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Correlation of Foot Postures with Dynamic Balance in Recreational Football Players

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Abstract: ***This study explores the correlation between foot posture and dynamic balance in recreational football players, focusing on the relationship between the Foot Posture Index FPI and the Modified Star Excursion Balance Test MSEBT. Thirty recreational football players aged 18 to 25 participated, with foot posture and dynamic balance assessed through FPI and MSEBT, respectively. Results showed that 70% of participants had normal foot posture, while 30% had either pronated or supinated feet. However, no significant correlation was found between foot posture and dynamic balance across all test directions, suggesting that foot posture alone may not heavily influence dynamic balance in this population. The study calls for further research with larger sample sizes and varied foot postures.***

Keywords: foot posture, dynamic balance, recreational football players, Foot Posture Index, balance test

1. Introduction

Foot posture refers to the position and alignment of the foot and ankle in relation to the ground and other parts of the body. It can refer to the shape of the foot, the angle of the heel and forefoot, and the degree of arch or flatness of the sole of the foot. Dynamic balance refers to the ability to maintain balance while moving or performing activities such as walking, running, or jumping.

Football is a game that may be played in many different ways, and it involves aggressive and violent behavior (e. g. tackling, jumping, kicking, turning and changing pace). In managing the majority of these tasks, lower extremity alignment plays a significant role. When doing several bodily activities, the feet need to bear the right weight. (1)

Since dynamic movements predominate in football, dynamic balance is one of the key components supporting football talents. (2)

Football players frequently use their lower extremities to pass, shoot, and dribble while donning either cleated or non - cleated shoes and on a variety of surfaces. The sensorimotor systems are likely to face a variety of difficulties as a result of the skill demands and environmental demands of football, which together may have an impact on player's balance capabilities. (3)

The foot, which represents a relatively small area on which the body maintains balance, is the most distal component in the chain of the lower extremities. Although it makes sense that small changes to biomechanics changes the ground reaction and weight bearing which could affect postural - control techniques. (4)

Balancing is the process of keeping the center of gravity within the body's base of support and is frequently employed as an indicator of lower extremity function. Extremely pronated or supinated foot postures may affect peripheral (somatosensory) input by altering joint mobility or the surface area with which they make contact, or, secondarily, by altering the muscle techniques used to maintain a solid base of support. (5)

During locomotion, the foot anatomy plays a crucial role in shock absorption. The foot arch type and risk of injury have a significant association, according to a prior study. Injuries to the musculoskeletal system have been linked to high and low arches. (6)

Since football players must frequently jump and change directions, ankle sprains are the most frequent sports injury among football players. Ankle sprain victims are more likely to re - injure the same ankle. It has been proposed that poor ankle function and recurring ankle sprains are mostly a result of poor proprioceptive function. (7)

2. Need of the Study

The force of gravity and ankle biomechanics are significant factors in football performance and injury avoidance. The ankle must have the power to move the body forward, accelerate and decelerate, and change direction swiftly during a football play. For optimal performance and injury avoidance, proper ankle biomechanics are crucial. The trajectory of the ball and the player's body movement are both impacted by gravity, which also has an impact on football play. The ankle joint must take the impact and maintain equilibrium when a player jumps or heads the ball since gravity drags the body back down to the earth. (8) (9) (10)

When foot posture alters it affects the base of support surface which further results in alterations of postural control strategies. Poor dynamic balance in the sports of football may affect the overall performance of the player while kicking, dribbling and passing the ball. The alignment and position of the foot and ankle can affect the distribution of weight and pressure through the foot, as well as the way the body senses and responds to movement and changes in balance. (11)

This study is done to find out any deviations from normal values of foot posture and correlate it with dynamic balance.

3. Research Question

Is there a correlation between foot posture and dynamic balance in recreational football players?

Operational Definition of Recreational Football Player:

"Recreational football players are individuals who participate in football primarily for enjoyment and fitness rather than for competitive purposes. Unlike competitive football players, recreational football players may not have access to the same level of coaching, training facilities, or equipment. However, they can still benefit from regular physical activity and football - specific training in terms of improved fitness, skill development, and social interaction. " [(12)]

4. Review of Literature

1) Title: Impact of Various Foot Arches on Static and Dynamic Balance Among Trained Football Players- A Pilot Study.
Author: Abhilash PV, Bhaskara Bhandary, Gayatri Karki.
Journal: IOSR Journal of Sports and Physical Education
Year: 2021

SUMMARY: 24 trained football players between the ages 20 to 30 years were recruited in this study. The Navicular drop test (NDT), Lower Quarter Y balance test (LQ - YBT) and Single Leg Stance Test (SLST) in both eyes open and eyes close were used to assess for Food arch type, dynamic balance and static balance respectively.

