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Foot Print Analysis and Prevalence of Flat Foot among Children of Rural India – A Study Protocol

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Study Protocol

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ABSTRACT

Introduction: Foot shape and its proportions changes gradually during normal growth of human beings, but the mechanical stresses during bipedal locomotion are a key factor for development of foot. To sustain static position and to arrange for stable base while performing various functional activities, Foot plays major role in it. Deformities in lower extremities of children's are being very common. As this conditions are physiological, that's why most of the time this conditions do not require treatment. In an average 90% of patient who are visiting to clinic for foot problem are flat foot. Primary manifestation of flat foot is decreasing in longitudinal arch, which shows that while standing or walking, there is transmission of whole body weight towards the medial side of foot sole. This is the main reason for which flat foot is considered as problem of static alignment of foot and ankle structure.
Objective: To analyze footprint of children and to determine prevalence of flat foot, their anthropometric measurement, Prevalence of structural pathologies of foot and correction of foot prints and radiological evaluation of 8 – 13 years age group of children.
Methodology: All the visiting patients of orthopedic department of AVBRH of age group 8 – 13 year, with sample size. Examination will be done along with radiological examination, radiological assessment and different anthropometric will include Plain X-ray of both feet.
Results: We expect that, anthropometric measurements of rural children may differ from other literatures.

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Keywords: Anthropometry; children; flat foot; foot; radiological assessment.

1. INTRODUCTION

Foot shape and its proportions changes gradually during normal growth of human beings, but the mechanical stresses during bipedal locomotion are major key factor for development of foot. To sustain static position and to arrange for stable base while performing various functional activities, Foot plays major role in it. Deformities in lower extremities of children are being very common in this age of era. As this conditions are physiological that's why most of the time this conditions do not require treatment. In an average 90 % of patient who are visiting to clinic for foot problem are flat foot [1]. It is being burning problem in the Pediatric age group. Primary manifestation of flat foot is decreasing in longitudinal arch, which shows that while standing or walking, there is transmission of whole body weight towards the medial side of foot sole. This is the main reason for which flat foot is considered as problem of static alignment of foot and ankle structure.

Though flat foot is very rarely being the reason of disability in humans, but still this topic is the major concerning for parents whose child is having flat foot. It has been considered that flat foot will be the reason for gait disorders [2-5] there is two main components of flat foot, one is medial arch sagging and another is valgus heel [1]. Medial arch flattening is the worldwide finding in flat foot, which is very much common in pediatric as well as in adult population [5-13]. In neonatal and infantile period of life, there is fattypad which is existing at foot under the medial longitudinal arch, as there is development of arch, though fat pad resolves in the age of 2 -5 year of life period. Nearly almost children are having Flat foot, when they starts walking. Lack of neuro muscular control and intrinsic laxity leads to flattening of foot when child starts weight bearing over foot [14].

Flat foot in pediatric age group can be divide into two terms as flexible flat foot and rigid flat foot. In flexible flat foot, there is normal arch while weight bearing over foot and on stance there is flattening or arch, this condition may be symptomatic or asymptomatic [15]. In Rigid flat foot, there is stiffness, flatness in arch in both the condition like in weight posture of standing and non-weight posture. Maximum patients of the rigid flat foot are accompanied with pathological problem which require specific attentions [10,16].

Through this study, we wish to assess over anthropometric assessment and measure along with prevalence structural pathologies including flat foot and co-relation of foot prints and their radiological evaluation of children who are in the age group of 8 – 13 years.

1.1 Aim and Objectives

1.1.1 Aim

1. To study and analyse foot prints of children's of age group of 8 – 13 years
2. To determine the prevalence of flat foot among the children's of age group of 8 -13 years

1.1.2 Objectives

1. Anthropometric measurement of foot in children's of age group of 8 -13 years
2. Prevalence of structural pathologies of foot including flatfoot.
3. Correlation of footprints and radiological evaluation.

2. MATERIALS AND METHODOLOGY

2.1 Study Design

Prospective study type.

2.2 Study Setting

Patient will be selected from the OPD and IPD of Department of Orthopedics and Department of Pediatrics, at Jawaharlal Nehru Medical College, Sawangi and Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha. Study will be conducted from the period of June 2020 to April 2023.

2.2.1 Sample size of study

200 children will be selected for the study with irrespective sex in between the age group of 8 – 13 years.

2.2.2 Type of study

This study is a Prospective observational study.

2.2.3 Method of collection of data

All the patients in this study will be selected with irrespective sex from the OPD and IPD of

Department of Orthopedics and Department of Pediatrics, at Jawaharlal Nehru Medical College and Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha.

2.2.4 Assessment technique

1. Detailed history of patient will be taken from parents and clinical examination of patient will be done by the points of age, sex, socio-economic status, personal habits if any. Thorough examination of both feet's will be done in all enrolled patients as per technique given below.

