

## **Kinematical Analysis of Right Ankle Angle in Different Phases of Take-off in Fosbury-Flop Technique in High Jump**

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### **ABSTRACT**

**Background:** The purpose of the study was to assess and compare kinematical analysis of Right Ankle Angle in different phases of take-off in fosbury - flop technique in high jump.

**Methods:** Eight male (national / inter university level) high jumpers of Sub Centre Sports Authority of India, Lucknow and Guru Gobind Singh Sports College, Lucknow (who had been participating regularly and who have attained the performance level of 01.95 meters) were selected and their age ranging between 16 to 28 year. The purpose of the study was explained to the subjects and requested to Fosbury-flop technique in high jump in their best effort during each attempt. The data was analyzed by applying Descriptive Statistics (Mean, Standard Deviation) and Analysis of Variance (ANOVA) technique to assess and Compare Kinematical analysis of Right Ankle Angle in different phases of take-off in fosbury - flop technique in high jump. The level of significance was set at 00.05.

**Results:** There was significant difference between Right Ankle Angle at Initial Take-off & Right Ankle Angle During Take-off; Right Ankle Angle at Initial Take-off & Right Ankle Angle at Final Take-off; Right Ankle Angle During Take-off & Right Ankle Angle at Final Take-off of male high jumpers in fosbury flop technique in relation to Right Ankle Angle, as mean differences were (16.38), (30.63) and (14.25) which were higher than the critical difference value of (12.11).

**Conclusion:** The Right Ankle Angle of initial Take-off was found greater than during Take-off as well as final Take-off in Fosbury-flop technique.

**Key words:** Angular, Kinematical, Fosbury-flop technique, Right ankle joint, Right Ankle Angle and High jump.

### **Objectives of the Study**

1. To assess kinematical analysis of Right Ankle Angle in different phases of take-off in fosbury -flop technique in high jump.
2. To compare kinematical analysis of Right Ankle Angle in different phases of take-off in fosbury - flop technique in high jump.

### **PROCEDURE AND METHODOLOGY**

#### **Selection of Subjects**

For the purpose of the study, Eight male (national / inter university level) high jumpers of Sub Centre Sports Authority of India, Lucknow and Guru Gobind Singh Sports College, Lucknow (who had been participating regularly and who have attained the performance level of 01.95 meters) were selected and their age ranging between 16 to 28 year. The purpose of the study was explained to the subjects and requested to Fosbury-flop technique in high jump in their best effort during each attempt.

#### **Selection of Variables**

Keeping the feasibility criterion in mind, the Angle of Right ankle joint variables of different phases of take-of skill in Fosbury-flop technique in high jump was selected for the present study.

1. Angle of Right ankle joint Variables at initial Take-off (touching the ground by Take-off foot) in Fosbury-flop technique in high jump.
2. Angle of Right ankle joint Variables at during Take-off (total body weight on the Take-off foot) in Fosbury-flop technique in high jump.
3. Angle of Right ankle joint Variables at final Take-off in Fosbury-flop technique in high jump.

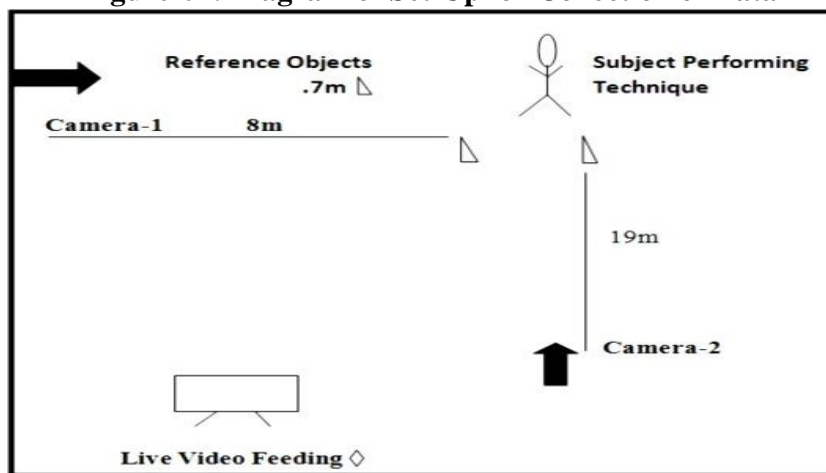
**Criterion Measures:**

The following criterion measures were adopted for the present study: Angle of Right ankle joint variables of different phases of take-of skill in Fosbury-flop technique was measured by Silicon Coach Pro-7 Motion Analysis Software in degree.

