 70 patients by Laaveg and Ponseti [7], the mean age was 6.9 weeks at initial presentation. A mean age of 10.8 weeks was reported by Lehman et al in a series of 30 patients treated by Ponseti technique.

Sex incidence

In our study there were 17 males and 13 female children that is 57% and 43% respectively. Incidence of males and females in our series is not very different from other reported series. Kite in the series of 1509 cases reported 70% males and 30% females. 22 Turco in his series of 468 patients reported 71.36% males and 28.64% females. 13 Raju Rijal et al. in his series reported 76.2% males and 33.8% females. 19

Laterality

As regards laterality, 15 of our cases were bilateral (50%) and 15 were unilateral (57.5%) (10 right and 5 left sided) which is in concordance with other series presented by, Wyne Davis (44% bilateral and 56% unilateral).²⁵ Chung reported bilaterality in 55.75% of cases. Turco reported bilaterality in 56.76% cases. 13 Ponseti found 40% bilateral cases.⁴

In unilateral cases a slight preponderance of right side involvement was reported by Kite²² and Palmer²⁶. However Laaveg and Ponseti⁷ reported slight preponderance towards left side in their series.

Family history

In the present study positive family history was ascertained in 13.3% of Patients. However, review of literature revealed that the percentage of positive family history varies between 5 to 50%.²⁶ Similar incidence of 17.9% of positive family history has been observed by Turco.¹³ On the other hand Morcuende et al³ had reported 22% patients having a positive family history of clubfoot deformity.

Mean Pirani Scores at initial presentatio

In the present study clubfoot deformity was classified, according to the Pirani scoring system into 3 groups. Group-I with a Score of 1.5 to 2.5 points was seen in six feet (13%), Group-II the most common category, with a Score of 3 to 4.5 points was seen in twenty eight feet (62%) and group-III with a Score of ≥ 5 points was seen in eleven feet (24%). Overall mean Pirani Score of 3.81 was recorded for all feet. Similarly mean Pirani Score of 4.6 was noted by Lehman et al.

Pirani Scores Vs Number of Cast Required

We found that those feet belonging to Group I and II were more amenable to correction and responded relatively early when compared to those belonging to Group III. In the Morcuende et al series, no assessment regarding the security of the deformity was available before the initiation of the castings. They used number of casts needed for correction of CTEV as a marker of severity of the deformity.³ Raju Rijal et al. showed in their series, faster rates of decrease in pirani score (improvement) treated by Ponseti technique, regardless of side, mean pirani scores improved much faster similar to our study.¹⁹ In our study, number of casts required for full correction ranged from 4 to 6 and most patients requiring mean number of 5.8 casts. In our study we used Pirani scoring system which is in accordance with Lehman et al series, which shows Pirani scoring is easy to use and simple and fairly reproducible.

Tenotomy

In our study, 11(18%) patients required Percutaneous Tenotomy of tendo Achilles. In Morcuende et al study (n=256) tendoachilles tenotomy was done is 86% of the cases.³ In M Chagulani et al study, 85% (n=100) patients required percutaneous tenotomy of tendo Achilles.¹⁷ Most important observation noted from this study is the recognition that feet requiring tenotomies were equally well corrected clinically at the end of casting as those that did not require tenotomies. This conclusion reinforces the notion that even severe idiopathic clubfeet can be successfully treated using proper application of the Ponseti technique and the need for a tenotomy does not suggest a poorer result.

Number of casts

In the present study the mean number of casts that were applied to obtain correction in group I, II and III were 4.2, 5.53 and 7.7 respectively. The more severe the initial deformity, the more casts were required to obtain correction. However overall mean number of cast for all groups was 5.84 (range, three to ten casts), which is quite similar to Laaveg and Ponseti⁷ and Herzenberg et al¹² who reported mean number of cast as 7. In Morcuende et al³ series, number of casts ranged from 1 to 7, 90% of the patients required ≤ 5 casts for correction.

Duration of Plaster cast application

In present study minimum duration of plaster cast application was five weeks, maximum being thirteen weeks. Average duration was 8.15 weeks. It is quite similar with Herzenberg et al¹², who reported casting for average of 8 weeks, range being 4-12 weeks. While Morcuende et al³ reported that average time from first cast to tendoachilles tenotomy (full correction of deformity) was 20 days which is lower than present study.

