



STUDY OF IMPROVEMENT IN PAIN IN CONGENITAL PES PLANUS (FLAT FOOT) DUE TO CONSERVATIVE REHABILITATIVE MEASURES

Medicine

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ABSTRACT

Introduction: Pes planus is one of the commonest foot deformities during childhood. Pain is one of the commonest symptom in these patients. The pain becomes continuous and progressively worse leading to disability. This study was our humble attempt to put some light to assess the role of non-surgical treatment approaches in cases of congenital pes planus with respect to improvement in pain.

Methodology: This Prospective Randomized Open Label Control Trial was conducted in the Department of Physical Medicine and Rehabilitation, Sambhu Nath Pandit Hospital, 11, Lala Lajpat Rai Sarani, Kolkata-700020 between December 2009 to November 2011 after getting Institutional Ethical Committee clearance. Proper consent was taken from the legal guardian of the patient. Confirmed cases congenital pes planus (flat foot) between 6 years to 18 years were included according to inclusion and exclusion criteria and were being randomly subdivided into two (2) groups. **One group (GROUP:1)** of patients received: Exercise (Ex) therapy, Shoe Modification (SM) and Acetaminophen (paracetamol) S.O.S and the other group of patients (**GROUP :2**) received :Exercise (Ex) therapy, Shoe Modification (SM), Electrical Stimulation in the form of Faradic Foot Bath (FFB) and Acetaminophen (paracetamol) S.O.S and **after initial visit followed up on 6th, 12th, 24th weeks; every time with respect to improvement in pain** on Visual Analogue Scale (VAS).

Results: There was statistically significant improvement (with p value less than 0.05) in pain scores in both the groups. Interesting observation in our study is that there is statistically significant improvement of pain score of group 1 patients is only evident after 6 weeks of treatment. Another interesting finding is that while comparing the numerical variables of group 1 and group 2 shows statistically significant improvement of pain score with p-value less than 0.05 from the beginning of the our study.

Conclusion: Faradic foot bath definitely improves the pain score in congenital pes planus (flat foot) with statistical significance of less than 0.05 (p value < 0.05). Conservative management like exercise and orthosis also statistically improves pain score after 6 weeks of treatment.

KEYWORDS

Congenital Pes Planus (flat foot), Faradic Foot Bath (FFB), Visual Analogue Scale (VAS) score

INTRODUCTION:

Pes planus (flat foot) by convention refers to loss of the normal medial longitudinal arch. Flat foot is an extremely common condition. It causes considerable difficulty. The foot becomes flattened on the ground with pronation of the hind foot and abduction of the foot, which plays out laterally².

Pes planus is one of the commonest foot deformities during childhood. The Physiatrists are coming across more and more patients with pes planus particularly of congenital aetiology due to the increase awareness of the parents, schoolteachers, family members. Many theories have been advanced over the years about the cause of physiologic pes planus, most centering around abnormal bone configuration, muscle imbalance, or ligamentous laxity³.

Jack (1953)⁴ reviewed the anatomical types of flat foot and pointed out that in normal weight bearing foot an axis through the talus, the middle of the navicular, the medial cuneiform and the metatarsals, formed a straight line on lateral radiographs taken with patient standing. As per Adam's *Outline of orthopaedics*, when the deformity persists into adult life it becomes a permanent structural defect, the tarsal bones being so shaped that when articulated they tend to form a straight line rather than an arch. In many cases it probably has a congenital basis, but it may be caused by selective muscle weakness or paralysis⁵.

According to *Mercer's Orthopaedics Surgery*, in addition to pain and tenderness initially the patient notices feet feel tiredness after use. Later on, the feet become stiff after sitting or resting, and become most uncomfortable in the morning particularly⁶. As per Samuel Turek, sooner or later, but often in adolescence, pain and fatigue occur on walking or standing. The child has limited capacity for indulging in

sports or other heavy activities. The disability becomes continuous and progressively worse. At first, feet feel uncomfortable, burning sensations are experienced, and easy fatigability is noted. The Gait becomes clumsy. Pain is more severe when standing, than when walking or running⁷.

