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The Relationship of Selected Biomechanical Variables with the Performance in Javelin Throw

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Abstract
The aim of the study is to assess the relationship between selected biomechanical variables with the performance in Javelin throw. Five male Javelin throwers of Lakshmibai National University of Physical Education, Gwalior from the track & field match practice group were selected as the subject for the present study. Their age was between 17 to 25 years. The sequential photography technique was employed to record the technique of javelin throwers. A Motor driven, Nikon D-40 camera was used. The subjects were photographed at stance position and release moment in sagittal plane. From the photographs, the stick figures were prepared by using Joint-point Method, and various biomechanical variables were obtained at the moment of releasing the javelin, suggested by Hay. Pearson's product moment correlation was used to find out the relationship of selected biomechanical Variables with the performance of male Javelin throwers. The level of significance was tested at .05. The angle right and left ankle joint and left elbow joint have exhibited significant relationships at stance position and In case of release moment shoulder joint (right) and elbow joint (left) have shown significant relationship with the performance of subject. The result of the height of C.G. at selected moments has insignificant relationship with the performance of subject at stance position and at release moment. Training focusing on Right knee, ankle, hip and shoulder joint is recommended.
Keywords: Javelin Throw-Biomechanical variables-Joint-Point Methods

1. Introduction

Biomechanics is one of the areas of inquiry, regarding human movement. Biomechanics is a multidisciplinary science with application in many professional fields because biomechanics come from different academic background biomechanical research address a spectrum of problems and question. **(Susan J.Hall,1991)** Biomechanics is an applied form of mechanics and consequently the method used to investigate it must be derived from those of mechanics .However the mechanics have not developed in the wake of mechanics, but a bordering science in order scientific disciplines such as anatomy, physiology and techniques of sports. **(Gerlord Gochmuth, 1984)** In each sport and activity every athlete has his own way of performing that particular activity so they are many factors involved in determining the style for the execution of such movement. **(Jag Mohan Singh, 1985)**

In the javelin throw, the javelin is released at a height of seven feet or more above the surface to which it falls. Since the angle of projection of the $30\text{-}40^0$ range in order to attain the greatest distance, is prediction on the fact that the implement projected will not fall below the level from which it was projected **(John W. Bunn, 1978).** In the recent years, greater stress has been laid on quality rather than the quantity of training. The coaches and teachers of physical education want their athlete to extract maximum achievement from their training procedures without causing too much strain on them **(Rustom N. Sadri,)**. The aspects of mechanics, biomechanics have revealed the lowest and simplest dependencies in a problem of athletic movement and thus produced the prerequisites for understanding the higher and more complicated form of movements before and further knowledge actually exists**.(Gerlord Gochmuth, 1984).** While in the latter events throwing must be from a circle, the javelin must be discharged from behind the arc of a circle drawn with a radius of 8mt. Such arc shall consist of a strip made of wood or metal. **(Gerhardt Schmolinsky 1987)**

The role that sports biomechanics widely understood in sports community and the demand for service increasing researchers in sports biomechanics will have to consider carefully how much time they can devote to the provision of scientific services without improving their performances as scholar researchers. To avoid the problems inherent in this situation, it may be necessary to develop programmed of study of the training of technicians in sports biomechanics, who can provide the kind of services sought by sporting bodies**. (James G. Hay,1984).** The center of gravity in the human body is located in the mid of the trunk and at about hip level when standing in the normal erect position with the arm hanging at the side. The change in position of the center of gravity with movement of a body part is instantaneous. External weight added to the body will increase the total body weight and effect the location of the center of gravity of the body and the added weight**. (Fred Wilt, 1960**)

The role of cinematography in biomechanical research involved from a simple form of recording motion to a sophisticated means of computer analysis of motion efficiency over the years, new technique in filming and timing having been perfected to aid the research in achieving accurate time measurements of both simple and complex locomotion patterns. **(John Newton, et. all May 1971).**

2. Material and Methods

2.1 Subjects

Subjects: Five male javelin throwers of Lakshmibai National University of Physical Education, Gwalior from the track & field match practice group were selected as the subject for the present study. These javelin throwers represented the university in all India intervarsity Athletic competition in the year 2007-08.There age was between 17 to 25 years, volunteered to participate in the study.

