



A Kinematical Analysis of Trunk inclination in Different Phases of Take-off in Fosbury-Flop Technique in High Jump

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Received Aug 29, 2020; Accepted Sep 07, 2020; Published Oct 01, 2020

Abstract

Background: The purpose of the study was to assess and compare Kinematical analysis of trunk inclination 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 trunk inclination in different phases of take-off in fosbury –flop technique in high jump. The level of significance was set at 00.05.

Results: that there was significant difference between Trunk Inclination Angle at Initial Take-off & Trunk Inclination Angle During Take-off; Trunk Inclination Angle at Initial Take-off & Trunk Inclination Angle at Final Take-off and Trunk Inclination Angle During Take-off& Trunk Inclination Angle at Final Take-off initial Take-off, during Take-off and final Take-off of male high jumpers in fosbury flop technique in relation to Trunk Inclination Angle, as mean differences value were (05.63), (09.00) and (14.63) respectively, which were higher than the critical difference value of (04.78).

Conclusion: The Trunk inclination of final Take-off was found greater than during Take-off as well as initial Take-off in Fosbury-flop technique.

Key Words: Angular, Kinematical, Fosbury–flop technique, Trunk inclination and High jump.

1. Objective of the Study:

- To assess Kinematical analysis of trunk inclination in different phases of take-off in fosbury -flop technique in high jump.
- To compare Kinematical analysis of trunk inclination in different phases of take-off in fosbury -flop technique in high jump.

2. Procedure and Methodology:

2.1 Subjects for the Study:

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.

2.2 Selection of Variables:

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

- Angle of Trunk inclination Variables at initial Take-off (touching the ground by Take-off foot) in Fosbury-flop technique in high jump.

- Angle of Trunk inclination Variables at during Take-off (total body weight on the Take-off foot) in Fosbury-flop technique in high jump.
- Angle of Trunk inclination Variables at final Take-off in Fosbury-flop technique in high jump.

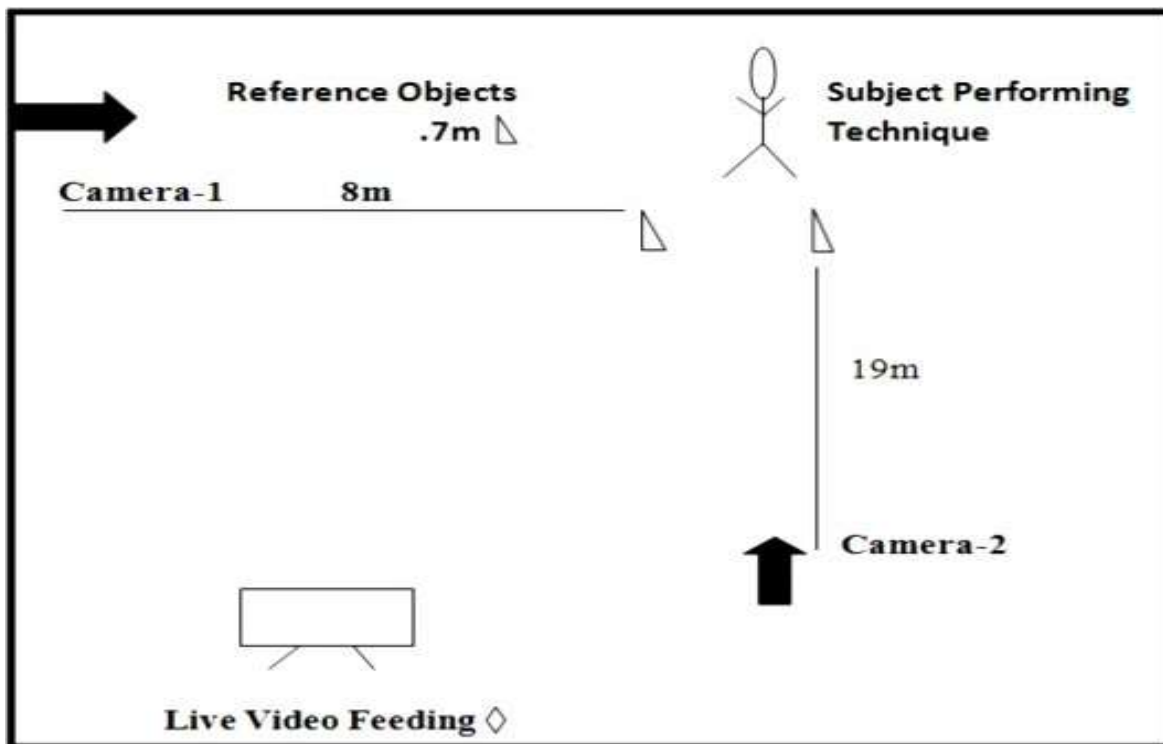
2.3 Criterion Measures:

The following criterion measures were adopted for the present study: Angle of Trunk inclination 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



2.4 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. Trunk inclination the Angle at selected Joints was measured as shown in figures 02, 03 and 04 as follow.