According to a study done on assessment of pain intensity and pain relief in acute pain by H. Breivik *et al.* the well-known visual analogue scale (VAS) and numeric rating scale (NRS) for assessment of pain intensity very much effective⁸.

This study was our humble attempt to put some light to assess the role of non-surgical treatment approaches available such as exercise, shoe modifications, electrical stimulations of intrinsic foot muscles in cases of congenital pes planus in respect to improvement in pain due to Conservative Rehabilitative measures.

Aims and Objectives:

To observe the improvement in pain in cases of congenital pes planus (flat foot) due to Conservative Rehabilitative measures including non-surgical treatment approaches available such as exercise, shoe modifications, electrical stimulations of intrinsic foot muscles.

MATERIALS AND METHODS:

Study Design: A Prospective Randomized Open Label Control Trial

Place of Study: The study was conducted in the Department of Physical Medicine and Rehabilitation, Sambhu Nath Pandit Hospital, 11, Lala Lajpat Rai Sarani, Kolkata-700020.

Study Population: Subjects of this study were selected from the

patients attending the OPD, Department of Physical Medicine and Rehabilitation, Sambhu Nath Pandit Hospital, Kolkata-70020

Study Period: December 2009 to November 2011

Study Duration: 24 months

Sample Size: 60

Inclusion Criteria:

Patient selection: Confirmed cases congenital pes planus (flat foot),

Age group: Between 6 years to 18 years

Exclusion Criteria: 1.Acquired flat foot, 2.Consent not given by the legal guardian, 3.Flat foot as a part of syndrome complex, 4.Flat foot complicated with infection or recent fracture, 5.Otherwise contraindicated for treatment option applied (e.g., flat foot associated with sensory changes)

Study Group: After getting Institutional Ethical Committee clearance all the patients attending the outpatient department of Physical Medicine and Rehabilitation Sambhu Nath Pandit Hospital fulfilling the above-mentioned inclusion and exclusion criteria were being randomly subdivided into two (2) groups. Randomization was done by computer generated random number list. Software used for randomization is Win Papi, version 10.

Group: 1 (N=30) -These patients received: Exercise (Ex) therapy, Shoe Modification (SM) and Acetaminophen (paracetamol) S.O.S

Group: 2 (N=30) - These patients received: Exercise (Ex) therapy, Shoe Modification (SM), Electrical Stimulation in the form of Faradic Foot Bath (FFB) and Acetaminophen (paracetamol) S.O.S

Exercise Protocol: Both the groups were given a set of four exercise to strengthen intrinsic foot muscles, tibialis anterior and peronei muscles. Duration- 10 minutes each. Frequency- twice a day. **Shoe Modification:** All the patients were given medial heel wedge of 3/16 inch size (tapering to 0 laterally) placed between the outer sole and the inner sole for the mild cases. In moderate cases, the patients were given medial heel wedge and medial arch support. For severe and heavier patients were given Thomas heel in addition to medial heel wedge and medial arch support. **Electrical Stimulation:** All the patients of **Group: 2** were being treated with electrical stimulation (faradic foot bath) in addition to exercise and shoe modification/orthosis. Sitting: 21 sitting, one sitting per day.

Follow up Plan: Initial Visit or Visit-1 (V₁), Visit-2 (V₂) on 6th Weeks, Visit-3 (V₃) on 12th Weeks and Visit-4 (V₄) on 24th Weeks. At the initial visit and the subsequent visit, Pain measured on VAS Score and documented.

