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COMPARISON OF THE EFFECT OF WEIGHT BEARING AND NON WEIGHT BEARING EXERCISE ON GAIT PARAMETERS IN FLEXIBLE FLATFOOT CHILDREN

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ABSTRACT

The aim of the study was to compare the effect of weight bearing and non-weight bearing exercise on gait parameters in flexible flatfoot children with medial shoe insert. The sample consists of 180 children of both sexes age between 6-10 years diagnosed with flexible flat foot, 60 samples in each group. Group 1 received weight bearing exercise with foot orthotics, group 2 – received non weight bearing exercise with foot orthotics and group 3 received only foot orthotics the design of the study was pre-test, post test control group design. In this study subjects were randomized selected and allocated into any of the three groups by lottery method. Gait parameters such as gait velocity, step length and cadence were the outcome measures. Outcome measures improved in all the three groups due to intervention and foot orthotics. At the same time improvement in Group 1 was better than Group 2 and 3.

INTRODUCTION

The paediatric flat foot is a common concern and has long been regarded as a problem, and feared to be potentially disabling. A recent review of the consultation prevalence for musculoskeletal problems found that the foot was the most common region presented in children [1]. Earlier reports have cited flat foot as the most frequent condition seen in paediatric orthopaedic clinics [2, 3]. Flat feet have long been associated with pain and disability, and are a concern to parents from a preventative perspective as a part of their children's health and mobility [4, 5].

Definition of what exactly constitutes a flat foot remains surprisingly debatable, given its common presentation [6, 7]. It is widely accepted that a low medial arch and a valgus heel position are consistent attributes [2, 3, 8]. An array of cumbersome synonyms have described flat feet including: pesplanus [9], calcaneovalgus [10], pes valgus [11], flexible flat foot [12], flexible pesplanus [13], planovalgus, postural valgus hind feet [14], hypermobile flat foot [15], pronated foot [16]. The term flat foot is so ensconced within our common parlance that its use is indisputable. This presence of flat footed posture has long been described as an abnormality associated with pain and poor gait function [17, 18]. For this reason, many parents are naturally anxious to obtain prophylactic advice and treatment if they suspect that their child may suffer from this condition.

There is copious literature addressing the paediatric flat foot, the methodological quality of the research realises a relative paucity from which clinical decisions about the management of paediatric flat foot can be derived. Indeed the summary from a Cochrane Library systematic review states that the evidence from randomised controlled trials is currently too limited to draw definitive conclusions about interventions (non-surgical) for paediatric flat foot [19]. The literature provides common views on conservative treatment to be prescribed for flexible flat foot in children Therapeutic

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exercises has been prescribed for a wide range of pediatric foot disorders and tipped as a potential treatment for flexible flat foot in children.

In comparison to traditional treatments, such as orthotic and corrective shoe, which are time consuming, costly, often ineffective and potential cause of foot muscles weakness in the long term, exercise may offer an affordable, available, and healthy part of a treatment plan. Although there is conflicting evidence regarding the effectiveness of exercises there is a definite need for more methodologically sound studies examining exercise and physical activity as a potential treatment option for flexible flat foot in children.

Current research does not seem to allow or promote exercise treatment to be used as an independent treatment option. However, the data from the published studies seem very promising indicating that the exercise could be very beneficial in helping to treat flexible flat foot in comparison to other treatments, but the available evidence is not sufficient regarding the effectiveness of weight bearing exercises in children with flexible flat foot. Therefore research is definitely needed that provides more insight into the effect of weight bearing exercises and its effect on gait parameters in flexible flat foot children. Hence the investigator felt it timely and to find effectiveness weight bearing exercises in children with flexible flat foot and provide an insight among health personnel's for effective management of flexible flat foot in children.

METHODOLOGY

Sampling size: a total number of 180 children of both sexes age between 6-10 years diagnosed with flexible flat foot participated in the study. Subjects were selected according to inclusion and exclusion criteria.

Inclusion Criteria

1. School Children diagnosed as flexible flat foot.
2. Age group from 6 -10 years of both sexes.
3. Present during the period of data collection.
4. No medical contradiction in exercises for foot.

Exclusion Criteria

1. Congenital musculoskeletal deformities in lower limbs.
2. Children having other foot deformities.
3. Symptomatic and stiff (rigid) flat foot
4. Flexible flat foot with neuro-muscular involvement
5. Any past history of injury / treatment of the affected limb.
6. Other obvious clinical alignments abnormalities of that lower limb e.g. Genu varum / valgum etc.

Obesity

Variables: Independent variables: Independent variables of this study were Weight-bearing Exercises, Non-weight Bearing Exercises and Orthotic Medial Shoe inserts. Dependent variables of this study were Gait Parameters (Gait Velocity, Cadence and Step-length)

Materials & Methods: Data was collected from children of both sexes between the age group of 6-10 years attending Pediatric OPD Maxfort Hospital, Jamia Nagar, New Delhi and nearby schools in Delhi. All the subjects will be undergoing a pre test measurement ie the gait parameters. The basic gait parameters measured were Gait Velocity, Cadence and Step-length by using gait analiser.

Gait Velocity = Distance walked/Time [20].