This study concludes that the supinated foot arch group possesses good dynamic and static balance compared to other 2-foot arch groups. Thus, the balance component does not differ according to different foot arches among trained football players.

2) Title: Effect of pronated and supinated foot postures on static and dynamic balance in dancers.
Author: Nidhi Ladha, Hardhi Jain
Year: 2021
Journal: Indian Journal of Physiotherapy and Occupational therapy.

Summary: In this study 30 dancers were studied in the mean age of 21.40±4.22 of both genders. Altered foot posture was assessed using Navicular drop test followed by using flamingo balance test to assess static balance and star excursions balance test was used to assess dynamic balance.

Study showed that dancers are affected with pronation and shows a strong correlation with static balance proposing that foot alteration affects balance. Overall study concludes that foot alteration affects balance and proposes a higher risk of injuries in future.

3) Title: The effect of various degrees of foot posture on standing balance in a healthy adult population.
Author: Sami S. Al Abdulwahab, Shaji John Kachanathu
Journal: Somatosensory and Motor Research
Year: 2015

Summary: 41 healthy subjects with mean age of 24±4 participated in this study. Foot posture was assessed using Food Posture Index (FPI) and standing balance was assessed using Computerized Dynamic Posturography (CDP).

The study showed that highly pronated foot arches significantly affect the dynamic body balance in healthy individuals.

4) Title: Comparison of Static and Dynamic Balance in Female Collegiate Soccer, Basketball, and Gymnastics Athletes.
Author: Eadric Bressel, Joshua C. Yonker, John Kras, Edward M. Heath.
Journal: Journal of Athletic Training
Year: 2007

Summary: 34 female student athletes from three different sports soccer, basketball and gymnastics with mean age of 20.4 ±1.1, 21.6 ±1.9 and 21.2±1.7 respectively.

Static balance was assessed using the Balance Error Scoring System (BESS) and dynamic balance was assessed using Star Excursion Balance Test (SEBT).

Female basketball players demonstrated inferior static balance compared to gymnasts and inferior dynamic balance compared to soccer players. No differences were noted between gymnastics and soccer players. The studies suggest that specific sensorimotor challenges rather than just general sports activity are important for development of optimal balance.

Aim
To determine correlation between foot posture and dynamic balance in recreational football players.

Objectives
Primary Objective:
a) To assess foot posture using Foot Posture Index.
b) To assess dynamic balance using Modified Star Excursion Balance in recreational football players.
c) To find correlation between foot posture and dynamic balance in recreational football players.

5. Methodology

Study Type: Correlation study
Study Design: Cross section observational study
Study Setting: Community
Study Population: Football players
Sampling Technique: Convenience sampling

Sample Size: 30

Inclusion Criteria:
1) Age group of 18 - 25. years.
2) Players of both genders.
3) Recreational football player (plays 2 hours per week since minimum 1 year)

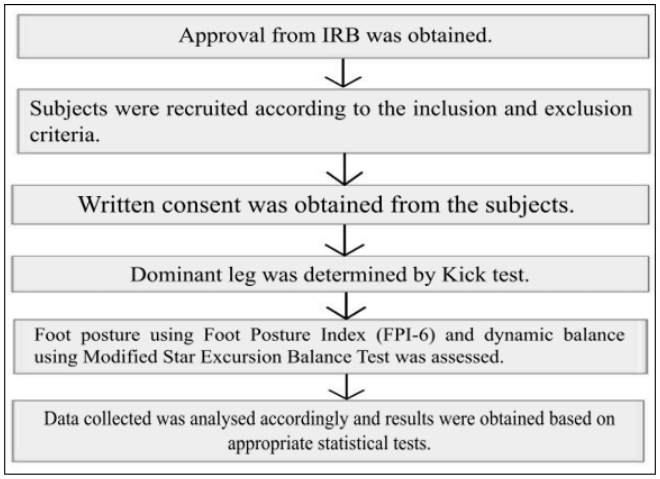
Exclusion Criteria:
1) Clinically diagnosed limb length discrepancy

2) Clinically diagnosed neurological dysfunctions.
3) Acute lower limb injuries.