Initial Visit (Visit - 1): Thorough clinical examination including biochemical and radiological assessment was done on the very first (1st) visit and all the information was documented. After the initial assessment, the patients were being treated with different types of conservative modes according to the above randomization. All patients were advised some basic management which includes patient education regarding rest, using best type and shape of shoe (well-fitting shoes), correct method of standing and walking, using a pair of running shoes for the runners, control of body weight as per BMI, attempt to remove any provoking painful activity and attempt to improve posture of the foot. Aerobic conditionings were also advised. Advises were also given for improving quality of life and general well-being. On the subsequent visits (i.e., 6th weeks, 12th weeks, 24th weeks), the patients were followed on and improvement patterns were clearly documented in the proforma and any adverse effects if occurred also documented.

ASSESSMENT PARAMETERS: At the initial visit, a demographic profile including Age, Sex distribution, were documented. The pain on VAS Score assessment was also done for every patient in every visit.

DATA COLLECTION: Data were collected by taking detailed history of patients' ailment, thorough clinical examination, VAS Score assessment for pain was also done in every visit.

DATA ANALYSIS: All the data collected during this study period were analyzed by using statistical software Statistica version 6 [Tulsa, Oklahoma: Stat Soft Inc., 2001] and Graph Pad Prism version 4 [San Diego, California: Graph Pad Software Inc., 2005]



Fig. 1: Flat foot (side view), 8yrs/Male



Fig. 2: Tip-toe test showing flexible flat foot, 8yrs/Male

Results and Analysis

Data collected in our study were analyzed using appropriate statistical tests and results obtained. Helps of statistical charts and diagrams were also taken to represent statistical data.

Software used

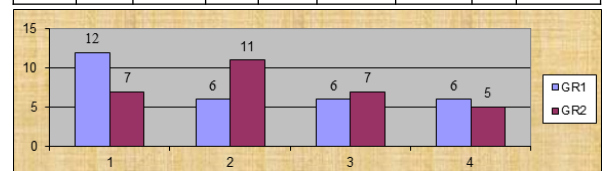
- Statistica version 6 [Tulsa, Oklahoma: StatSoft Inc., 2001]
- GraphPad Prism version 4 [San Diego, California: GraphPad Software Inc., 2005]

Sample size: total number of patients included in our study is 60. In each group number of patients is 30. (n=30)

A. Age Distribution:

Table: 1

Group	Mean	Median	Min	Max	Lower Quartile	Upper Quartile	S.D.	Standard Error
1	11.27	11.00	6.00	18.00	7.00	15.00	4.03	0.73
2	11.93	12.00	6.00	18.00	10.00	14.00	3.19	0.58



Age group: 1=6-9yrs., 2=10-12yrs., 3=13-15yrs., 4=16-18yrs. Fig. 3: Age Distribution Group 1 & 2

From the above table and figure, it is noted that the mean age of group 1 is 11.27, median 11, range is 6-18 with a standard deviation of 4.03 and in case of group 2 mean age is 11.93, median 12, range 6-18 with a standard deviation of 3.19.

B. Sex Distribution:

Table: 2 Comparison of Categorical Variables Between Group 1 and Group 2

Group	Variables	Sex		Row Totals
		Male	Female	
Group 1	No.	16	14	30
	Row%	53.33%	46.67%	
Group 2	No.	13	17	30
	Row%	43.33%	56.67%	
Total		29	31	60

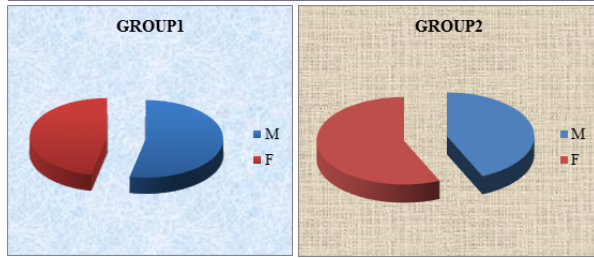


Fig. 4A: (Gr.1)

Fig. 4B: (Gr.2)

Pie Chart Showing Sex Distribution in Group 1 & 2

As the table and figures show that incidence is more or less similar in both sexes in both the groups in males and females. Incidence among male is 53.33% in case of group 1 and in group 2 is 43.33%; in case of female the same is 46.67% in group 1 and in group 2 is 56.67%.