Cadence = Number of steps/Time[20].

Step-length = Gait Velocity/ Cadence[20].Following the pretest measurement all the three groups (Group1 , 2 &3) had uncdergone the specific interventions

Group 1 (Weight-bearing Exercise & Orthotic (Medial shoe insert) group)

All subjects in this Weight-bearing Exercise & Orthotic (Medial shoe insert) groups 1 participated in 3 supervised half hour (30 minute) exercise sessions per week for the first three months and 2 supervised and 1 unsupervised exercise session per week for the next three months and 1 supervised and 2 unsupervised for last three months. Subjects in each exercise group were seen on alternating times to avoid cross contamination of treatment intervention. Repetitions of every exercise were 10 for first three months and 15 for next three month and 15 for last three months. Outcome of the treatment Gait Parameters (Velocity, Cadence and Step-length), were measured on 12th week, 24th week and finally 36th week

Feet Exercises in Weight-bearing (Position)
1. **Walking** on the outer borders of the foot.
2. **Standing:** heel raising and lowering to the outer borders.
3. **Standing:** with the feet inverted.
4. **Standing** on a book: The toes are then flexed and extended.
5. **Standing:** foot shortening.
6. **Walking** along a straight line.
7. **Correct heel and toe walking:**
8. Standing on one leg: Big toe up.
9. Standing: calf muscles (Soleus and Gastrocnemius) strengthen and stretching.
10. Standing: towel exercise

Group 2 (Non Weight-bearing Exercise & Orthotic (Medial shoe insert) group)

All subjects in this Non-weight Bearing Exercise & Orthotic(Medial shoe insert) groups 2 participated, as able, in 3 supervised half hour (30 minute) exercise sessions per week for the first three months and 2 supervised and 1 unsupervised exercise session per week for the next three months and 1 supervised and 2 unsupervised for last three months. Subjects in each exercise group were seen on alternating times to avoid cross contamination of treatment intervention. Repetitions of every exercise were 10 for first three months and 15 for next three month and 15 for last three months. Outcome of the treatment Gait Parameters (Velocity, Cadence and Step-length), were measured on 12^{th} week, 24^{th} week and finally 36^{th} week

Group 3 - Orthotic Group (control Group)

All subjects will be wearing medial shoe insert with the proper advice and guidelines given by Orthotist & Prosthotist. Outcome of the treatment using Gait Parameters (Velocity, Cadence and Step-length were measured on 12th week, 24th week and finally 36th week

Data Analysis

The intra-rater reliability between the measures was calculated using the intra-class correlation coefficient (ICC) and the error between repeated measures was indicated by the 95% confidence intervals for the absolute difference between trials. The effect of the non-weight bearing and weight bearing measures on flat foot in children were calculated by comparing the changes in the selected dependent variables with a repeated measure ANOVA. All the analysis was done using SPSS 20 statistical software.

RESULT AND DISCUSSION

A total of 180 subjects were enrolled for this with mean age 7.48±1.44 ranging from 6-12 years of age. There were no significant differences in age, gender ratio, height, body weight, and body mass index (BMI) between all the groups.

The gait velocity increased significantly after 24^{th} week as shown by the ANOVA table (Table 1). The post hoc Bonferonni test demonstrated that though there was improvement in non-weight bearing exercise group as well but the difference in improvement between non-weight bearing exercise group with weight bearing exercise group and control were not statistically significant after 36 weeks of treatment. But there was a statically significant improvement in the gait velocity in the weight bearing group, when compared to control group.

Both Step length & Cadence showed non-significant improvement after 36 week of treatment. A representative clinical population with flexible flat feet was used in this study; participants were included according to clinical signs and symptoms rather than diagnostic imaging. The sample would have been reduced to a specific subgroup of children with flat foot if a single imaging modality had been used as the inclusion criteria. Furthermore, diagnostic imaging is not always necessary for the diagnosis of flat foot, and many health professionals who frequently treat the condition (such as podiatrists and physiotherapists) rely on clinical criteria. We therefore believe that the use of a clinical diagnosis for inclusion into the flat foot group provides results that can be generalised to the broader population of children seeking treatment for flat foot [21]. A final limitation is that the overall effect size was relatively low, which indicates that there may be other variables of importance that were not included in our test battery. Further research is required to determine whether the inclusion of other postulated tests can improve the classification accuracy of the multivariate model.

Fig 1.Line graph demonstrating the mean value walking speed of the three groups during baseline, 12^{th}, 24^{th}, & 36^{th} week treatment

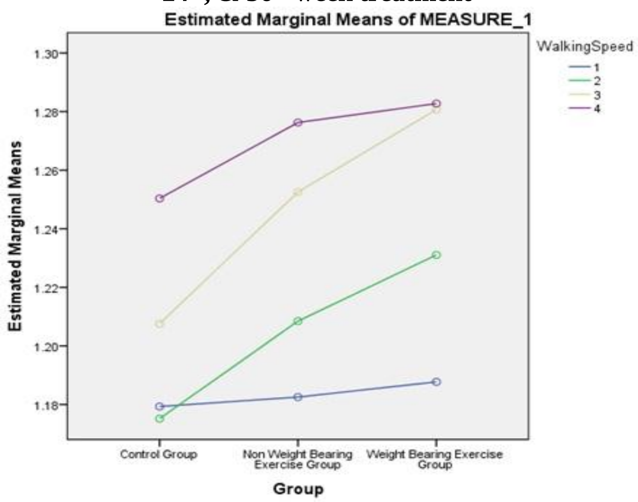

Fig 2. Line graph demonstrating the mean value Step Length of the three groups during baseline, 12^{th}, 24^{th}, & 36^{th} week treatment

