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EVALUATION OF FOOT POSTURE INDEX, MEDIAL LONGITUDINAL ARCH ANGLE, NAVICULAR DROP, FOREFOOT ANGLE AND REARFOOT ANGLE IN YOUNG DANCERS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Research has shown that dancers who practice high-intensity physical routines may suffer from musculoskeletal ailments. The shifted foot position is a primary contributing component to the altered kinematics of the lower limbs. The aim of this study was to look into the young dancers' foot postural abnormalities. Techniques: Based on eligibility criteria, 40 female young dancers from Mandi Gobindgarh's Om Parkash Bansal Modern School were screened for the study. The Foot Posture Index, Medial Longitudinal Arch Angle, Nacular Drop, Rearfoot angle, and Forefoot angle were used to evaluate the subjects' postural abnormalities. Findings: According to a percentile study of the Foot Posture Index scores, young dancers have a higher prevalence of pronated feet (Left 5%, Right 7.5%) and supinated feet (Left 5%, Right 12.5%). The Medial Longitudinal Arch angle variations among young dancers exhibit both a decrease (Left 17.5%, Right 7.5%) and an increase (Left 17.5%, Right 12%) in angle. The majority of the young dancers had increases in their rearfoot angle (about 90%), forefoot angle (approximately 33%), and lateral drop (approx. 35%).Conclusion: The current study suggests that foot postural abnormalities are common among dancers, especially in their early years. Therefore, due to foot posture variations among dancers, preventive and interventional measures must be done to prevent various forms of musculoskeletal problems in the foot.

Keywords: juvenile dancers, foot postural aberrations, one foot issues, and biomechanical

1. INTRODUCTION

Dance is a active, non-competitive form of physical activity and unique art in which human foot plays a very important role to perform various static-dynamic functions within the locomotor system. Proper functioning and efficiency of the foot depends upon the morphological structure and proper shape of the foot **(Gorwa et al., 2021).** Both static and dynamic function of the foot which includes qualities of adaptability during different type of weight bearing activities depends upon four arches of foot which include anterior transverse arch, posterior transverse arch, medial longitudinal arch and lateral longitudinal arch **(Hawes and Sovak., 1994)**.

There are many health benefits of performing various dance activities which includes enormous increase in muscular endurance and maintaining a very low level of body fat **(Merchant., 2013).** Beside various effects on physical health dance activity also have an potential of having positive impact on mental and emotional wellbeing. There are different types of dance forms in the world which differ among different places and culture. In India according to states different dance forms are known like Bharatnatyam, Manipuri, Odyssey, Kathak, Kuchipudi and many more and western dance forms are Hip-Hop, Jazz, Salsa, Locking and Popping, Cabaret, Tap dance, Belly dancing, Ballet, Passo etc **(Merchant., 2013).**

Foot posture plays a vital role in dancer's ability to execute and synchronize with the leg and foot. Foot postural deviations can severely affect the function of lower extremity kinetic chain which enables the risk for musculoskeletal injuries and discomfort among dancers. Most dancers begin their training at a young age, which may cause early postural deviations among young dancers. This can have a significant influence on their future health and according to various research studies there is very less attention paid among dancers as an occupational category **(Cote., 2005).**

According to health literature there is an estimate that approximately 90% of professional dancers will agonise at least one musculoskeletal injury during their career. Different causes of dance injuries include anatomical placement, poor exercise, technical errors, unskilled choreography or style and environmental factors including flooring surfaces which will affect the future fitness of dancers **(Merchant., 2013).** Foot Posture Index is one of the commonly used simple and reliable method which can be used to effectively assess and identify foot postural deviations among dancers **(Sammarco., 1984).**

During various dance activities foot reacts to to these forces by either pronating or supinating the hind foot which is a major factor of causing change in the foot posture. An excessively supinated foot is characterized by a high arch along with hypomobile mid foot and excessive pronation is characterized by flattening of medial arch along with hypermobile mid foot which further place greater demands on the neuromuscular systems to stabilize the foot and maintain upright stance posture **(Merchant., 2013).** So, traditional practices of the dancers need to be carefully studied and compared with the modern system of physical training to understand the predisposing factors and mechanism of injury among dancers **(Macintyre and Joy., 2000).**

2. MATERIALS AND METHODS

Before the commencement of study, a voluntary consent was taken. Total of 40 students (female) was taken in present study as per selection criteria. Population of study included dancers between the age group of 10 to 15 years. The participants were selected from Om Parkash Bansal Modern School

Inclusion Criteria 1. Female dance students of Om Parkash Bansal Modern School. 2. Age group – between 10 to 15 years. 3. Minimum 1 year of Dance Practice. 4. Free style dancers.

Exclusion Criteria 1. Any dance student not willing to participate. 2. Any type of recent Traumatic injury.

3. PROCEDURE

The participants were selected from Om Parkash Bansal Modern School. The various instruments which were required during the study were Universal Goniometer, Foot Stepper, Index Card, Ruler and Marker. Postural Deviations at foot were assessed with the help of Foot Posture Index, Medial Longitudinal Arch angle, Navicular Drop, Forefoot angle and Rearfoot angle which were measured to quantify the biomechanical deviations occurring at the foot.