Relapse

In the present series 10% of the patients (3 children) reported relapses

after initial successful treatment. Similar observations were reported by Morcuende et al³, who reported that there were 17 (10%) relapses. While Dobbs et al¹⁴ reported relapses in sixteen infants (31%, twenty-seven feet) at a mean age of six months (range, 3-18 months), when there was $\geq 5^\circ$ of hind foot varus and/or $< 15^\circ$ of ankle dorsiflexion. These relapses were significantly associated with noncompliance with the Denis Browne splint. Relapses were treated with a second series of sequential manipulation and casting, followed by the strict usage of the orthotic.

Ponseti²⁷ has reported a relapse rate of 78% in patients noncompliant with the FAB and a relapse rate of 7% in compliant patients. All of the noncompliant patients in Ponseti's series were corrected with recasting.

Complications

There were 12 complications among all the castings performed, constituting 26.7% of total feet. Lehman et al reported 25 complications with rate of 10.2%. Cast saw injuries were commonest accounting for 25% of complications on the contrary Morcuende et al³ reported low incidence of complication (in 12 cases i.e. 8%) which included erythema, slight swelling of the toes, or downward slippage of the cast. Dobbs et al¹⁴ retrospectively reviewed 134 consecutive infants with 219 clubfeet and detected that 4 patients had serious bleeding complication following percutaneous tendoachilis tenotomy. However no such serious bleeding was recorded in the present study.

Final Results

In our study, overall 93.3% of the patients showed satisfactory results. Wallace B Lehman, MD, 50 patients with idiopathic clubfoot deformity were treated by Ponseti Protocol and reported that over 90% of cases will require no other treatment except for percutaneous tenotomy of Achilles tendon.¹⁵ John E Herzenberg, MD showed 88% good to excellent results and 3% recurrence in his series of 46 clubfoot treated by Ponseti Method.²³

Noam Bor, MD In his series (20 cases) of treating clubfoot in older children more than 3 months by Ponseti method found that only 5% required open surgical release. 85% required percutaneous Achilles tenotomy at average age 6 month. Average number of Ponseti casts applied before tenotomy was ^{5,18}

In the present study follow-up was of short duration, however we anticipate equal results in long term. Clearly, the true functional outcome of these patients cannot be determined until the child has completed growth, and perhaps not until later in life. Other important measures that could clarify our comparison includes the need for further treatments, the appearance and function of the feet at walking age, and the appearance and function during adulthood. Still, the results of treatment at the end of casting, using these validated scoring systems, allow an accurate assessment of the ability of casting and Achilles tenotomy to correct the clubfoot to a supple, plantigrade position.

However, Ponseti technique for treatment of clubfoot is simple, effective, noninvasive, nonoperative and economical procedure, which is suitable for the Indian subcontinent.

Compliance of bracing

Compliance with the foot abduction brace has also been an issue. Those patients compliant with foot abduction brace wear had 100% success at final last follow-up. However patients not compliant with FAB wear but, with initial good results after casting, had maintained correction in only 40% of the patients. Non-compliance of children with foot abduction bar & even with clubfoot splints or boot as well as low educational level of parents are important factors to predict relapse after the use of Ponseti method of CTEV management. We feel that counselling of parents is important to maintain regular follow up and prevent relapse.¹⁶ Thacker et al reiterated the fact that compliance with the foot abduction orthosis is essential for the success of the Ponseti technique.²⁸

CONCLUSION

Based on the above study we concluded that Ponseti Method is an excellent conservative method for treatment of Congenital Talipes Equino Varus (CTEV) deformity. Treatment must be started at the earliest possible age. Number of casts required to achieve full correction increases as the age at presentation increases. The patients

who have lower Pirani score at initial visit (i.e. less severe deformity) respond better and faster to the treatment as compared to those who have higher Pirani score at initial visit (i.e. more severe deformity). Strict adherence to the casting technique helps in successful correction and to minimize complications. Early results of treatment of Idiopathic CTEV by Ponseti technique results in good correction of the deformity with minimal surgery i.e. tenotomy of tendo Achilles. Maintenance of the corrected deformity with moulded orthosis is as important as deformity correction, parent motivation & compliance is very important for successful management of the deformity. Duration of the study is not sufficient to predict the long-term results but early results are certainly encouraging.

