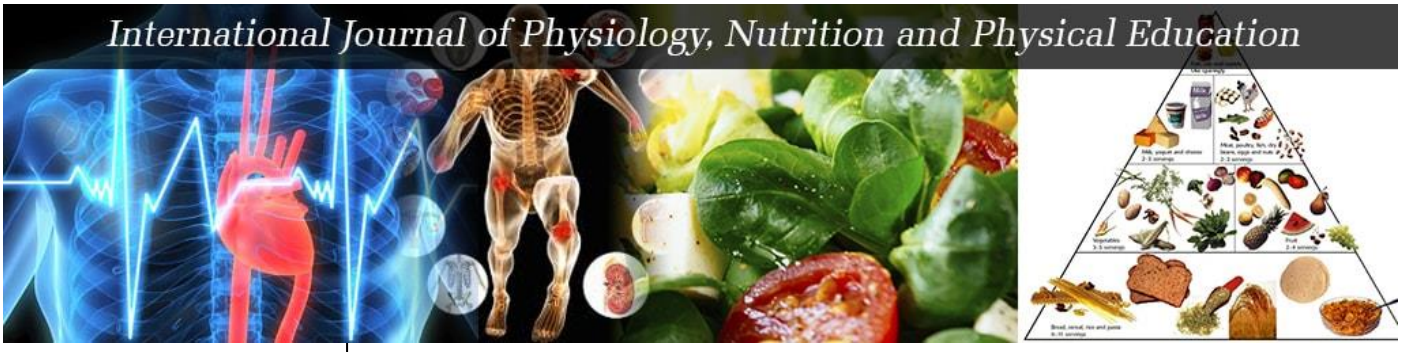

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Analysis of selected kinematical variables of set shot & jump shot with performance in basketball

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Abstract
The purpose of the study was to analyse the selected kinematical variables of set shot & jump Shot with performance in basketball. The present study was conducted on twenty males (n = 20), aged between 18 to 25 years of North Zone Intervarsity Basketball team for the session 2021-22. Each subject were given 10 chances each to perform (5 Set Shot & 5 Jump shot). One Digital Video camera Canon 90D were used in order to register the technique of set shot & jump shot performance of subjects in basketball. The video quality of the camera which is shown by software (KINOVEA 0.9.5) was 90 fps. Video camera was specifically placed for more accurate filming. Karl Pearson coefficient of correlation were applied for interpretation. The level of the significance was set at 0.01. The results of the study shown no significant relationship between the selected kinematical variable with set shot & jump Shot performance.

Keywords: Frames per second (fps), performance, software

Introduction
In the sport of basketball, the ability to shoot the basketball is a key skill. Though shooting techniques have changed, as shooting one handed, with one hand behind the ball and the other to the side, has become the common method of shooting both jump shots and free throws. Since shooting is such an integral part of the game, an ability to shoot successfully from a variety of distances would naturally be desirable. Consequently, identifying the characteristics which skilled performers use to achieve success across different distances should be useful information to coaches, teachers and players. Martin (1981) [17] suggested using a movement analysis approach to describe good shooting skill and advocated the use of kinematic variables. Yates and Holt (1982) [18] examined kinematic characteristics of 10 feet and 20 feet jump shots but did not report how the 10 feet shot differed from the 20 feet shot. In general, they found that the ball was released while the body was moving upward in a predominantly vertical path and that the body, shoulder, elbow, wrist, and hand all contributed to ball projection.
Kinematics is the study of bodies in motion without regard to the causes of the motion. It is concerned with the describing and quantifying both the linear and angular positions of the bodies and their time derivatives. Kinematics is the preferred analytical tool for researchers interested in questions such as, who is faster? What is the range of motion of a joint? How do two motion patterns differ? Kinematic analysis may be an end in itself or an intermediate step that enables subsequent kinetic analysis. The most common method for collecting kinematic data uses an imaging or motion-caption system to record the motion of markers affixed to a moving subject, followed by manual or automatic digitizing to obtain the coordinates of the makers. These coordinates are then processed to obtain the kinematic variables that describe segmental or joint movements. Bio mechanist interested in improving athletes. It is ideal for the analysis of single movements or intervals of exercise lasting up to minutes. The most effective method is qualitative analysis, in which the athletes, coach or sport scientist simply view the video together and decide immediately how technique could be improved. The athlete can then attempt any recommended changes and the filmed for a further round analysis.