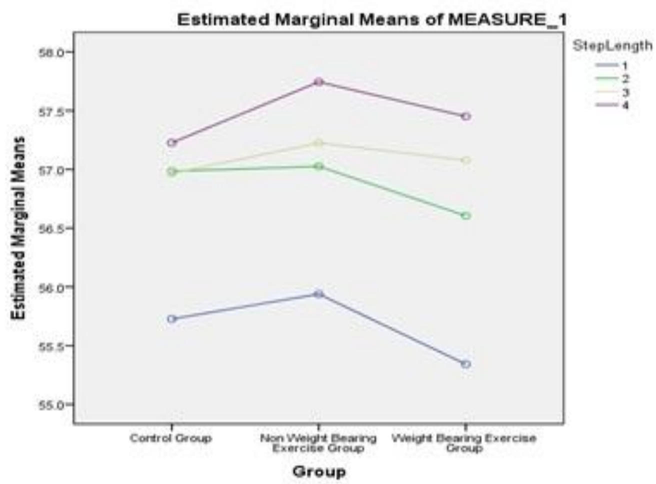

Fig 3. Line graph demonstrating the mean value Cadence of the three groups during baseline, 12th, 24th, & 36th week treatment

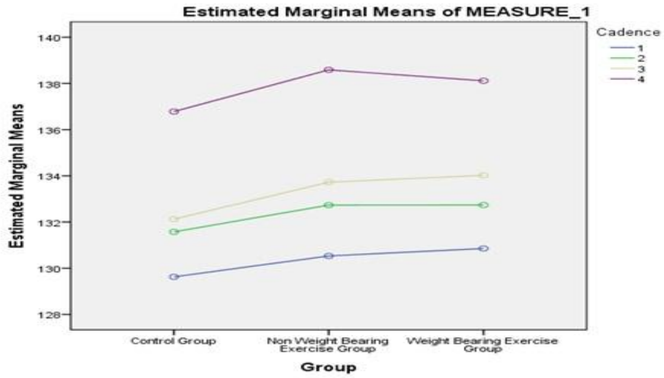

Table 1. ANOVA to find the effect different techniques on Gait Velocity

		Sum of Squares	df	Mean Square	F	Sig.
Baseline	Between Groups	.002	2	.001	.168	.845
	Within Groups	1.049	171	.006		
	Total	1.051	173			
Week 12	Between Groups	.034	2	.017	.744	.477
	Within Groups	3.901	171	.023		
	Total	3.935	173			
Week 24	Between Groups	.091	2	.045	4.493	.013
	Within Groups	1.732	171	.010		
	Total	1.823	173			
Week 36	Between Groups	.157	2	.078	5.889	.003
	Within Groups	2.274	171	.013		
	Total	2.431	173			

Table 2. ANOVA to find the effect different techniques on Step Length

		Sum of Squares	Df	Mean Square	F	Sig.
Baseline	Between Groups	10.556	2	5.278	.645	.526
	Within Groups	1399.017	171	8.181		
	Total	1409.573	173			
Week 12	Between Groups	6.168	2	3.084	.453	.636
	Within Groups	1163.750	171	6.806		
	Total	1169.918	173			
Week 24	Between Groups	1.976	2	.988	.200	.819
	Within Groups	845.423	171	4.944		
	Total	847.399	173			
Week 36	Between Groups	7.905	2	3.952	1.198	.304
	Within Groups	564.279	171	3.300		
	Total	572.184	173			

Table 3. ANOVA to find the effect different techniques on Cadence

		Sum of Squares	Df	Mean Square	F	Sig.
Baseline	Between Groups	46.655	2	23.328	.667	.514
	Within Groups	5977.517	171	34.956		
	Total	6024.173	173			
Week 12	Between Groups	51.961	2	25.980	.692	.502
	Within Groups	6420.624	171	37.548		
	Total	6472.584	173			

Week 24	Between Groups	120.455	2	60.227	1.313	.272
	Within Groups	7841.007	171	45.854		
	Total	7961.462	173			
Week 36	Between Groups	102.116	2	51.058	.992	.373
	Within Groups	8802.995	171	51.480		
	Total	8905.110	173			

CONCLUSION

The study was the first study to evaluate the relationship between flexible flat foot in children and effect of weight bearing exercises. Our study has demonstrated that the weight bearing exercises have beneficial effects and has improved various factors associated with ankle function, thereby improving the child's functional activity. Inconsistent findings between the experimental and control groups indicate that pathology may play a role in the relationship between flexible flat foot and dynamic function. However, prospective studies are required to determine whether this relationship is causal

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