C. Pain Scores:

Comparison of Numerical Variables between Groups 1 and 2- Mann-Whitney U test

Table: 3

Pain	Rank Sum Group1	Rank Sum Group2	U	Z	p-level	Valid N Group1	Valid N Group2
PainV ₁	861.50	968.50	396.50	-0.79	0.43	30	30
PainV ₂	1292.50	537.50	72.50	5.58	0.00	30	30
PainV ₃	1362.00	468.00	3.00	6.61	0.00	30	30
PainV ₄	1365.00	465.00	0.00	6.65	0.00	30	30

Assessment of significance of change in pain VAS score over time- Friedman's ANOVA followed by Dunn's multiple comparison tests

Table: 4A

Group 1: P value < 0.001 Number of groups 4 Friedman statistic 72.640

Dunn's Multiple Comparison Test	Difference in rank sum	P value	Significance
Pain-V ₁ vs Pain-V ₂	16.00	P > 0.05	NS
Pain-V ₁ vs Pain-V ₃	43.50	P < 0.001	***
Pain-V ₁ vs Pain-V ₄	70.50	P < 0.001	***
Pain-V ₂ vs Pain-V ₃	27.50	P < 0.05	*
Pain-V ₂ vs Pain-V ₄	54.50	P < 0.001	***
Pain-V ₃ vs Pain-V ₄	27.00	P < 0.05	*

(* = p < 0.05, *** = p < 0.001) followed for all the tables

Table: 4B

Group 2: P value < 0.001 Number of groups 4 Friedman statistic 90.000

Dunn's Multiple Comparison Test	Difference in rank sum	P value	Significance
Pain-V ₁ vs Pain-V ₂	30.00	P < 0.05	*
Pain-V ₁ vs Pain-V ₃	60.00	P < 0.001	***
Pain-V ₁ vs Pain-V ₄	90.00	P < 0.001	***
Pain-V ₂ vs Pain-V ₃	30.00	P < 0.05	*
Pain-V ₂ vs Pain-V ₄	60.00	P < 0.001	***
Pain-V ₃ vs Pain-V ₄	30.00	P < 0.05	*

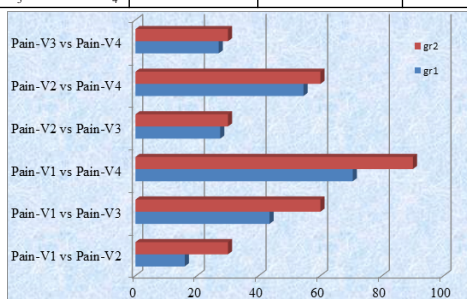


Fig. 5: Change in pain VAS score over time- Friedman's ANOVA followed by Dunn's multiple comparison tests

From the above tables and figure it is shown that statistically significant improvement of pain score of group 1 is only evident after 6 weeks of treatment and whereas in group 2 this is from the beginning. While comparing the numerical variables of group 1 and group 2 Mann-Whitney U test, it shows statistically significant improvement of pain score with p values of less than 0.05 from the beginning of the study.

DISCUSSION:

In current medical practice pes planus has becoming a real rehabilitation challenge in our society. Pes planus is relatively much commoner condition with an incidence of 23% of the public as per Nelson *Textbook of paediatrics*⁹. According to literature, the prevalence rate varies a lot including even 45% in preschool children and 15% of older children according to a Cochrane review published in the European Journal of Physical Medicine and Rehabilitation¹⁰. Chen JP *et al.* showed that the prevalence of flat foot in a child of 5-13 years was 28% with a decreasing trend with the age¹¹. In an Indian study done by Sachithanandam V. *et al.* reported that incidence of pes planus was 3.24% among those children who started wearing shoes before the age of 6 years¹². Rose¹³ stated that the critical age of development of plantar arch is 6 years.