Figure-02: Front View of Initial Take-off (Touch the Ground of Take-off Foot) in Fosbury- flop Technique

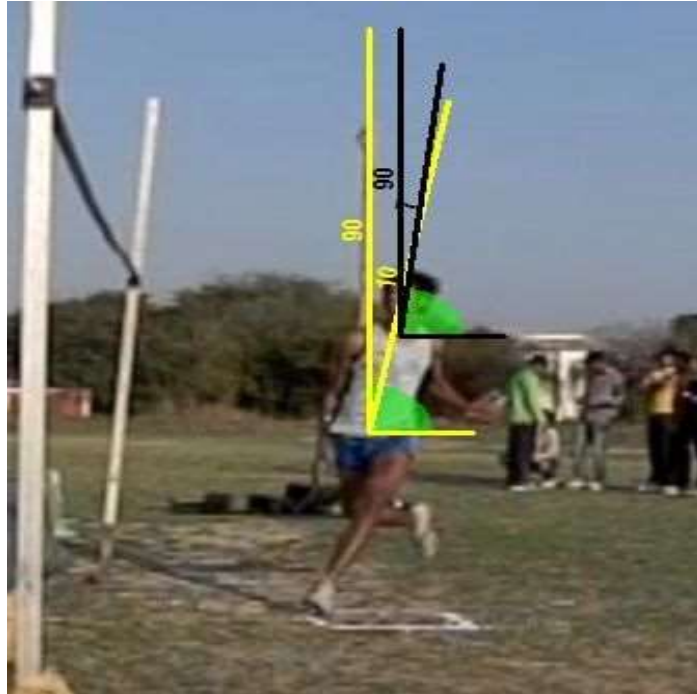
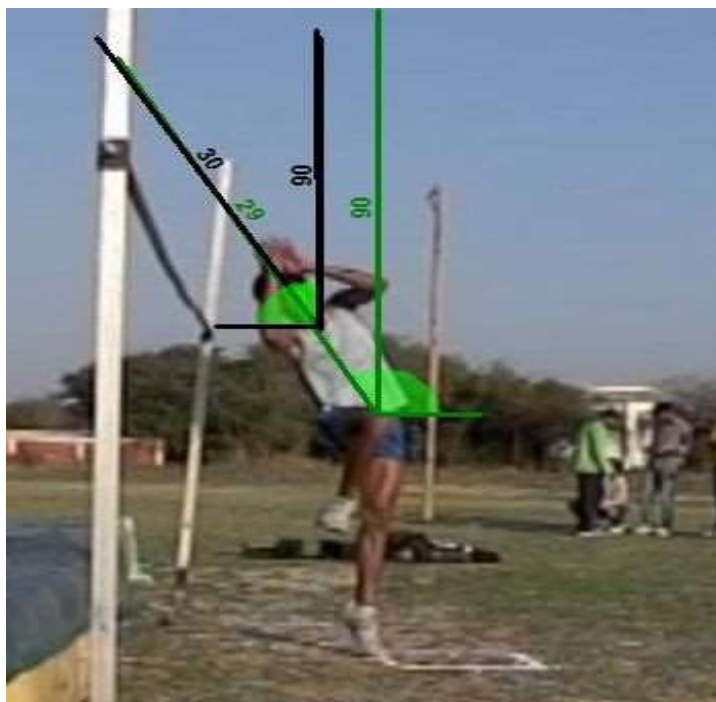


Figure-03: Front View of During Take-off (Total Body Weight on the Take-off Foot) in Fosbury-flop Technique



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



2.5 Statistical Analysis:

- To kinematical analyze 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.
- To compare the different phase of Take-off skill in Fosbury-flop technique in high jump, analysis of variance (ANOVA) was used.
- The level of significance was set at 0.05.

3. 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 Trunk inclination 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 Trunk inclination in different phases of (Initial, during and Final) Take-off in fosbury –flop technique in high

Variables	Initial Take-off	During Take-off	Final Take-off
Mean	12.13	06.50	21.13
Standard Deviation	01.96	04.11	06.53
Standard Error	00.69	06.50	02.31
Range	06.00	12.00	20.00
Minimum	10.00	02.00	09.00
Maximum	16.00	14.00	29.00
Sum	97.00	52.00	169.00

It is evident from table - 01 that mean, standard deviation, scores of Trunk inclination in different phases of (Initial, during and Final) take-off in fosbury –flop technique in high have been found as follow: Trunk inclination in initial take-off (12.13 ± 01.96), Trunk inclination in during take-off (06.50 ± 04.11) and Trunk inclination in final take-off (21.13 ± 06.53), respectively.

Table-02:

Analysis of Variance of High Jumpers in Relation to Trunk inclination 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	870.75	02	435.38	20.60*
Within Groups	443.75	21	21.13	

* Significant at 0.05 level of significance

F 0.05 (02, 21) = 03.47

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 Trunk inclination Angle, as obtained F-ratio was 20.60, which was higher than the tabulated value of 03.47, at 0.05 level with (02, 21) degree of freedom.