2.2 Methodology

Sequential photography was employed for conducting the biomechanical analysis of throwing the javelin. The camera used for this purpose was a digital standard Nikon Model EM (with motor drive). The frequency of the camera was 3 frames/ second. Even through this camera registered three sequence photographs at the moment of release the javelin was selected for the purpose of analysis. The subjects were photographed in saggital plane for obtaining individual photographic sequence; the subjects were photographed in a controlled condition. The distance of the camera from the subjects was 8.38 meters and was fixed 1.28 meter high. The scholar developed stick figures utilizing joint were measurement by protector. The scholar developed stick figures on the photographs, from which selected kinematical variables were calculated. The stick figures were developed by using joint-point method. The center of gravity of each subject, at all two selected moments (stance, release) was located by using segmentation method. The performance of each subject of javelin throws for distance. The distance measured from the arc of javelin sector to the first mark of the javelin on the ground and it was recorded in meters. The Kinematic variables selected in the study during stance and releasing moment was:

Angular Kinematic Variables

A-Angle of Shoulder Joint (R/L)
B- Angle of Hip Joint (Right/Left)
C- Angle of Knee Joint (Right/Left)
D- Angle of Ankle Joint (Right/Left)

Linear Kinematic Variables

A- Height of CG at the stance position
B- Height of CG at the release moment

Figure 1 Stance Position

Figure 2 Release Moment

Data Analysis

The Pearson's product Moment Correlation Coefficient (r) method was used. The level of p= 0.05 was considered significant.

3. Results

The relationship of selected kinematic variables with the performance in javelin throw were obtained by employing the Pearson's product moment correlation method, further the significance of relationship ,if any, was tested at 0.05 level of confidence. The mean values of selected angular and linear kinematic variables & their relationship with dependent variables are presented in the following tables:

Table 1: Relationship of selected angular kinematic variable with the performance of subjects in javelin throws

S.no	Variables	Correlation coefficient (r) Stance positions	Release moments
1	Ankle Joint right	.908*	.533
2	Ankle Joint left	.909*	.357
3	Knee Joint right	-.123	.566
4	Knee Joint left	-.134	.181
5	Hip Joint right	-.240	-.258
6	Hip Joint left	-.302	.728
7	Shoulder Joint right	.932	.905*
8	Shoulder Joint left	-.756	.282
9	Elbow Joint right	.622	-.165
10	Elbow Joint left	.896*	.882*
11	Wrist Joint right	.172	.255
12	Wrist Joint left	-.215	-.287

***significant, r.05 (3) =0.878**

Table-1 revealed that the value of coefficient of correlation required to be significant for 3 degree of freedom is 0.878, the above clearly shows that in case of left and right ankle joint and left elbow joint shown significant correlation at the stance position, obtained value is greater than table value therefore it has shown significant relationship with performance. In case of release moment shoulder joint (right) and elbow joint (left) have shown significant relationship with the performance of subject.

Table 2 Relationship of selected linear kinematic variables with the performance of subjects in javelin throws

Variable correlated	Coefficient Correlation
Height of C.G. at Stance position	-0.172
Height of C.G. at Release moment	-0.859

***significance, r.05 (3) =0.878**

Table 2 shown that the value of coefficient of correlation required to be significant for 3 degree of freedom is 0.878, the result of the height of C.G. at selected moments has insignificant relationship with the performance of subject at stance position and at release moment. All selected linear kinematic variable does not show any significant relationship because the obtain value is less than the required value to significant value at 0.05 level of confidence.

4. Discussion

In case of selected angular kinematic variables, right and left ankle joint and left elbow joint have exhibited significant relationships at stance position and In case of release moment shoulder joint (right) and elbow joint (left) have shown significant relationship with the performance of subject, it means that if the angle of right and left ankle joint and left elbow joint was less during release it might have contributed positively to the performance in javelin throw. In case of other kinematic variables only shoulder joint (right) and elbow joint (left) have shown significant relationship with the performance and other variables value of coefficient of correlation at selected moment were found insignificant, but this trend does not mean that the angles at different joint at selected moment do not play any important role while executing or performing the javelin throw technique.

The relationship of selected linear kinematic variables, height of C.G. at selected moments with the performance of the subjects at selected stance and moments found insignificant. As in this study the researcher was only confined to the relationship of height of C.G. at selected moments with the performance of subjects in javelin

throw but significant relationship may be obtained by studying the path or displacement of C.G. in whole moment. However the insignificant value of correlation coefficient of the variables with the performance may be due to small sample size and non-availability of sophisticated instruments.

5. Conclusions

The angle of left ankle joint at the stance position affects the performance of the subject in Javelin throws. The angle of right ankle joint, right knee joint, left knee joint, right hip joint, left hip joint, right shoulder joint, left shoulder joint, left elbow joint, right wrist joint, left wrist joint, and height of C.G. at selected moment are not related with the performance in Javelin throw. Training focusing on Right knee, ankle, hip and shoulder joint is recommended.

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