

A Biomechanical Analysis of The Shot Put Performance

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ABSTRACT

The aims of this study is to present a biomechanical over view of the performances of the men's shot put at the Podichery and Tamilnadu state interphysical education meet held at Annamalai Univeristy, Chidambaram. To make the study feasible the video graphic technique was adopted. The video was observed on biomechanical parameters of shot put performance namely angle of release, arm angle at the time of release and velocity of release. The collected data were analysed with simple correlation. The analysis of the data indicates that shot put throwing performance was depends upon the angle of release and velocity of release.

KEYWORDS : Release Angle, Release Velocity and Biomechanical Parameters related to Shot Put.

Introduction

Biomechanical Knowledge is a "Must" for Coaching. All movements of men and animals are determined by the laws of mechanics. It is the first task of science (but only the first) to understand movements of athletes; therefore it is an indispensable base for coaching. In the throwing events the factors influencing the performance are classified into: 1. the physical laws of the flight phases of the implement and; 2. the biomechanical laws of the movement of the system 'thrower and implement' before release. (Altmeyer, Bartonietz and Krieger, 1993) Projectiles obey constant acceleration, making them easier to describe and understand (Galileo's equations). Three factors determine trajectory, including horizontal displacement, of a projectile: speed of release, angle of release, height of release. Positive height of release, optimal angle should be slightly lower than 45°. Theoretically optimal angle is about 40-41°. Skilled shot-putters use angles of 35-37°. (Linthorne, 2001) Shot-putting requires great explosive strength, together with the ability to perform precisely timed movements in a confined space. The athlete's objective is to project the shot as far as possible, but competition regulations restrict the technique that may be used. The shot must be thrown from the shoulder using one hand and it must be held near to the chin throughout any preliminary movements (IAAF, 2000). Throughout the throwing motion, the athlete must remain within a circle of 2.135 m diameter that has a 10 cm high stop board placed at its front edge. The two most widely used throwing techniques are the glide technique and the rotational technique. These techniques differ in the preliminary movements that the athlete makes to move across the throwing circle, but the delivery phase is similar in both. During the delivery phase, the athlete exerts force on the shot with an explosive straightening of the legs, coupled with a raising and rotation of the trunk, followed by a rapid extension of the arm in the direction of the throw. To achieve the greatest possible flight distance, the athlete must project the shot with the optimum combination of release speed, angle and height. Release speed is strongly correlated with throwing distance and is undoubtedly the most important factor. World-class shot-putters have release speeds of 12.5 ± 14.5 m's⁻¹ and achieve distances of 19 ± 23 m (Dessureault, 1978; McCoy et al. 1984; Susanka and Stepanek, 1988; Tsirakos et al. 1995; Luhtanen et al. 1997). The release angle is less important than the release speed, but substantial deviations from the optimum release angle may have an adverse effect on an athlete's performance.

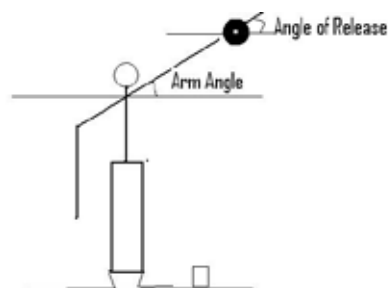
Video analysis is a great system that films one's performance and reconstructs a model of one. Athletes can then compare one's technique on a good day and a bad day, athlete can compare one's technique with an expert (if one are not already), and much, much more. Anyone with a serious interest in the performance of top-level athletes should appreciate the importance of the smallest worthwhile change in performance: the change that makes a meaningful difference to an athlete's chances of winning. Knowledge of this change is needed when assessing athletes with a performance test either to make decisions about meaningful changes in an individual or to research strategies that might affect performance.

Objectives

The objective of the study was framed i.e. Association between the mechanical principles that determine the velocity of release and angle of release in the shot put.

Methods

Data were collected during the men's shot put final at the 2008 - 2009 Podichery and Tamilnadu state inter-physical Education meet held at Annamalai Univeristy, Chidambaram. The best attempt and a lowest performance attempt from six male shot putters using glide technique. All the athletes studied were right handed. Two video cameras (SONY 3CCD) were used to record the putter's motion at 25 frames per second. One camera was fixed at the front (12meters distance from the thrower) side and the other at the right side of the throwing circle.



The video was observed with the help of computerized video analyzing soft ware (Dartfish) on biomechanical parameters related to glide technique (i.e. angle of release, Arm angle at the time of Release, and velocity of release). After repeated observation the angle of the above mentioned parameters was found out and recorded in degrees and meter/sec. To achieve the purpose of the study the simple correlation was used as a statistical technique. The level of significance was fixed at 0.05 level.

