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Comparative Analysis of Angular Kinematic Variables for Successful and Unsuccessful Free Shot in Female Basketball Players

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Abstract – The study aimed at comparing the angular kinematical variables responsible for a successful and unsuccessful free shot in basketball. Ten subjects of homogenous nature in terms of training age was selected. Cannon EOS 70D high speed camera was used for recording of performance and Kinovea software was used for the analysis of data. The patterns values were superimposed which revels hat there exists a specific difference in the pattern of successful and unsuccessful free throws.

Keywords: Basketball, Free Shot, Angular Kinematics.

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INTRODUCTION:-

The game of basketball has emerged today as one of the most exciting popular game in the world of sports. Although this game was invented by Dr. James Naismith in 1891, it appeared as one exhibition game only in the Olympic games of St. Louis and was included in Olympics in the year 1936 in berlin Olympics and the women took part in 1976 in Montreal Olympics. In 1910 Dr. Jhon Henry Grey, the director of physical education of the Calcutta YMCA College introduced Basketball game for the first time in India and it was at Calcutta in West Bengal

High level performance in basketball depends on various factors and one of the important factors is shooting. Shooting is the principal method used to score points in Basketball and for this reason it is the most frequently used technical action (hay 1994). The free throw shot is distinguished as the most important of all the shooting actions (Hess 1980).Efficacy in shooting is identified with the ability to perform well in this sport and consequently it is extensively practiced.

The free throw is considered to be one of the easiest shots in basketball (Okubo & Hubbard, 2006), since the player is all alone, 15 feet from the basket, with no defence and no close distractions. All the player has to do is get ready, aim, cock the ball and shoot but successful free throw shooting is required for all basketball players, regardless of position. The objective of the shooter is to shoot a basketball (circumference - 0.749-0.780 m) through a horizontally oriented hoop (inside radius 0.225 m; thickness radius 0.0085- 0.0100 m) whose centre is 3.05 m above the ground and 4.225 m in front of the free throw line (Pocock, 1992). The ball is released with an angle of release, speed and spin. The optimal trajectory, which is dependent upon the shooter, can be defined as the trajectory which maximizes the probability of a successful shot when it is attempted. If the optimal trajectory is currently not used, its adoption could increase the success of free throw shooting.

Since shooting in basketball is one of the most important part of the game it has been a huge area of interest for most of the researchers.Physicists (Tan and Miller 1981; Gablonski and Lang 2005), engineers (Okubo and Hubbard 2006), and sports bio mechanists (Hudson 1982; Elliot 1989; Walters, Hudson et al. 1990; Elliot 1992; Miller and Bartlett 1996; Rojast, Cepero et al. 2000;Button, MacLeod et al. 2003; Tsai, Ho et al. 2006) have dealt with various types of shooting styles in a very detailed manner. Many researchers have worked on a number of studies on male free throw shooting techniques and on female free throw shooting techniques individually but not much emphasis have been laid on the comparison of successful and unsuccessful female free throw shooting techniques. Therefore this study is an attempt to analyze and compare various kinematic variables of free throw shooting in successful and unsuccessful free throws.

OBJECTIVES OF THE STUDY

The objectives of the study are:

1. To find out the pattern of successful free throws.

2. To find out the pattern of unsuccessful throws.

3. To find out the difference in pattern.

METHODOLOGY:

Subjects

For the purpose of the study a total of ten female Basketball players age ranged from 18-25 years, who have represented their team in west zone intervarsity competition from Lakshmibai national institute of physical education, Gwalior, were randomly selected for the study. Purposive sampling technique was used to select the sample.

Variables

The selection of variables was done by using the following criteria:-

The research scholar gleaned through the scientific literature on related topic from different library sources available at the library of LNIPE, Gwalior and correspondence with the expert and scholar's own understanding. According to administrative feasibility of available instruments and expertise the following variables were selected.

- Angle of right shoulder joint.
- Angle of right elbow joint.
- Angle of right wrist joint.
- Angle of trunk.
- Angle of right knee joint
- Angle of right ankle joint.
- Angle of release

Instruments

To measure the reliability of the selected instruments Cannon EOS 70D high speed cameras used for recording of performance and Kinovea software used for the analysis of data in the study were obtained from the research laboratory of Lakshmibai national institute of physical education.

FILMING PROTOCOL AND ANALYSIS

The video camera Cannon EOS 70Dwas adjusted on a tripod at a height of 1.36 mts from the ground and at a distance of 7.33 mts from the performance area. The camera was positioned perpendicular to the sagittal plane and parallel to the medio-lateral axis (camera optical axes perpendicular on the sagittal plane) so as that the shooter's arm gives approximately a 90° between their respective optical axes.

24 frames per second as obtained by the use of high velocity videography were analysed (the best trail) by kinovia software. Only selected frames were obtained and the Research Scholar developed the stick figures from which various kinematic variables were obtained. The stick figures were developed by using joint point method in which the body projections at the joints facing the camera were considered for the study. For the purpose of analysis two moments were selected i.e.

1. Moment of stance in the free shot.

2. Moment of release of ball in the free shot.

Videography technique was used in this study. The films were analyzed by using standard motion analyzer software (kinovia). Only two selected moments were analyzed.

STATISTICAL TECHNIQUE

To compare the selected variables of successful and unsuccessful free throw shot, independent t-test was used with the help of data analysis software SPSS 20 and the level of significance was set at 0.05.

FINDINGS

Table 1:

Descriptive statistics of angular kinematic values of different joints during moment of stance.