**Filming Protocol**

The video graphic technique was used for collecting raw data. The video graphs would taken by a professional photographer under the supervision of an expert. According to availability of two Casio EX-F1 high speed camera was used, which have frequency from 60 to 300 frames per second (f/s). The data were recorded from sagittal plane and frontal plane. Camera-01 was placed perpendicular from the subject at a distance of eight meters and above from ground one meter height. Camera-02 placed perpendicular to camera-01 and in front of subject performing the Take-off in Fosbury-flop technique at the distance nineteen meters and above from ground one meter. For the purpose of the analysis of this study three phases were selected was initial, during and final Take-off in Fosbury-flop technique in high jump. The subject s had given two trials for Take-off in Fosbury-flop technique in high jump and the best trial was used for analysis. The set up of collecting data was showed in figure-01.

**Figure-01: Diagram of Set-Up for Collection of Data**

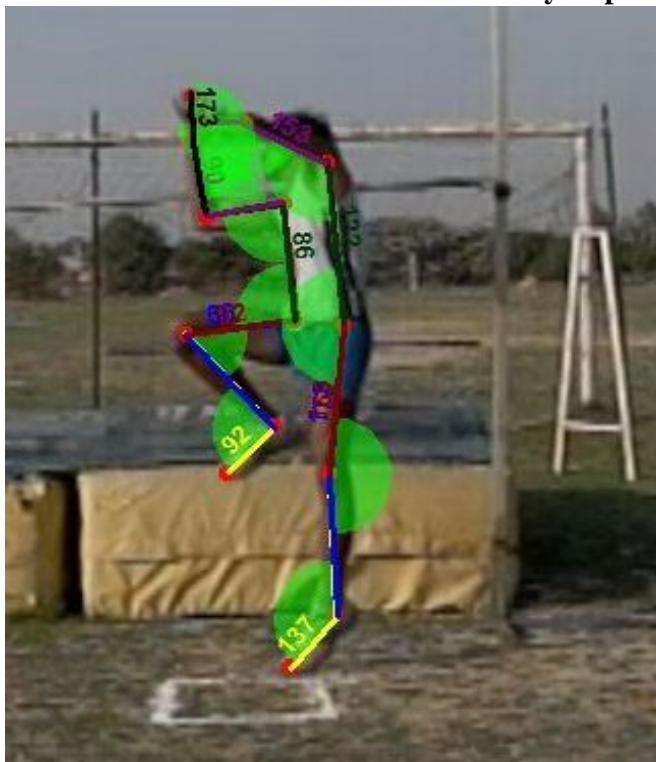


**Procedure for Collecting Angular kinematic Data**

On the basis of the video recording, the scholar marked various angular kinematic variables with the help Silicon coach pro-7 motion analysis software i.e. Right ankle joint Angle at selected Joints was measured as shown in figures 02, 03 and 04 as follow.



**Figure-04: Side View of Final Take-off in Fosbury-flop Technique**



**Statistical Technique**

1. To kinematical analyze (Right Ankle Angle) Take-off skill in Fosbury-flop technique in high jump and to determine the key components of Take-off in Fosbury-flop technique, descriptive statistic was used.
2. To compare (Right Ankle Angle) the different phase of Take-off skill in Fosbury-flop technique in high jump, analysis of variance (ANOVA) was used.
3. The level of significance was set at 0.05.

**RESULTS OF THE STUDY**

The findings pertaining to descriptive statistics, one way analysis of variance (ANOVA) as well as post hoc test for the Angle of Right ankle joint variable of Eight male (national / inter university level) high jumpers of Sub Centre Sports Authority of India, Lucknow and Guru Gobind Singh Sports College, Lucknow have been presented in table no. 01 to 03.

**Table-01: Descriptive Statistics of Male High Jumpers in Relation to Right Ankle Angle in different phases of (Initial, during and Final) Take-off in fosbury –flop technique**

Variables	Initial Take-off	during Take-off	Final Take-off
Mean	123.000	106.62	92.37
Standard Deviation	12.77	08.18	13.30

<b>Standard Error</b>	04.51	02.89	04.70
<b>Range</b>	48.00	19.00	35.00
<b>Minimum</b>	107.00	98.00	77.00
<b>Maximum</b>	150.00	117.00	113.00
<b>Sum</b>	984.00	853.00	739.00

It is evident from table - 01 that mean, standard deviation, scores of angle of Right ankle joint in different phases of (Initial, during and Final) take-off in fosbury –flop technique in high have been found as follow: Right ankle joint in initial take-off ( $123.00 \pm 12.77$ ), Right ankle joint in during take-off ( $106.62 \pm 08.18$ ) and Right ankle joint in final take-off ( $92.37 \pm 13.30$ ) respectively.