Analysis

Table I Descriptive statistics ON physical and release parameters

Variables	Mean	SD	Minimum	Maximum
Height (in cms)	179.5	6.63	172	187
Weight (in Kgs)	92.33	15.83	68	110
Arm angle at the time of Release (in degrees)	45.2	8.25	37.21	59.22
Angle of Release (in degrees)	57.05	4.98	49.64	63.43
Velocity of Release (in Mts/Seconds)	7.53	0.74	6.17	8.37
Shot-put performance (in mts)	10.72	1.44	8.15	11.72

Data analysis

Table II
INTER CORRELATION MATRIX AMONG THE SELECTED VARIABLES AND SHOT PUT BEST PERFORMANCE TRAIL

Variables	Arm Angle at the time of Release	Angle of Release	Velocity of Release	Shot Put Performance
Arm Angle at the time of Release	1.000	-0.663	0.371	0.409
Angle of Release	---	1.000	-0.869*	-0.838*
Velocity of Release	---	---	1.000	0.921*
Shot Put Performance	---	---	---	1.000

*Significant r0.05 (4) = 0.811.

Table III
INTER CORRELATION MATRIX BETWEEN THE LOWEST PERFORMANCE trail in SHOT PUT AND ANGLE OF RELEASE

Variables	Angle of Release	Lowest Performance in Shot Put
Angle of Release	1.000	0.827*

*Significant r0.05 (4) = 0.811.

Results

Analysis of the data indicates that performance in shot put (Highest and lowest) was significantly correlated with the angle of release. Velocity of release significantly associated with the performance. At the same time arm angle at the time of release was not significantly correlated with the performance. However, arm angle at the time of release were some relation to the release angle, velocity of release and performance in shot put.

Figure- 1: Relationship among the Shot Put Performance (Highest) Angle of Release and Velocity of Release

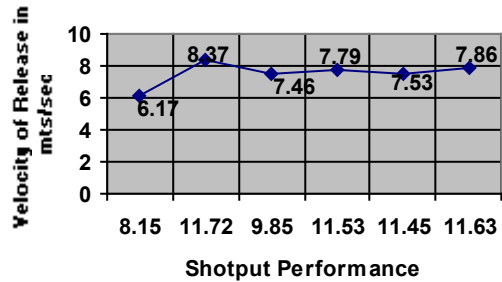
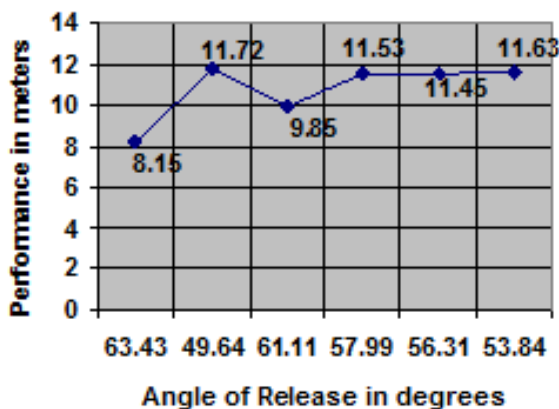
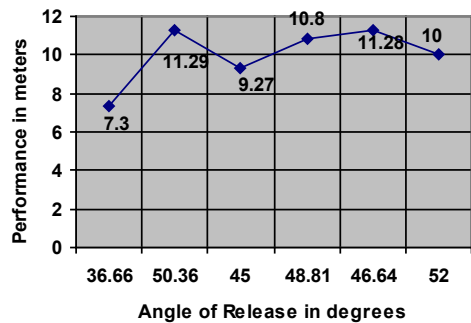


Figure- 3: Relationship between the Shot Put Performance (Lowest) and Angle of Release



Discussion

The results of the study may depend upon the following factors related to shot put performance: Lowest and highest shot put performance depends upon the angle of release. Shot-putting is a complex three-dimensional movement. All athletes had their own specific optimum release angle because of individual differences in the rate of force generation and apply. To achieve good performances, it is not necessary to throw at very close to the optimum release angle. Throwing with a high release speed is more important to performance than throwing at the optimum release angle. In the present study indicates that the shot-putters have release speeds of $6.17 \pm 8.37 \text{ m s}^{-1}$ and achieve distance of 8.15 ± 11.72 meters. Shot-putters use angles of release are 49.64° - 63.43° .

Conclusion

The present study was concluded that

1. Shot put performance was depends upon the angle of release and velocity of release.
2. The decrease in velocity of release with increasing release angle.
3. Arm angle at the time of release was close association with the angle of release.
4. Similar study could be conducted with more subjects on a more elaborate and extensive manner to cover all age groups.
5. The findings of this study may help the coaches and teachers in systematizing and modifying their training programmes.
6. The results of this study may help the coaches and teachers to understand the biomechanical principles involved during the shot put.

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