	Successful			Unsuccessful	
Moment of stance	Joint	Mean	SD	Mean	SD
	Shoulder	10.300	1.946	10.100	3.034
	Elbow	74.700	6.447	74.700	6.236
	Wrist	151.100	8.279	152.100	7.680
	Trunk	12.000	3.197	11.000	3.858
	Knee	126.600	4.948	127.500	6.276
	Ankle	93.400	2.270	91.700	3.401

Table 2:

Descriptive statistics of angular kinematic values of different joints during moment of release.

	Successful			Unsuccessful	
Moment of release.	Joint	Mean	SD	Mean	SD
	Shoulder	128.300	8.327	127.600	7.806
	Elbow	170.600	5.460	163.500	5.930
	Wrist	158.800	11.053	166.000	4.898
	Trunk	4.400	3.627	4.000	2.624
	Knee	159.000	9.729	149.900	5.724
	Ankle	118.800	6.088	119.100	3.665
	Angle of release	51.250	2.180	44.50	6.718

Table- 3

Independent t-test of angular kinematic variables of various joints during moment of stance.

	t-test			
Moment of stance	Joints	T	df	Sig. (2-tailed)
	Shoulder	.175	18	.863
	Elbow	.000	18	1.000
	Wrist	-.280	18	.783
	Trunk	.631	18	.536
	Knee	-.356	18	.726
	Ankle	1.315	18	.205

Table- 4

Independent t-test of angular kinematic variables of various joints during moment of release.

	t-test			
Moment of release	Joint	T	df	Sig. (2-tailed)
	Shoulder	.194	18	.848
	Elbow	2.785	18	.012*
	Wrist	-1.883	18	.076
	Trunk	.283	18	.781
	Knee	2.549	18	.020*
	Ankle	-.133	18	.895
	Angle of release	3.009	18	.008*

Tab t = 2.10 at degree of freedom=18 at 0.05 level of significance.

Interpretation of the output

The above results in the table indicates that none of the angular kinematic variables were found to have a significant difference between successful and unsuccessful free throw shots other than elbow joint, knee joint and angle of release during the moment of release at the 0.05 level of significance.

DISCUSSION OF FINDINGS

The study was conducted on comparative analysis of angular kinematic variables for successful and unsuccessful free shot in female basketball players. It was divided into two phases-Moment of stance in the free shot and moment of release of ball in the free shot. Descriptive statistics and independent t-test were used for selected angular kinematic variables at both the phases of the free throw shot.

Moment of Stance

The moment of stance is the beginning of the shot and is crucial to the execution. In order to begin the shot, the player needs to balance her body. This is the phase just before the breaking the inertia of the body. Ideal shooting stance with the shooter facing the basket, feet slightly staggered in the forward backward direction, and excellent range of knee flexion and trunk flexion.

During moment of stance, none of the joints of upper and the lower limbs showed any significant difference when compared between successful and unsuccessful shots in movement pattern as significant differences were ≥ 0.05. It may be due to the initial ball holding position was same for all the players.

Moment of Release

In this phase extension of all joints occurs which produces upward and forward force to project the ball towards the basket. Transfer of force takes place in this phase.

During the moment of release in the upper limb no significant difference was found in the angles of shoulder and wrist. The flexion of shoulder only helps in deciding the height at which the ball is being released and in production of force. If the player instead of using the shoulder to decide the height of release takes a jump, the void created can be easily fulfilled. Hence, the absence of significant difference in the variables is justified.

While a significant difference was found in the pattern of elbow joint. As the increase in angle of elbow joint will increase the release height within normal range of movement, as the angle of this joint is closer to 180^0.It is also to be noted that greater the angle of elbow extension more will be the force generated which will aid in propelling the ball at a higher release angle. Much of the power for the shot comes from extension of the elbow and the flexion of the wrist at release (Hartley and Fulton 1971). The elbow must be kept directly under the ball during the shot, so that all the forces are directed toward the basket. The elbow should be kept as close to the body as possible during the shot (Haskell 1985). The elbow position

checklist suggests that the elbow should be directly under the ball (Figure 18), pointed toward the basket and over the front foot prior to the upward movement of the ball (Haskell 1985).trunk and ankle

In case of lower limbs no significant difference was found in trunk and ankle joint. The joint of trunk helps in carrying the force generated by the legs to the ball to propel the ball towards the rim. Since the distance from where the subjects have been tested is constant, there are no significant changes in the angular kinematical values of the above mentioned variable. Hence, the absence of significant difference in the variables is justified.

On the other hand significant difference was found in the knee joint. The knee joint helps in the production of force in the upward direction. Hence greater the angle of the knee joint more will be the force generated which will be transferred to the upper body for better projection of the ball. Hence, the significant difference in the variable is justified.

Angle of Release

Angle of release for successful shot was 51.25^0 whereas for unsuccessful shot it was 44.50^0. Researcher has found that release angle between $45^0$and 55^0 will significantly increase the chances of a successful shot (Knudson, 1993). Ball shot with these trajectories have a better chance of passing through the basket than shot with a flatter release angle. Shots closer to the basket or shot from shorter player will require release angle in the upper range of desirable angles (Hudson, 1985).Hence it can be said that the ball should be released as high as possible, since the higher the ball is released the less time it is in the air to the basket and the less time it has to move off target. Release height is related to height of the player, amount of trunk extension, shoulder flexion and elbow extension at release, and whether the shooter leaves the ground during release. Also, less time in the air is related to a lower velocity at release, so joint range of motion is smaller and release time is decreased. Elite shooters have been found to have a higher release point and less trunk inclination than less skilled shooters (Hudson 1982; Hudson 1985).

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