Tools and Materials:

1) Foot Posture Index
2) Tape for Modified Star Excursion Balance Test.

Methodology in Flow Chart



6. Procedure

The participants/subjects were recruited using convenience sampling, according to inclusion and exclusion criteria and explained about the research procedure and its significance. A written informed consent was taken from the participant. Demographic details like (name, gender, age, number of hours played per month) were taken. Dominant leg was ascertained by **Kick Test.** [13] The Foot posture of the dominant leg was assessed using Foot Posture Index (FPI - 6). For dynamic balance assessment of the dominant leg Modified Star Excursion Balance Test was used. Data was collected and analyzed using appropriate statistical tests.

Outcome Measure

1) Foot Posture Index (FPI - 6).

The FPI - 6 is a novel method of rating foot posture using set criteria and a simple scale, and is a quick, reliable diagnostic tool. It is used to quantify the degree to which a foot is pronated, neutral or supinated. It is a measure of standing foot posture. The FPI has been used in a variety of clinical and research settings. The applications of the FPI include studies of biomechanical risk factors for neuropathic ulceration in diabetes, identifying foot type as a basis for screening subjects as inclusion or exclusion criteria in clinical research, investigating the relationship between foot types and risk factors for sports and training injuries, investigating whether foot posture is associated with falls in older people and as a means of assessing age - related differences in foot structure. [17]

Reliability [18]:
Inter - rater reliability (ICC) - 0.90 - 1.00
Intra - rater reliability (ICC) - 0.91 - 1.00 Test - retest reliability - 0.95

Validity [19]:
PSI= 0.88

2) Modified Star Excursion Balance Test used to evaluate dynamic balance.

The modified Star Excursion Balance Test (SEBT) is a functional screening tool to assess lower extremity dynamic stability and neuromuscular control, encompassing lower extremity strength, coordination, balance, and flexibility. The modified SEBT has been found to be a reliable assessment tool, with high test - retest reliability, and has been shown to discriminate dynamic balance and neuromuscular control strategies between limbs following unilateral lower extremity injury. [14]

Reliability [15]:
Anterior reach intra - rater reliability median ICC - 0.88 (Range= 0.84 - 0.93) Posteromedial reach intra - rater reliability median ICC - 0.88 (Range= 0.85 - 0.94) Posterolateral reach intra - rater reliability median ICC - 0.90 (Range= 0.68 - 0.94)

Validity [16]:
Anterior direction ($p = 0.023$) Posterior medial direction ($p < 0.001$)
Posterior lateral direction ($p = 0.001$) Composite scores ($p < 0.001$)
These values signify good validity.

Foot Posture Index (FPI6)


Talar head position


Curves above and below malleolus


Inversion/Eversion of calcaneus


TNJ prominence


Medial longitudinal arch congruence


Abduction/adduction of forefoot on rearfoot

3) Modified Star Excursion Balance Test


Posterolateral Reach

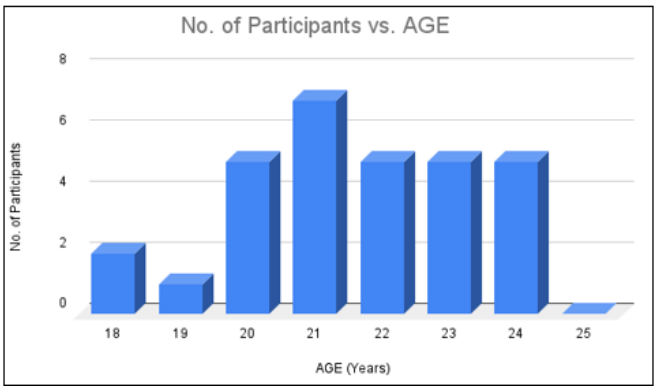

Anterior Reach


Posteromedial Reach

7. Result and Analysis

Microsoft Excel was used for data entry and analysis. Demographic details were assessed using descriptive stats. Normality was checked using the Shapiro - Wilk test. The data didn't pass normality - Spearman's correlation coefficient test was used for correlation.

Age Distribution



8. Discussion

Correlation between foot posture and dynamic balance among recreational football players is studied. Total 30 players were included in this study out of which 66.6% were

Males and 33.33% were females with a mean age 21±1.73.