In our study we got a mean age of presentation is 11.27 with a standard deviation of 4.025 in Group 1 and 11.93 with a standard deviation 3.19 in Group 2. Although we excluded the patients of less than 6 years of age due to difficulties with the use of modalities, education, assessment, and non-development of arch till 6 years.

According to Chen JP *et al.* boys had a significantly higher frequency for flat foot than girls (35% in boys and 20% in girls)¹¹. In our study girls and boys were almost equally affected with this particular clinical problem (male: female= 8:7 in case of group 1, and 13:17 in case of group 2).

In our study, we treated our patients with exercise, shoe modification for them who were in group 1 and for those of group 2, with modalities like faradic foot-bath in addition.

According to *AAOS Atlas of Orthoses and Assistive Devices*, a large variety of orthoses are available to cushion the foot, support the longitudinal arch in an attempt to relieve the foot pain and improve foot posture¹⁴. As per Braddom's *Text Book of Physical Medicine and Rehabilitation*, initial use of medial arch support is very much helpful in decreasing pain in many cases of pes planus. Thomas heel support can also offer medial support, particularly for heavier individuals. Each of these applications helps to prevent pronation at the subtalar joint¹⁵. As per *Rehabilitation Medicine* by Goodgold², medial heel wedges, arch support like Thomas heel are definitely helpful for diminishing pain and discomfort in patients of pes planus. Samuel Turek⁷ clearly establishes the role of shoes and supports to reduce the load ordinarily borne by the muscles. According to *Krusen's Handbook of Physical Medicine and Rehabilitation* by footwear modifications using a Thomas heel and a medial heel wedge are recommended for children with flexible flat feet who have leg pain in the evening following a long day of activity¹⁶. Cowell¹⁷ believes that the Thomas heel and medial heel wedge are most appropriately used for the flexible flat foot. Use of orthoses therefore falls into the category of Cushioning or accommodating the foot shape to relieve pain¹⁴. Similarly, the role of different exercise therapy to relieve the pain of pes planus was described in *Text book of Rehabilitation Medicine* by Goodgold². John V Basmajian. *et al.*¹⁸ also strengthen the evidences and describes the appropriate exercise protocol for the patients of pes planus deformity.

Overall, all the literatures tried to establish the positive effect of conservative management on pain score.

Our study also supports and strengthens the evidences.

As per result analysis, pain scores were improved in both the groups treated with exercise, shoe modification and modalities like faradic foot bath (given in patients of group 2).

Interesting observation in our study is that statistically significant improvement of pain score of group 1 patients is only evident after 6 weeks of treatment.

Another interesting finding is that while comparing the numerical

variables of group 1 and group 2 shows statistically significant improvement of pain score with p values of less than 0.05 from the beginning of our study.

According to literature, faradic bath is a very much effective method to apply muscles stimulation currents hand, forearm, foot, and leg¹⁹. Ted Li *et al.*²⁰ suggested that faradic stimulation is very much effective means in the treatment of pes planus.

Apley AG²¹ also opined to treat flat foot with exercises, **faradic foot baths** and a support which bring relief within two or three weeks.

Drop Out: We missed four patients (two from each group), as they were not turned up for follow up visit.

Limitations:

- i) Small number of sample population.
- ii) Short duration of follow up.

Conclusions:

1. Common age of presentation of congenital flat foot is latter half of 1st decade and early half of 2nd decade with a mean age group of 11 years.
2. Males and females are equally affected
3. Faradic foot bath definitely improves the pain score in congenital flat foot with statistical significance of less than 0.05 (p value < 0.05).
4. Conservative management like exercise and orthosis also statistically improves pain score after 6 weeks of treatment.