Objectives of the study

1. To analyse the relationship between Projection angle of set shot with performance of basketball players.
2. To find out the relationship between Projection angle of jump shot with performance of basketball players.
3. To evaluate the relationship between Horizontal angle of wrist joint of set shot with performance of basketball players.
4. To assess the relationship between Horizontal angle of wrist joint of jump shot with performance of basketball players.
5. To analyse the relationship between horizontal angle of elbow joint of set shot with performance of basketball players.
6. To evaluate the relationship between horizontal angle of elbow joint of jump shot with performance of basketball players.

Delimitations of the study

1. The study is delimited to the male basketball players of North Zone Intervarsity teams.
2. The age of the subjects ranged between 18-25 years.
3. Only right-handed shooters/players were be selected.
4. The study is further delimited to the following selected kinematical variables:

- Projection angle
- Horizontal angle of wrist joint.
- Horizontal angle of elbow joint

Hypotheses of the study

1. There would be a significant relationship between Projection angle of set shot with performance of basketball players.
2. There would be a significant relationship between Projection angle of jump shot with performance of basketball players.
3. There would be significant relationship between Horizontal angle of wrist joint of set shot with performance of basketball players.
4. There would be significant relationship between Horizontal angle of wrist joint of jump shot with performance of basketball players.
5. There would be a significant relationship between the horizontal angle of elbow joint of set shot with performance of basketball players.
6. There would be a significant relationship between the horizontal angle of elbow joint of jump shot with performance of basketball players.

Limitations of the study

1. The study had been conducted in controlled conditions not during the competitive conditions which might have affected the results of the study.
2. The validity and reliability of the biomechanical instrumentation.
3. The factors like environment, temperature, atmosphere pressure etc. were beyond the control of the investigator, which might have affected the performance of the subjects.

Significance of the study

1. It may be helpful for the basketball coaches to improve the performance of the players.
2. The Study can proving a great assisting hand in providing quality education.
3. The study may add a new dimension in literature of basketball and sports coaching.
4. The results may indicate the variables, which might be considered as factors affecting the performance of basketball players while set shot.
5. The results of the study may lead to the full understanding of the role played by set shot in achieving high performance efficiently.

Methodology and procedure

Sources of data and selection of the variables

Twenty male basketball players (N = 20) from North Zone Intervarsity level for the session 2021-22 selected as subjects by using purposive sampling technique and all subject were right hand shooters only. The age of the subjects were ranged between 18-25 years. The researcher thoroughly went through scientific literature related to the sport of basketball that was available from books, magazines and journals. Keeping in view the relevance of the variables to basketball performance and feasibility criteria, the following variables were selected for the study:

- Projection angle
- Horizontal angle of wrist joint.
- Horizontal angle of elbow joint

Analysis of data and interpretation of results

The main aim of the study was to find out the relationship between selected kinematical variables with set shot and jump shot with performance in basketball. Thus, the data were collected as per design of the study given in the procedure which was further subjected to statistical analysis. The results of the study are presented into following tables and figures.

Relationship between kinematical variable (Projection angle) and set shot performance in basketball has been presented in table 1 and depicted in figure 1.

Table 1: Relationship between projection angle and set shot performance in basketball

Trails	N	Variables	Mean	SD	Coefficient of Correlation (r)
100	20	Projection angle	55.62	2.79	-0.036
		Set Shot performance	7.51	1.76	

$r_{.01}$ (18) = 0.542

It may be observed from table 1 that the mean value of projection angle during set shot in basketball was 55.62° and standard deviation (SD) was 2.79°. Whereas mean value of set shot performance in basketball was 7.51 and standard deviation (SD) was 1.76.

The result further revealed that there were no significant relationship existed between the projection angle and set shot performance in basketball as the calculated value of r = -0.036 was less than the tabulated value of r = 0.542 at 0.01 level.