Foot postures were assessed using the Foot Posture Index (FPI), revealing 70% subjects with normal foot posture, 20% with supinated foot and 10% subjects with pronated foot. Dynamic Balance was assessed using the Modified Star Excursion Balance Test.

No significant correlation was found when Final Values of Modified Star Excursion Balance Test of single direction were correlated with Foot Posture Index.

Correlation was not found in MSEBT Anterior reach (r=0.02469, P=0.4485) and FPI; MSEBT Posteromedial reach (r=0.2773, P=0.0689) and FPI; MSEBT Posterolateral reach (r=0.05905, P=0.3783) and FPI.

The interaction of the plantar aponeurosis with the skeleton of the foot is a major component of arch stability while standing.[6]

A pilot study by Abhilash PV, Bhandary B, and Karki G (2021) investigated how differing foot arches impact trained football player's static and dynamic balance. Their work illuminates the biomechanical variations of foot anatomy in sports performance by examining how different foot arch types may affect players' ability to balance. Through the analysis of both static and dynamic balance, the study adds to our understanding of the relationship between foot anatomy and athletic performance in the context of football by shedding light on the possible effects of foot arch variability on athletes' stability during different movements. The study finds that in comparison to the pronated and neutral foot, the supinated foot arch group has good dynamic and static balance. As a result, the balancing element varies depending on the type of foot used by professional football players.[1]

Nidhi Ladha and Hardhi Jain (2021) studied Effect of Pronated And Supinated Foot Postures on Static and Dynamic Balance in Dancers. The results of study shows pronated feet are a problem for contemporary dancers and exhibit a strong correlation with static balance, suggesting that changing one's foot position can have an impact on balance. Dancers with supinated feet had different dynamic balances than those with pronated feet. The study suggests an increased risk of future accidents and shows that the foot modifications influence balance.[4]

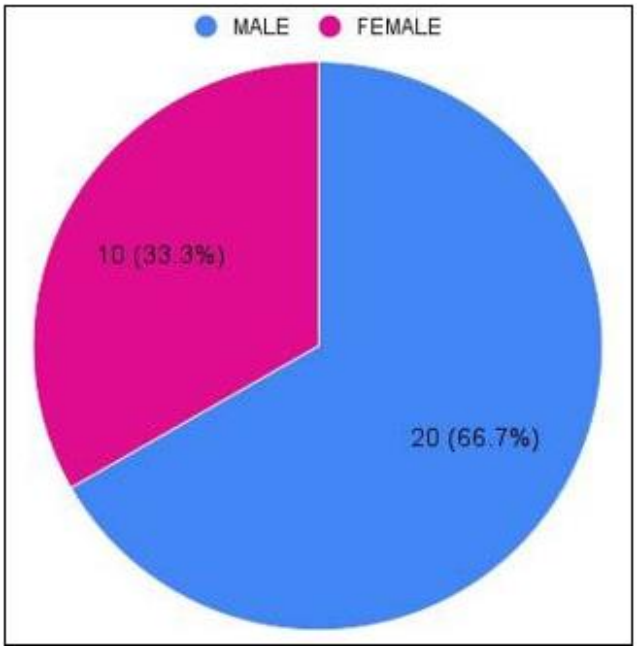
Al Abdulwahab and Kachanathu (2015) investigated the relationship between various adult foot positions and standing balance. The impact of different foot alignments on balance control was examined in their study. The research aimed to improve understanding of how foot posture affects balance mechanisms by using likely methods involving balance assessments under various foot conditions, such as flat feet, high arches, and neutral alignment. The results suggested that standing dynamic balance in healthy people may be impacted by greater FPI levels. If rehabilitation involves preventative measures, these elements could need special consideration.[6]

The feet, in conjunction with other lower extremity joints like hip and knee, play a crucial role in maintaining body balance, with small dynamic changes in foot posture influencing overall postural control.[6] Decreased dynamic balance is identified as a risk factor for lower extremity injury.[1]

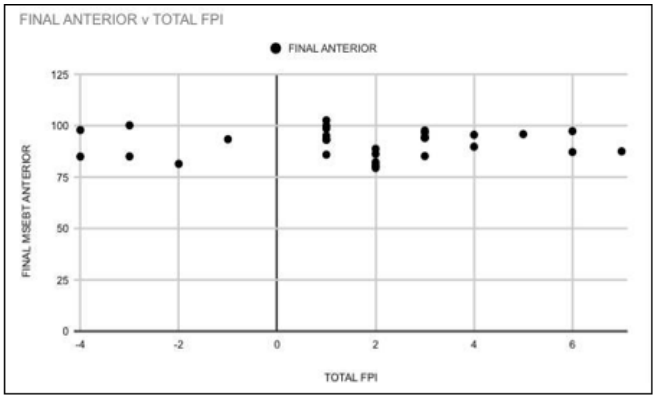
Abnormal foot posture can lead to increased stress on lower extremity structures, potentially causing musculoskeletal injuries that may affect standing dynamic body balance.[6]