REFERENCES:

1. Murphy GA. Pes Planus. In: Campbell's Operative Orthopaedics, 11th Edition. Canale ST & Beaty JH (eds.); Philadelphia, Mosby Elsevier 2008;4587-4618.
2. Kaplan LI. Shoe correction and foot pathology. In: Rehabilitation Medicine. Goodgold J (ed); ST. Louis, The C.V. Mosby Company 1988; 851-854
3. Lippert LS. Clinical kinesiology and Anatomy. 4th. Edition. Philadelphia: F. A. Davis Company (first Indian edition. New Delhi: Jaypee Brothers); 2007:265-283.
4. Jack EA. Naviculo-cuneiform fusion in the treatment of flatfoot. Journal of Bone and Joint Surgery 1953;35B:75-82.
5. Adams JC, Hamblen DL. Pes planus (the leg, ankle, and foot). In: Outline of Orthopaedics. 13th. Edition. Adams JC, Hamblen DL (eds.); London. Churchill Livingstone; 2001:519-528.
6. Bentley G, Shearer JR. In: Mercer's Orthopaedic Surgery, Duthie RB, Bentley G (eds). 9th. Edition. Revised and updated by Dhal AK. New Delhi, Jaypee Brothers 2003;1193-1253.)
7. Samuel L. Turek, Flat Foot. 2nd. Edition. Philadelphia, New York: Lippincott-Raven Publisher, (Indian edition distributed in India by Jaypee Brothers Medical Publishers (P) Ltd.);1998:341-345, 1446-1450.
8. Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Breivik Hals EK, Kvarstein G, Stubhaug A. Assessment of Pain: Assessment of Pain Intensity and Pain Relief in Acute Pain.
9. Hosalkar HS, Spiegel DA, Davidson RS. The Foot and Toes. In: Nelson Textbook of Paediatrics. Vol. 2. 18th ed. Kliegman RM, Behrman RE, Jenson HB, Stanton BF (eds); Philadelphia, Saunders Elsevier 2007; Chapter 673, pages 2776-2784.
10. Rome K, Ashford RL, Evans A. Non-surgical interventions for paediatric pes planus: Cochrane Database Systemic Review. European Journal of Physical Medicine and Rehabilitation 2010 Jul;7:7.
11. Chen JP, Chung MJ, Wang MJ. Flatfoot prevalence and foot dimensions of 5- to 13-year-old children in Taiwan. Foot Ankle Int 2009 Apr;30(4):326-332.
12. Sachithanandam V, Joseph B. The influence of footwear on the prevalence of flat foot. A survey of 1846 skeletally mature persons. J Bone Joint Surg Br 1995 Mar;77(2):254-257.
13. Rose GK. Flat feet in children. Br Med J 1990;301:1330-1331.
14. Gabriel K. Congenital and acquired disorders. In: AAOS Atlas of Orthoses and Assistive Devices. 4th. Edition. Hsu JD, Michel JW, Fisk JR (eds.); Philadelphia, Mosby Elsevier 2008;451-464.
15. Hrnnessey WJ. Lower limb orthosis (pes planus). In: Physical Medicine and Rehabilitation 3rd. Edition. Braddom RL (ed); St. Louis, Missouri, Saunders Elsevier 2007;344-345.
16. Bistevins R. Footwear and Footwear Modifications. In: Krusen's Hand Book Of Physical Medicine And Rehabilitation. 4th. Edn. Wickland EH, Jr, (ed); Philadelphia, W.B. Saunders Company, Harcourt Brace Jovanovich, Inc. 1990;971-972.
17. Cowell HR. Shoe and shoe corrections. Pediatr Clin North Am 1977;24:791-797.
18. Basmajian JV. Exercise in Foot Disabilities. In: Basmajian JV (ed). Therapeutic Exercise. 4th. Edition Baltimore/London, Williams and Wilkins: 19--:519-528.
19. Low J, Reed A. Electrotherapy Explained-Principles and Practice. 4th edition. London. Butterworth Heinemann. 2006; 1st Indian edition. Noida, U.P. Elsevier 2009; 56-57.
20. Ted Li and William Thng. An evaluation of the effectiveness Faradic stimulation (faradic footbath) in treating flat foot. Hong Kong Polytechnic 1988;10:43.
21. Apley AG. Flat Foot. The Post-Graduate Medical Journal 1937;29:257.