Foot prints will be taken of enrolled patients by using ink stamp pad. After cleansing feet of participant, participant will ask to step their both feet sole in ink pad with minimum pressure while standing on ink pad and after that participant will ask to stand on white A4 size paper with inked foot, which will be kept on flat surface beside the ink pad, by this way the ink will transfer on white A4 size paper and foot print will be taken for assessment.

2. The radiological assessment of foot will be done with the help of Plain X-ray of both feet.
3. The following measurements will be taken on each footprint:-

The foot morphology measurements conducted on the foot prints will be:

1) Length of foot – Distance of foot will be measured from the point of pternion to the most anterior point of finger of the long toe (which may be first or may be the second toe depending on length), this length of foot will be measure and noted in parallel axis.
2) Ball of foot length – Distance of ball of foot length will be measure, starting from end part of the heel up to the metatarsal tibiale. This length will be measure and noted in parallel axis of foot.

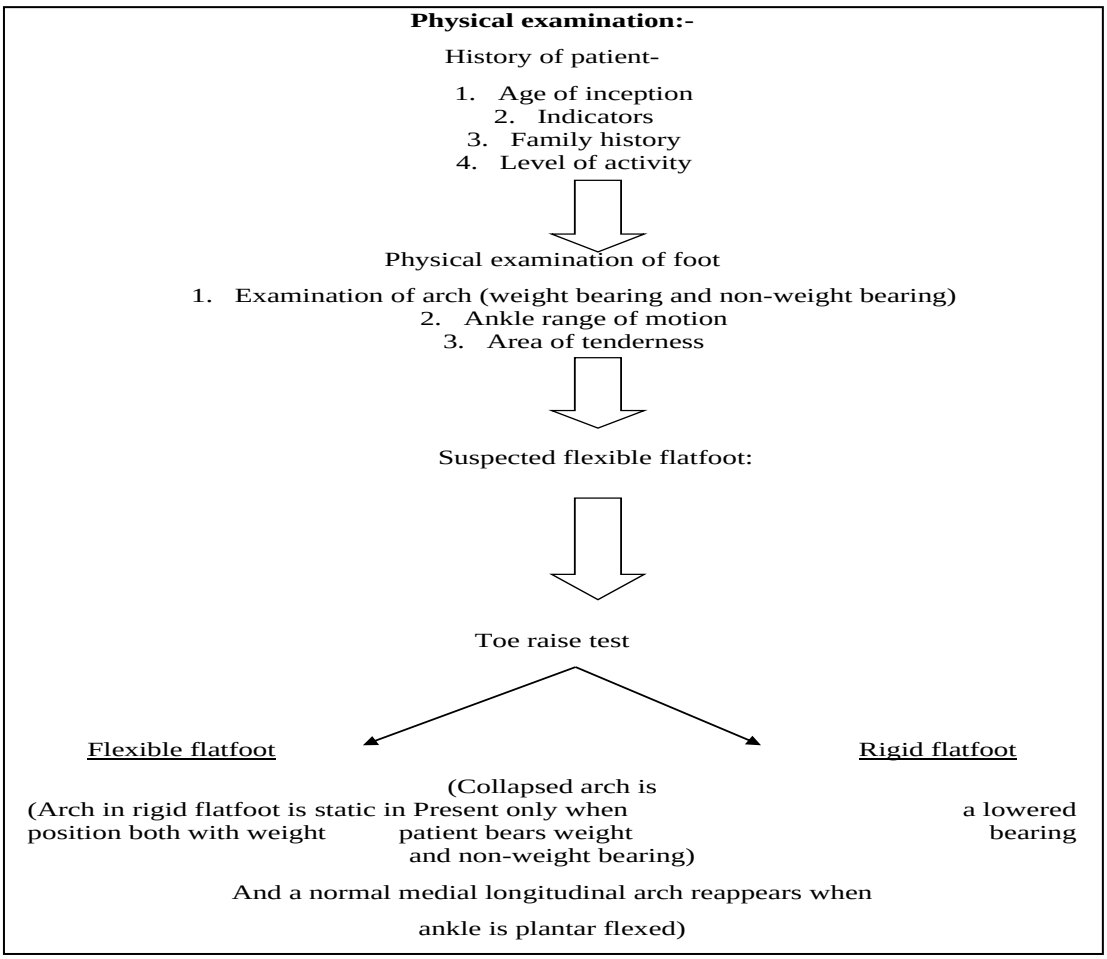

Fig. 1. Physical examination protocol

3) Outside ball of foot length– Distance of outside ball of foot will be measure from the end part of the heel up to the metatarsal fibulare. This distance will be measure in parallel axis of foot.
4) Diagonal of Foot breadth– Diagonal of foot breadth will be measure by the distance in between the metatarsal tibiale and metatarsal fibulare of the ball cross section projected to the surface of standing will be measure.
5) Foot breadth horizontal– The horizontal breadth of foot will be measure from the distance of metatarsal tibiale to the metatarsal fibulare.
6) Heel breadth – Breadth of heel position will be measure by length of foot which will be straight from pternion part of foot toe.
7) Length measurement- T1 – The measurement will be taken from the pternion to the anterior part of toe 1.
8) Length measurement- T2 – The measurement will be taken from the pternion to the anterior part of toe 2.
9) Length measurement- T3 – The measurement will be taken from the pternion to the anterior part of toe 3.
10) Length measurement- T4 – The measurement will be taken from the pternion to the anterior part of toe 4.
11) Length measurement- T5 – The measurement will be taken from the pternion to the anterior part of toe 5.