Above studies show there is a correlation between Foot Posture Index and dynamic balance[4] but the small population size in our study makes it difficult to draw a firm conclusion. The reason for not establishing correlation may be due only 30 % of subjects having altered foot posture.

Gender Distribution

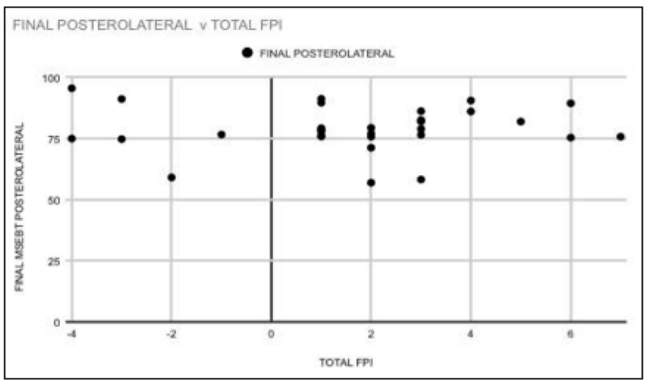


FPI vs MSEBT Anterior Reach



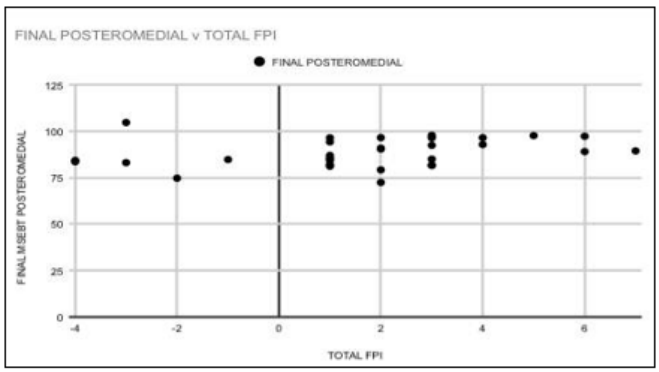
	Mean	Standard Deviation	r value	P value
FPI	1.666666667	2.820287749	0.02469	0.4485
Final Anterior	91.6182	6.477572599		

FPI vs MSEBT Posterolateral Reach



	Mean	Standard Deviation	r value	P value
FPI	1.666666667	2.820287749	0.05905	0.3783
Final Posterolateral	78.778	9.351355941		

FPI vs MSEBT Posteromedial Reach



	Mean	Standard Deviation	r value	P value
FPI	1.666666667	2.820287749	0.2773	0.0689
Final Posteromedial	88.50533333	7.639607651		

9. Conclusion

It is concluded that,

1) Mean value for Foot Posture Index was 1.66±2.82
2) Mean value for Modified Star Excursion Test - Anterior reach 91.61±6.47, Modified Star Excursion Test Posterolateral reach 78.77±9.35, Modified Star Excursion Test Posteromedial reach 88.50±7.63 is found.
3) No significant correlation was found between FPI and all three directions of MSEBT. (Anterior reach P=0.4485; Posteromedial reach P=0.0689; Posterolateral reach P=0.3783)

10. Limitations

- Small population size
- Less number of subjects with abnormal foot postures

11. Suggestions

Comparative Study can be performed on population with normal foot posture, pronated feet and supinated feet.

Clinical Implications

Though our study could not establish a significant correlation of Foot Posture Index and Modified Star Excursion Balance Test, it is important to correct abnormal foot posture and include balance in rehabilitation protocol as literature review indicates affection of balance in pronated feet.