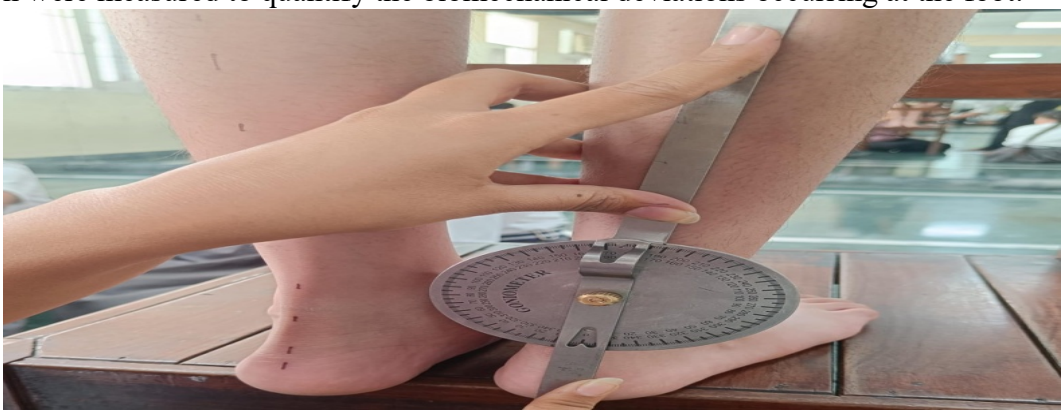

Figure 1 Markings and Placement of Goniometer for measurement of Rearfoot angle.

Figure 2 Marking of Navicular bone on an Index card.

Figure 3 Placement of Goniometer for measurement of Medial Longitudinal Arch angle.

4. RESULTS

Data regarding foot postural deviations among young dancers was analyzed using Microsoft Office Excel 2007. Mean and Standard deviations were analyzed for Demographic details and Percentile was done to analyze the results.

TABLE 1
FOOT POSTURAL DEVIATIONS AMONG YOUNG DANCERS (N=40) (FOOT POSTURE INDEX)

Foot Posture	Highly Pronated	Pronated	Normal	Supinated	Highly Supinated	Total
Left foot	(0) 0%	(2) 5%	(35) 87.5%	(2) 5%	(1) 2.5%	(40) 100%
Right foot	(0) 0%	(3)7.5%	(31) 77.5%	(5) 12.5%	(1) 2.5%	(40) 100%

Table 1 The observations suggested that 5% of dancers showed foot posture deviations towards pronation in the left foot and 7.5% pronation in the right foot where as supinated foot was observed in 5% dancers in left foot and 12.5% supination in the Right foot. Highly supinated left and right foot was observed in 2.5% dancers. Normal foot posture index was observed in 87.5% dancers left foot and 77.5% dancers in the right foot. None of the dancers showed any deviation towards Highly pronated feet.

TABLE 2
DEVIATIONS IN MEDIAL LONGITUDINAL ARCH ANGLE AMONG YOUNG DANCERS

Medial Longitudinal arch angle	Increased	Normal	Decreased	Total
Left foot	(7) 17.5%	(26) 65%	(7) 17.5%	(40) 100%
Right foot	(5) 12%	(32) 80%	(3) 7.5%	(40) 100%

Table 2 The findings suggested that 17.5% dancers showed increase in Medial Longitudinal arch angle at left side and 12% increase in angle at right side. There was decrease in Medial Longitudinal arch angle among 17.5% dancers in the left foot and 7.5% decrease in angle in the right foot. Normal medial longitudinal arch angle in left foot was observed in 65% dancers and 80% dancers had normal angle in right foot

TABLE 3
DEVIATIONS IN NAVICULAR DROP AMONG YOUNG DANCERS.

Navicular drop	Supinated	Normal	Pronated	Total
Left foot	(13) 32.5%	(22) 55%	(5) 12.5%	(40) 100%
Right foot	(14) 35%	(18) 45%	(8) 20%	(40) 100%

Table 3 The findings suggested that 12.5% dancers showed pronated foot at left side and 20% pronated foot in the right side where as normal navicular drop was observed in 55% dancers in left foot and 45% normal navicular drop was observed in the Right foot. Supinated foot was observed in 32.5% dancers in left foot and 35% supination in the Right foot.

TABLE 4
DEVIATIONS IN FOREFOOT ANGLE AMONG YOUNG DANCERS.

Forefoot angle	Increased	Normal	Decreased	Total
Left foot	(13) 32.5%	(25) 62.5%	(2) 5%	(40) 100%
Right foot	(10) 25%	(29) 72.5%	(1) 2.5%	(40) 100%

Table 4 The findings suggested that 32.5% dancers showed increase in Forefoot angle at left side and 25% increase in angle at right side. There was decrease in forefoot angle among 5%

dancers in the left foot and 2.5% decrease in angle in the right foot. Normal forefoot angle in left foot was observed in 62.5% dancers and 72.5% dancers had normal forefoot angle in right foot.