Since the one way analysis of variance was found significant in relation to Trunk inclination 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:

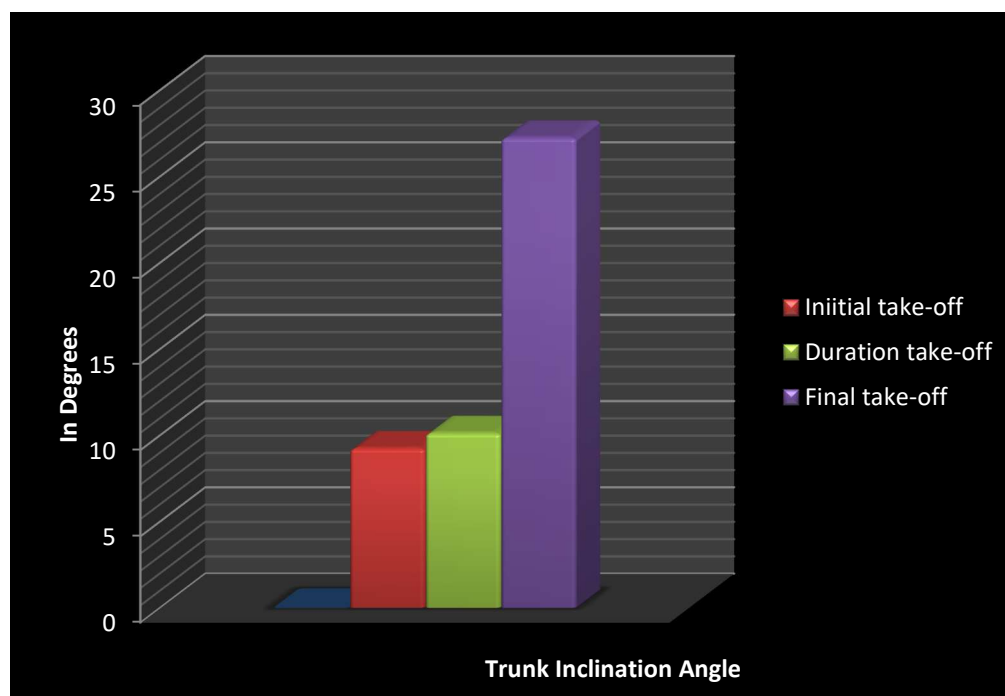
Least Significant Difference (LSD) Post Hoc Test for the Paired Means among Initial Take-off, During Take-off and Final Take-off of Male high jumpers in Fosbury-flop Technique in Relation to Trunk inclination Angle

Trunk inclination Angle at Initial Take-off	Trunk inclination Angle During Take-off	Trunk inclination Angle at Final Take-off	Mean Difference	Critical Difference
12.13	06.50		05.63*	
12.13		21.13	09.00*	04.78
	06.50	21.13	14.63*	

* Significant at 0.05 level of significance

Table- 03 revealed that there was significant difference between Trunk Inclination Angle at Initial Take-off & Trunk Inclination Angle During Take-off; Trunk Inclination Angle at Initial Take-off & Trunk Inclination Angle at Final Take-off and Trunk Inclination Angle During Take-off& Trunk Inclination Angle at Final Take-off initial Take-off, during Take-off and final Take-off of male high jumpers in fosbury flop technique in relation to Trunk Inclination Angle, as mean differences value were (05.63), (09.00) and (14.63) respectively, which were higher than the critical difference value of (04.78).

Figure-05:
Graphical Representation of the Comparison of Means of Jumpers at Different Phases of Take-off in Fosbury-flop Technique in Relation to Trunk inclination Angle



The Trunk inclination of final Take-off was found greater than during Take-off as well as initial Take-off in Fosbury-flop technique.

4. Discussion and Finding:

The findings of the study revealed that the In case of angular kinematical variable (Trunk Inclination 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 trunk inclination angle. Further, Significant differences were also found in paired means of (LSD) Post Hoc Test in relation to trunk inclination angle as mean differences were higher than the critical difference value. This may be attributed to the fact that at initial Take-off the position of the trunk was slightly tilt toward left side from the vertical axis with mean angle of (12.13°) while during Take-off, the trunk was tilt toward the right side from the vertical axis with angle of (6.50°) and at final Take-off the trunk was bent toward the right side from the vertical axis with angle of (21.13°) to create angular momentum of the body. The present study is also supported by **Ae Michiyoshi, Ryu Nagahara et.al. (2008)** strongly supported and conducted the study on Thomas's technique was characterised by a strong forward lean of the trunk and deeply flexed support knee during the preparation phase, accelerative transition to the take-off phase, fully used take-off knee and hip, and the large inward lean of the body. **Francesca Bradamante, et al. (2004)** strongly supported and conducted the study on High jumper achieves the continuous connection between the trajectory of first and second phase by a complex movement in the Take-off: he flexes legs (for the upward vertical thrust of the Take-off) and rotates the trunk, while the centre of mass maintains a positive (upward) vertical motion.

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

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