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Annexures - 1 Mastersheet

Serial No.	Gender	Age	Dominant leg	Limb length (cm)	FPI TOTAL	MSEBT FINAL ANTERIOR REACH	MSEBT FINAL POSTEROLATERAL REACH	MSEBT FINAL POSTEROMEDIAL REACH
1	Male	18	Right	83	2	88.91	71.20	79.27
2	Male	21	Right	95	-3	100.31	91.12	104.77
3	Male	21	Right	91	-4	98.02	95.53	84.35
4	Male	20	Right	93	-2	81.57	59.06	74.76
5	Male	18	Left	102	-3	85.19	74.73	83.16
6	Male	19	Right	97	1	93.36	79.21	87.04
7	Male	21	Right	90	-1	93.55	76.6	84.81
8	Male	21	Left	90	3	94.33	76.48	81.62
9	Male	23	Right	96	7	87.67	75.72	89.47
10	Male	24	Right	104	-4	85.12	74.93	83.65
11	Male	22	Right	94	6	87.34	75.35	89.11
12	Male	22	Right	88	1	98.78	75.83	81.21
13	Male	23	Right	88	1	93.33	76.09	84.46
14	Male	23	Right	94	2	79.57	56.91	72.48
15	Male	22	Right	99	2	80.8	75.75	90.9
16	Male	21	Right	106	1	95.28	89.62	94.33
17	Male	20	Right	101	2	86.40	79.33	96.63
18	Male	20	Right	91	3	97.80	86.15	97.87
19	Male	20	Left	96	1	102.77	78.43	85.52
20	Male	24	Right	88	5	96.02	81.89	97.72
21	Female	22	Right	90	3	94.48	81.92	92.48
22	Female	24	Right	80	3	85.37	78.91	85.04
23	Female	23	Right	83	1	86.06	77.79	82.28
24	Female	24	Right	85	1	100.11	91.21	96.54
25	Female	22	Right	88	3	94.166	58.20	81.85
26	Female	23	Right	76	6	97.5	89.38	97.36
27	Female	24	Left	84	4	95.71	90.51	96.58
28	Female	20	Right	84	3	96.70	82.53	96.5
29	Female	21	Right	88	2	82.42	76.93	90.49
30	Female	21	Right	80	4	89.91	86.03	92.91

Data Record Sheet

Date of assessment - _ / _
Name - Age - Gender
-
Dominant leg - Limb length -

Foot Posture Index (FPI - 6)

Factor	Plane	Score (Dominant leg)
Talar head position	Transverse	
Curves above and below the lateral malleolus	Frontal/ Transverse	
Inversion/ Eversion of the calcaneus	Frontal	
Prominence in the region of the TNJ	Transverse	
Congruence of the medial longitudinal arch	Sagittal	
Abduction/adduction forefoot on rear foot	Transverse	
TOTAL		

Modified Star Excursion Balance Test

Distance reached in each direction		
Anterior	Posterolateral	Posteromedial

Patient Information Sheet

Study Title: Correlation Of Foot Posture with Dynamic Balance in Recreational Football Players

Introduction: You are invited to participate in this research study. It is important that you read the description of this study and understand your role in it including the nature of participation. Please give your consent to participate in this study only if you have completely understood the nature and course of the study and if you are aware of your rights as a participant.

Purpose of the study: To study the correlation of foot posture with dynamic balance in recreational football players.

Study Procedure: If you agree to participate in this study, you shall be examined for your foot posture which will be assessed using Foot Posture Index (FPI - 6) for which you should stand in relaxed stance position with double limb support, standing straight with arms by the side and looking straight.

Dynamic balance which will be assessed using Modified Star Excursion Balance Test, the dominant limb will be placed on the center of 'Y', while maintaining a single leg stance you should reach in all three directions. Trial should be repeated if the foot is lifted, moved, weight is transferred to reach the foot, balance is lost, or hands are removed from hips.

Risks of Participation: There is no risk of participation.

Possible Benefits of the Study: There are no obvious benefits associated with the study.

Compensation for Participation: No compensation will be provided.

Right to Withdraw from the Study: Participation in the study is entirely voluntary. you may choose not to take part or you may leave the study anytime.

Confidentiality: All the study records and subject's photos shall be kept confidential at all times. Your identity shall not be revealed except as required by law. The results of your examination may be published for scientific purposes. Your identity shall not be revealed in this publication.

Information Regarding Rights as A Research Participant:
You may contact the ethics Institutions Committee Secretary for your queries related to your rights as a study participant.
Contact timings: Monday to Friday - 9 am to 4 pm and Saturday - 9 am to 1 pm.

Further Study Related Information: If you have any questions, please let us know. If you wish to ask questions later, you may contact the study investigators.
Contact timings: Monday to Friday - 9 am to 4 pm

Investigators - Nihar Kathane, IV BPTh, K. J. Somaiya College of Physiotherapy.