TABLE 5
DEVIATIONS IN REARFOOT ANGLE AMONG YOUNG DANCERS.

Rearfoot angle	Pronated	Normal	Supinated	Total
Left foot	(28) 70%	(12) 30%	(0) 0%	(40) 100%
Right foot	(36) 90%	(4) 10%	(0) 0%	(40) 100%

Table 5 The findings suggested that 70% dancers showed pronated foot at left side and 90% pronated foot in the right side where as normal rearfoot angle was observed in 30% dancers in left foot and 10% normal rearfoot angle was observed in the Right foot. None of the dancers showed any deviation towards supinated foot.

4. DISCUSSION

The present study was conducted with an aim to find out the various Foot Postural deviations amongst Young Dancers. Foot postural deviations were assessed by means of demographic details, foot posture index, medial longitudinal arch angle, navicular drop, forefoot angle and rearfoot angle.

Total 40 female subjects with mean age group of 11.71 ± 0.87 were included in the study. According to height of subjects, the mean height of female subjects was 4 feet. 84 inches ± 0.52.According to weight of subjects, the mean weight of female subjects was 44.55 kg ± 9.72. According to BMI of subjects, 15 (37.5%) female dancers were Underweight and 25 (62.5%) female dancers had Normal weight. None of the subjects were overweight. It was observed that 38 (95%) of female dancers were right side dominant where as only 2 (5%) of dancers were left side dominant. According to total years of dance practice, 13 (32.5 %) of dancers had experience of dance practice of less than 2 years followed by 11 (27.5 %) dancers experience of 2-4 years, 9 (22.5 %) dancers experience of 4-6 years, 4 (10 %) dancers experience of 6-8 years and only 3 (7.5 %) dancers had dance experience of 8-10 years.

The observations suggested that 5% of dancers showed foot posture deviations towards pronation in the left foot and 7.5% pronation in the right foot where as supinated foot was observed in 5% dancers in left foot and 12.5% supination in the Right foot. Highly supinated left and right foot was observed in 2.5%. Normal foot posture index was observed in 87.5% dancers left foot and 77.5% dancers in the right foot. None of the dancers showed any deviation towards Highly pronated feet. This study concludes that foot posture deviations are 12.5% in left foot and 22.5% foot posture deviations in right foot according to foot posture index among young dancers. **Modak et al. in 2023** conducted a study to evaluate foot posture in Bharatnatyam dance form in which it was concluded that Bharatanatyam dancers have increased pronation of foot compared to control group.

The findings suggested that 17.5% dancers showed increase in Medial Longitudinal arch angle at left side and 12% increase in angle at right side. There was decrease in Medial Longitudinal arch angle among 17.5% dancers in the left foot and 7.5% decrease in angle in the right foot. Normal medial longitudinal arch angle in left foot was observed in 65% dancers and 80% dancers had normal angle in right foot. This study concludes that medial longitudinal arch angle deviations in left foot was 35% and 20% subjects had angle deviations in right foot.

The findings suggested that 12.5% dancers showed pronated foot at left side and 20% pronated foot in the right side where as normal navicular drop was observed in 55% dancers in left foot and 45% normal navicular drop was observed in the Right foot. Supinated foot was observed in 32.5% dancers in left foot and 35% supination in the Right foot. This study

concludes that foot posture deviations are 45% in left foot and 55% foot posture deviations in right foot according to Navicular drop among young dancers. As suggested in a study navicular drop in high heel footwear user was found to be more than navicular drop in non-high heel footwear user **(Purnima Kumari et al., 2023).**

The findings suggested that 32.5% dancers showed increase in Forefoot angle at left side and 25% increase in angle at right side. There was decrease in forefoot angle among 5% dancers in the left foot and 2.5% decrease in angle in the right foot. Normal forefoot angle in left foot was observed in 62.5% dancers and 72.5% dancers had normal forefoot angle in right foot. This study concludes that foot posture deviations are 37.5% in left foot and 27.5% foot posture deviations in right foot according to forefoot angle among young dancers.

The findings suggested that 70% dancers showed pronated foot at left side and 90% pronated foot in the right side where as normal rearfoot angle was observed in 30% dancers in left foot and 10% normal rearfoot angle was observed in the Right foot. None of the dancers showed any deviation towards supinated foot. This study concludes that foot posture deviations are 70% in left foot and 90% foot posture deviations in right foot according to rearfoot angle among young dancers. According to **(Fengfeng et al., 2022),** strengthening the lower extremity muscles is also a recommendation to improve muscle coordination and reduce injuries.

5. CONCLUSION

From above observations this study concludes that free style dancing includes constant exposure to the forces on foot which can lead to instability, foot problems, injuries and various types of foot postural deviations among dancers even at young age. Therefore, the study recommends that young dancers should be educated and trained about the foot problems associated with dance activity and various Interventional measures must be taken to prevent various types of musculoskeletal injuries in foot due to foot posture deviations among dancers.

6. LIMITATIONS

This study included all free style dancers as these were only available in the present Geographical area (Om Parkash Bansal Modern School). Further studies can be done among dancers to evaluate the foot posture deviations on the basis of different types of classical and western dance styles.

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