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Release characteristics of shotput: A kinematic approach

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Abstract
The Present study intended to find out the release characteristics of shotput: A kinematic approach. The aim of the study was to find the relationship between different kinematic variables with anthropometric variables of shot put with their performance. The sample consisted of 5 female shot putters in the age group of 17-24 years with the mean 19.20. The test item (parameters) selected for examined linear kinematics is Centre of Gravity and angular kinematic namely (angle at right ankle joint, right knee joint, hip joint, right shoulder joint, right elbow joint and right wrist joint) were determined by using "Kinovea" software (version- 08.25). The statistical analysis Pearson Correlation was used for the study. The present finding towards, kinematic parameters are quite through provoking and noteworthy. The results have shown a significant relationship with selected kinematic variables i.e. angle of right elbow joint and performance of the performers are correlated in a positive direction (.945) at the significant level 0.05 whereas angle of right shoulder joint and performance of the performers has negative correlation(-.814) at the significant level 0.01. The result also exhibited that the other kinematic variables have insignificant relationship with performance of shotput.

Keywords: track and field, shot-put, linear kinematics, angular kinematics

1. Introduction
The shot put is a field event in athletics and each of the events has a specific set of restrictions including (a) the characteristics of the implement used (size weight and aerodynamic qualities), (b) space limitations and (c) technique requirements which influence the sequence of events and make them unique. The goal in the throwing events is to maximize the measured distance covered by the implement and this distance is determined by a number of parameters for example height, velocity, angle of release, aerodynamic qualities and environmental factors. Hence, Good performance in mentioned track and field competitions are mainly determined by the athlete's technique than the tactics

Shot-put is an explosive power event developed to maximum efficiency through the proper sequence of events and directed at the correct angle is a secret to a record put of the shot. Spin and glide are the main techniques used by athletes during shot put performances. Especially the spin shot put technique is an extremely complex movement, which requires a high level of motor control, bio motor abilities and an optimal constitution of the thrower (Čoh & Jošt, 2005). Power is a function of force times velocity. The sequence of movements with mechanical principles can be divided into four phase's i.e. the hop, the body rotation, the arm thrust and weight snap. The proper and correct sequence of involvement of phases and muscles, joints helps one to attain the maximum possible distance. This present study aims to find the relationship between different kinematic variables of shot putter with their performance.

Methodology
For the purpose of the study five female shot putter (N=5) of track and field match practise voluntarily participated in the study. The subjects were from the age group of 17 to 24 years with mean age of 19.20 years. Since the subjects had been going under regular training at Chattarsal Stadium therefore it was considered that they possess good level technique. Purposive sampling technique was used for recruitment of the subjects. The purpose of the research was explained to the subjects. The test was conducted on Chattrasal Stadium track and field ground and standard measures were taken care of during collection of data. The data were recorded using digital camera and values of different variables were obtained using Kinovea 2D analysis software. The subjects were urged to perform their best during the test.

Selection of variables
- **Key Phases:** Delivery Phase
- **Key Position:** Position at the time of release

Linear Kinematic Variables
- Height of CG at the time of release

Angular Kinematics Variables:
- Right Ankle joint
- Right Knee Joint
- Right Hip Joint
- Right Shoulder Joint
- Right Elbow Joint
- Right Hip Joint
- Right Wrist Joint

Table 1: Descriptive Statistics of Height and Weight

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Weight (kg)	5	62.00	80.00	71.75	2.69	10.27
Height (m)	5	1.62	1.75	1.47	.02	.047

The variables which are selected are listed in "Table 2".

Table 2: List of Variables

Serial No.	Variable
1	Centre of gravity
2	Right Ankle joint
3	Right Knee joint
4	Right Hip joint
5	Right Shoulder joint
6	Right Elbow joint
7	Right Wrist joint

Results and discussion

Table 3: Descriptive Statistics of kinematic variables and performance

	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
Centre of gravity (m)	5	0.80	.031
Angle of right ankle joint	5	132.17	7.26
Angle of right knee joint	5	151.82	13.60
Angle of right hip joint	5	174.24	15.03
Angle of right shoulder joint	5	130.00	11.37
Angle of right elbow joint	5	165.14	10.30
Angle at right Wrist Joint	5	115.62	8.62
Performance	5	7.94	1.27

The performance of the subjects in shot put was correlated to seven selected kinematic variables and with one anthropometric variable (height) using Person's Product Moment Correlation Method. For analysis purposes SPSS software package is used.

Table 4: Relationship of selected kinematic variables to performance in Shot Put

Variables	Performance
Centre of gravity	.218
Angle of right ankle joint	.476
Angle of right knee joint	-.246
Angle of hip joint	.726
Angle of right shoulder joint	-.814*
Angle of right elbow joint	.945**
Angle of Right Wrist Joint	.385
Height	.538

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 3 clearly shows that the performance of shot put is significantly related to angle of right shoulder joint (-.814) and angle of right elbow joint (.945) whereas other selected variables i.e. centre of gravity, angle of right ankle joint, angle of right knee joint, angle of hip joint and height of the player do not have any statistically significant relationship with performance.

Hence, the statistical data reveals that angle of right shoulder joint negatively correlated with performance of the subjects. Here mean value of angle of right shoulder joint is 130 degree with standard deviation of 11.37 degree. Since angle of right shoulder joint is negatively correlated with performance; so we can conclude that, those who are having more than 130^o angle of shoulder joint will put the shot for lesser distance as compared to those who are having less than 130^o angle.

Again the statistical data from above table also reveals that angle of right elbow joint (M=165.14 & SD=10.30) is positively correlated with performance which means those who extend their elbow joint more, will have higher performance compare to those who have not extended their elbow more than 165.14 degree.

Discussion of Finings

The purpose of the study was to find the relationship between different kinematic variables with anthropometric variables of shot put with their performance. Hence the kinematic variables i.e. Right shoulder Joint (negatively) and Right Elbow Joint (positively) found significant with the performance in Shot Put. Shot Put also provides further insight into shot Put Performance, although not all variables associated with real throwing performance were studied. On the other hand, the insignificant value obtained for all their variables might be attributed to the improper techniques of the subjects. Causes can be:

- Low release angle.
- Insufficient leg strength
- Slower movement time
- Low push off force from the ground.

Conclusion

Hence, the idea of movement is generated through the stage of motor learning. So after the completion of the study it can be concluded that the performance is found significant with the performance in shot put with two selected kinematic variables angle of right shoulder joint (negatively) and angle of right elbow joint(positively). As the maximum strength is generated by shoulder joint comprises of Pectorals and deltoid muscles which plays a prominent role in throwing. More the strength of shoulders, chest and back thrower arm which will aim in making the positive impact on the stages of putting. And the functional training programmes can lead to improve neuromuscular control and integration of motor and enhance the muscle strength and power.

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