Axis of foot will be measure perpendicular to the base line of flat surface. The axis of foot will be measure from the line which is crosses from the pternion up to the tip part of 2nd toe. From the pternion, in medial and lateral side direction base line will be drawn:

1) Staheli's Plantar Arch Index (SPAI) – In this type the arch index will be calculated as per the ratio of the width of the supportive central region of foot and heel region of the foot.
2) Chippaux - Smirak Index (CSI) – In this, the ratio will be calculated between the smallest length of the mud part of the foot and the largest length of the region of the metastarsal head.
   The angle of the foot is included in the angular measurement. (Nikolaidu and Boudolos, 2006).
1) Foot angle – Angle of the foot is opted by measuring the angle of the first medial tangential line which connect with the medial edge of the first metatarsal head and the heel of the foot and the second line, which connect the first metatarsal head and the innermost point of the longitudinal region of the arch on the foot print which will be drawn on white A4 size paper.

Radiological assessment will be carried out in all patients included in the study in the department of orthopedic and the department of the pediatric outpatient department. The radiological assessment will include a plain x-ray. X-ray lateral view of both the feet will be taken:-

Different anthropometric parameters will be studied on x-ray will be:

- Calcaneal inclination angle: Calcaneal angle of inclination is the angle that is present between the inferior surface of the calcaneus and the supporting surface of the foot.
- Calcaneal first metatarsal angle: Calcaneal first metatarsal angle is the angle, this angle is formed in the inferior surface of the calcaneus and the line which is parallel to the dorsum surface of the mid-shaft of the first metatarsal.

The images will be digitized and put in storage on the PACS (Picture Archiving Communication System). PACS is a computerized system, which is used to maintain record, and store the radiographic images of patients, this system also permits the collection and storage of multiple numbers of the image in the system, and also allow and permits access from any network location. Also, PACS provides a storage facility which gives the option of image development and an operational tool like magnification at various level and rotation of mage image in different sides of aspect. This system also gives operational option for sensitive measuring tools.

- Calcaneal inclination angle
- Calcaneal first metatarsal angle

2.2.5 Inclusion criteria

1. All the visiting patients of age group 8 – 13 years will be selected from the OPD and IPD of the Department of Orthopaedics and Department of Paediatrics department from AVBRH, Sawangi (Meghe)
2. Patients will be selected irrespective of sex.

2.2.6 Exclusion criteria

1. All children with major medical illnesses will be excluded from the study.
2. Patient suffering from musculo-skeletal disorders (like as club foot, deficit limb, and discrepancy of leg length)
3. The patient suffering from recent lower limb injuries or disorders in the foot bones which can affect footprint measurements

2.3 Implementation

Primary investigator of this study will enroll the patients and will do an examination and assessment.

2.4 Data Management

Data entry and data management will be done by the primary investigator.

2.5 Dissemination Policy

The data will be distributed in future clinical work and also in paper publication. Authorship eligibility guidelines and any intended use of professional writers.

2.6 Statistical Analysis

Appropriate statistical test will be applied for the analysis of data to obtain the result of the study.

2.7 Observation

Through this study, observation will be done over the prevalence of flat foot, the analysis of the result of foot prints and their co-relation with radiological evaluation in between the age group of children of 8 to 13 years.

3. RESULTS

Result will be formulated on basis of observations and statistical analysis report. In this study result, we are expecting that the anthropometric measurements of rural children may differ from other literature.

4. DISCUSSION

The major reason for the selection of study is to determine the prevalence of flatfoot in a rural area. Flat foot condition can be opted as independent pathology, which is associated with generalized ligament laxity, muscular and neurological defects along with genetic and collagen disorders [10]. Flatfoot in pediatric age group is been as most controversial and burning topic for long time, which was questioning about the naturalness flat foot, which flatfoot is pathological, when to observe for flat foot, when to start treatment for flat foot, which is the best and specific conservative treatment for flat foot and when to take decision for surgical correction of flat foot. In general, Infants born with flexible flat foot, and natural arch of foot starts developing in their first decade of life [17]. This indicates that desorption of mid foot planter fat pad starts after the starting walk without support. To study its prevalence this study is going to be conducted. Few of the related studies were reviewed [17-19].

Discussion over study will be made over this study in points, representing the study procedure highlighting the study along with its result will be discussed in brief.

5. CONCLUSION

The overall conclusion will be drawn based on observation and results obtained from the study.

CONSENT

Written informed consent will be taken at the time of enrollment of the patient in the study.

ETHICAL APPROVAL

Research approval will be taken from Institutional Ethics Committee. After clearance, the study will be performed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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