**Table-02: Analysis of Variance of High Jumpers in Relation to Right Ankle Angle of Initial Take-off, During Take-off and Final Take-off in Fosbury- Flop Technique**

Source of Variation	Sum of Squares	df	Mean Square	F-Value
Between Groups	3757.59	2	1878.79	13.86*
Within Groups	2847.75	21	135.61	

\* Significant at 0.05 level of significance

$F_{0.05}(2, 21) = 3.47$

Table - 02 revealed that there was significant difference among initial Take-off, during Take-off and final Take-off of male high jumpers in fosbury flop technique in relation to Right Ankle Angle, as obtained F-ratio was (13.86), which was higher than the tabulated value of (3.47), at 0.05 level with (2, 21) degree of freedom.

Since the one way analysis of variance was found significant in relation to Right Ankle Angle, the LSD test was applied to find out the differences of the paired means among initial Take-off, during Take-off and final Take-off of male players in Fosbury-flop technique.

**Table-03: Least Significant Difference (LSD) Post Hoc Test for the Paired Means among Initial Take-off, During Take-off and Final Take-off of Male high jumpers in Fosbury-flop Technique in Relation to Right Ankle Angle**

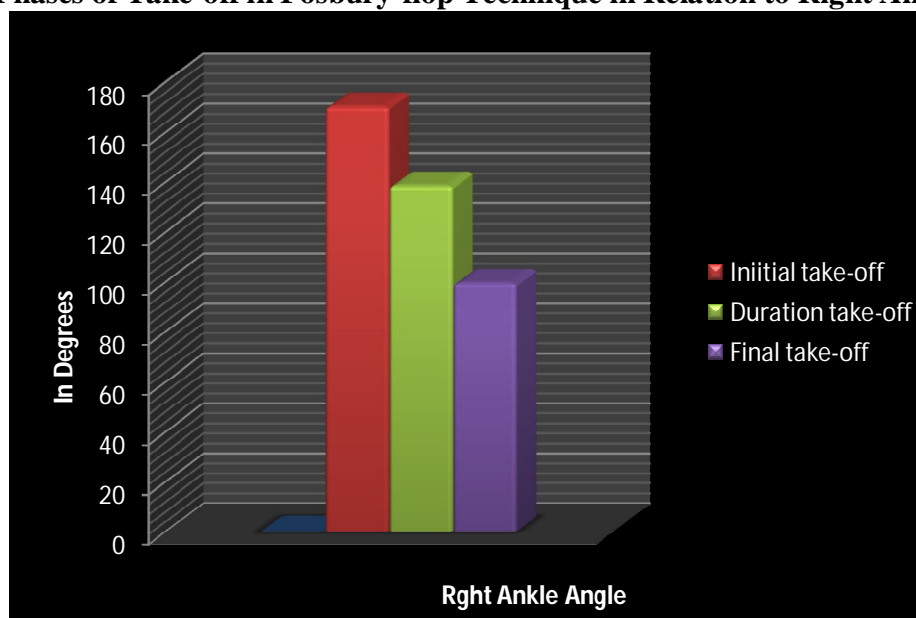
Right Ankle Angle at Initial Take-off	Right Ankle Angle During Take-off	Right Ankle Angle at Final Take-off	Mean Difference	Critical Difference
123.00	106.62		16.38*	12.11
123.00		92.37	30.63*	
	106.62	92.37	14.25*	

\* Significant at 0.05 level of significance

Table- 03 revealed that there was significant difference between Right Ankle Angle at Initial Take-off & Right Ankle Angle During Take-off; Right Ankle Angle at Initial Take-off & Right Ankle Angle at Final Take-off; Right Ankle Angle During Take-off & Right Ankle Angle at Final Take-off of male high jumpers in fosbury flop technique in relation to Right Ankle

Angle, as mean differences were (16.38), (30.63) and (14.25) which were higher than the critical difference value of (12.11).

**Figure-05: Graphical Representation of Comparison of Means of Jumpers at Different Phases of Take-off in Fosbury-flop Technique in Relation to Right Ankle Angle**



The Right Ankle Angle of initial Take-off was found greater than during Take-off as well as final Take-off in Fosbury-flop technique.

#### **DISCUSSION AND FINDING**

The findings of the study revealed that the In case of angular kinematical variable (Right Ankle Angle) significant difference was found among initial Take-off, during Take-off and final Take-off of male high jumpers in fosbury flop technique in relation to right ankle angle. Further, Significant differences were also found in paired means of (LSD) Post Hoc Test in relation to right ankle angle as mean differences were higher than the critical difference value. The reason for this may be that at initial Take-off the position of the right foot was vertical/perpendicular to the ground and toe touching the ground with mean ankle angle of (123.00<sup>0</sup>) while during Take-off, the foot was also vertical to the ground as well as in air born action with decreased angle of (106.62<sup>0</sup>) and at final Take-off the foot was planter flexed in air with angle of (92.36<sup>0</sup>)

Finally, the sequence of performance was found that the right ankle angle of initial Take-off was found greater than during Take-off as well as final Take-off in Fosbury-flop technique.

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