Guide - Dr Rupali Shevalkar (PT), Associate Professor, K. J. Somaiya College of Physiotherapy
Address - K J Somaiya College of Physiotherapy, Somaiya Ayurvihar Complex, Eastern Express Highway, Sion (E), Mumbai - 400 022, India.
Phone no - 022 50954700, +91 8356964432.

Consent Form

Study Title: Correlation Of Foot Posture with Dynamic Balance In Recreational Football Players.

Name of the Participant:
I confirm that I have been informed and explained the research and the methodology of research in the language I understand.
I understand that my participation in this study is voluntary and that I am free to withdraw any time, without giving any reason.
I confirm that the authorities will not need the permission to look at my health records and I understand that my identity will not be revealed in any form or information released to the third party.
I agree not to restrict the use of any data or result that arises from this study provided such a use is only for research purposes.
I, thus, give my consent to participate in the above-mentioned study.

Date:

Signature:

Name of the Investigator /Researcher Signature:

Annexures – 2

1) Foot Posture Index (FPI - 6)

THE FOOT POSTURE INDEX©
FPI-6

Reference Sheet

The patient should stand in their relaxed stance position with double limb support. The patient should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the patient to take several steps, marching on the spot, prior to settling into a comfortable stance position. During the assessment, it is important to ensure that the patient does not swivel to try to see what is happening for themself, as this will significantly affect the foot posture. The patient will need to stand still for approximately two minutes in total in order for the assessment to be conducted. The assessor needs to be able to move around the patient during the assessment and to have uninterrupted access to the posterior aspect of the leg and foot.

If an observation cannot be made (e.g. because of soft tissue swelling) simply miss it out and indicate on the datasheet that the item was not scored.

If there is genuine doubt about how high or low to score an item always use the more conservative score.

Rearfoot Score	**-2**	**-1**	**0**	**1**	**2**
Talar head palpation	Talar head palpable on lateral side/but not on medial side	Talar head palpable on lateral side/slightly palpable on medial side	Talar head equally palpable on lateral and medial side	Talar head slightly palpable on lateral side/ palpable on medial side	Talar head not palpable on lateral side/ but palpable on medial side
Curves above and below the malleoli	Curve below the malleolus either straight or convex	Curve below the malleolus concave, but flatter/ more shallow than the curve above the malleolus	Both infra and supra malleolar curves roughly equal	Curve below malleolus more concave than curve above malleolus	Curve below malleolus markedly more concave than curve above malleolus
Calcaneal inversion/eversion	More than an estimated 5° inverted (varus)	Between vertical and an estimated 5° inverted (varus)	Vertical	Between vertical and an estimated 5° everted (valgus)	More than an estimated 5° everted (valgus)
Forefoot Score	**-2**	**-1**	**0**	**1**	**2**
Talo-navicular congruence	Area of TNJ markedly concave	Area of TNJ slightly, but definitely concave	Area of TNJ flat	Area of TNJ bulging slightly	Area of TNJ bulging markedly
Medial arch height	Arch high and acutely angled towards the posterior end of the medial arch	Arch moderately high and slightly acute posteriorly	Arch height normal and concentrically curved	Arch lowered with some flattening in the central portion	Arch very low with severe flattening in the central portion – arch making ground contact
Forefoot abd/adduction	No lateral toes visible. Medial toes clearly visible	Medial toes clearly more visible than lateral	Medial and lateral toes equally visible	Lateral toes clearly more visible than medial	No medial toes visible. Lateral toes clearly visible

Foot Posture Index Datasheet

Patient name **ID number**

	FACTOR	PLANE	SCORE 1 Date Comment		SCORE 2 Date Comment		SCORE 3 Date Comment	
			Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2
Rearfoot	Talar head palpation	Transverse						
Rearfoot	Curves above and below the lateral malleolus	Frontal/ transverse						
Rearfoot	Inversion/eversion of the calcaneus	Frontal						
Forefoot	Prominence in the region of the TNJ	Transverse						
Forefoot	Congruence of the medial longitudinal arch	Sagittal						
Forefoot	Abd/adduction forefoot on rearfoot	Transverse						
	TOTAL							

Reference values
Normal = 0 to +5
Pronated = +6 to +9, Highly pronated 10+
Supinated = -1 to –4, Highly supinated –5 to -12