REFERENCES

- Ignacio Ponseti, Jose A. Morcuende, Vincent Mosca, Shafiq Pirani, Fred Dietz, John E. Herzenberg, Stuart Weinstein, Norgrove Penny, Michiel Steenbeek. Clubfoot: Ponseti Management, 2nd edition, Global- Help Publication 2005.
- Cummings JR, Davidson RS, Armstrong PF, Lehman W. Congenital clubfoot- Journal of bone and joint surgery [Am]; 2002; 84(2): 290-308
- Morcuende JA, Dolan LA, Dietz FR, Ponseti, I.V. Radical reduction in the rate of extensive corrective surgery for clubfoot using Ponseti method- Journal of Pediatrics 2004; vol-113: 376-380
- Ponseti IV, Smoley EN. Congenital clubfoot: the results of treatment. J Bone Joint Surg. 1963; 45A: 261-275.
- Blakeslee TJ. Congenital idiopathic talipes equinovarus (clubfoot). Current concepts Clin Podiatr Med Surg. 1997; 14: 9-56.
- McKay DW. New concept of and approach to clubfoot treatment: section II—correction of the clubfoot. J Pediatr Orthop. 1983; 3: 10-21.
- Sterling J, Laaveg, and Ignacio V, Ponseti, Iowa City, Iowa. Long term results of treatment of congenital clubfoot, Journal of Bone and Joint Surgery, 1992, 44B-454, University of Iowa
- Ponseti IV. Congenital Clubfoot. Fundamentals of treatment. New York: Oxford University Press; 1996.
- Ippolito E, Fraracci L, Farsetti P et al. The influence of treatment on the pathology of clubfoot-CT study at maturity. J Bone Joint Surg (Br). 2004; 86(4): 574-80.
- Hutchins PM, Foster BK, Paterson DC, Cole EA. Long-term results of early surgical release in clubfeet. J Bone Joint Surg [Br] 1985; 67: 791-9.
- Dobbs MB, Rudzki JR, Purcell DB, Walton T, Porter KR, Gurnett CA. Factors predictive of outcome after use of the Ponseti method for the treatment of idiopathic clubfeet. J Bone Joint Surg Am 2004; 86-A(1): 22-27.
- Herzenberg JE, Radler C, Bor N. Ponseti Versus Traditional Methods of casting for Idiopathic Clubfoot. J Pediatr Orthop 2002; 22(4): 517-521
- Turco VJ. Clubfoot, Churchill Livingstone, 1981: 1-84.
- Mathew B Dobbs, José A Morcuende, Christina A Gurnett and Ignacio V Ponseti, Treatment of Idiopathic Clubfoot-An Historical Review, Iowa Orthop J. 2000; 20: 59-64.
- Wallace B Lehman, Method of evaluating the effectiveness of Iowa (Ponseti) clubfoot technique. Paper No. 051 AAOS-Podium presentations, Dallas, TX (Feb: 2002).
- Dyer PJ, Davis N. The role of the Pirani scoring system in the management of clubfoot by the Ponseti method. J Bone Joint Surg (Br) 2006; 88B: 1082-1084.
- Changulani M, Garg NK, Rajagopal TS, Boss A, Nayagam SN, Sampath J, Bruce CE. Treatment of idiopathic clubfoot using the Ponseti method. J Bone Joint Surg (Br) 2006; 88B: 1385-138.
- Noam Bor, MD & John E Herzenberg. Ponseti clubfoot treatment in older children for whom traditional casting has failed. Paper no. 053 AAOS-Podium presentations, Dallas, TX (Feb: 2002).
- Rijal et al. Treatment of idiopathic clubfoot. Ponseti vs Kite method Ind J Ortho 2010; 44(2): 202-207.
- Lehman WB, Atar D, Grant AB et al. Functional rating system for evaluation of Long Term results of clubfoot surgery. The Clubfoot. The present and a view of the future Ed. Simons. G.W. Springer Verlag, 1994.
- Dimeglio A, Bensahel H, Souchet P, Mazeau P, Bonnet F. Classification of clubfoot. J Pediatr Orthop B. 1995; 4(2): 129-36.
- Kite JH. The Clubfoot. Philadelphia: Grune & Stratton; 1964.
- MR, Lee EH, White S, Munroe R. Clubfoot analysis with three-dimensional computer modeling. J Pediatr Orthop 1988; 8: 257-62.
- Staheli L. Clubfoot: Ponseti Management. 2nd Ed. Global HELP publication; 2005.
- Wynne-Davies, Ruth. Talipes Equinovarus. A review of eighty four cases after completion of the treatment. J Bone Joint Surg 1964; 46-B: 464-476.
- Palmer RM. The genetics of talipes equinovarus. J Bone Joint Surg Am. 1964; 46: 542-56.
- Ponseti IV. Relapsing clubfoot: causes, prevention, and treatment. Iowa Orthop J. 2002; 22: 55-56.
- Thacker MM, Scher DM, Sala DA, van Bosse HJP, Feldman DS, Lehman WB. Use of foot abduction orthosis following Ponseti casts. Is it essential? J Pediatric Orthop 2005; 25: 225-228.