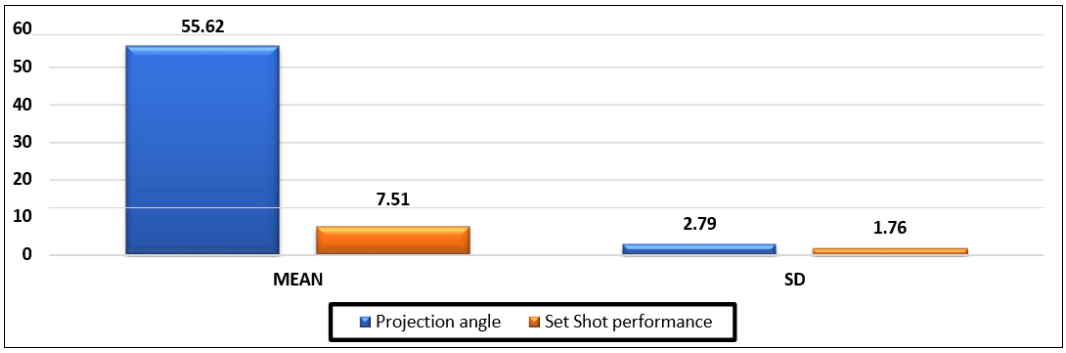

Fig 1: Relationship between projection angle and set shot performance in basketball

Relationship between kinematical variable (Projection angle) and Jump shot performance in basketball has been presented in table 2 and depicted in figure 2.

Table 2: Relationship between projection angle and jump shot performance in basketball

Trails	N	Variables	Mean	SD	Coefficient of Correlation (r)
100	20	Projection angle	48.69	2.63	-0.028
		Set Shot performance	7.4	1.79	

$r_{.01}$ (18) = 0.542

It may be observed from table 2 that the mean value of projection angle during Jump shot in basketball was 48.69º and standard deviation (SD) was 2.63º. Whereas mean value of Jump shot performance in basketball was 7.4 and standard deviation (SD) was 1.79.

The result further revealed that there were no significant relationship existed between the projection angle and Jump shot performance in basketball as the calculated value of r = -0.028 was less than the tabulated value of r = 0.542 at 0.01 level.

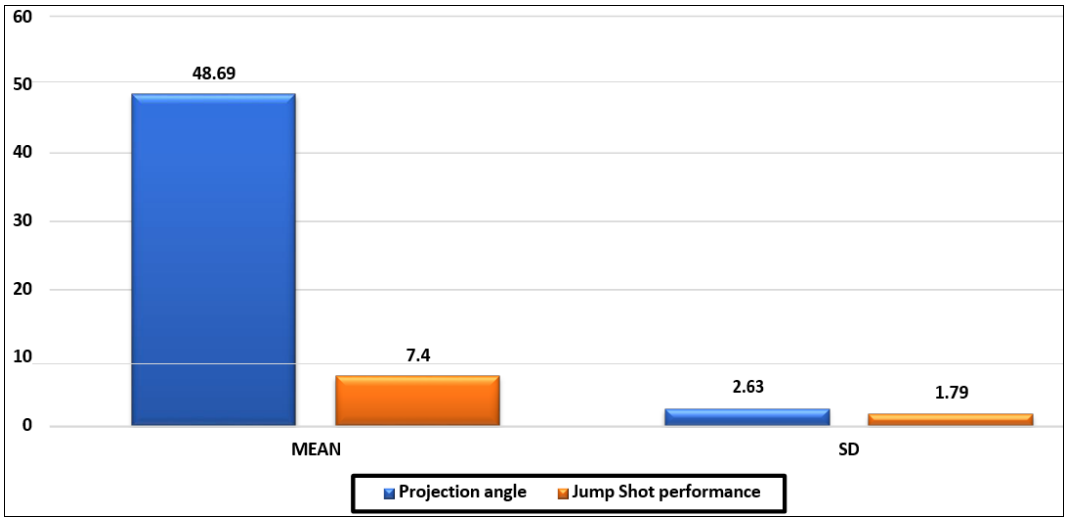

Fig 2: Relationship between projection angle and jump shot performance in basketball

Relationship between kinematical variable (Horizontal angle of wrist joint) and set shot performance in basketball has been presented in table 3 and depicted in figure 3.

Table 3: Relationship between horizontal angle of wrist joint and set shot performance in basketball

Trails	N	Variables	Mean	SD	Coefficient of correlation (r)
100	20	Horizontal angle of wrist joint	45.25	3.15	-0.017
		Set Shot performance	7.51	1.76	

$r_{.01}$ (18) = 0.542

It may be observed from table 3 that the mean value of Horizontal angle of wrist joint during set shot in basketball was 45.25º and standard deviation (SD) was 3.15º. Whereas mean value of set shot performance in basketball was 7.51 and standard deviation (SD) was 1.76.

The result further revealed that there were no significant relationship existed between the Horizontal angle of wrist joint and set shot performance in basketball as the calculated value of r = - 0.017 was less than the tabulated value of r = 0.542 at 0.01 level

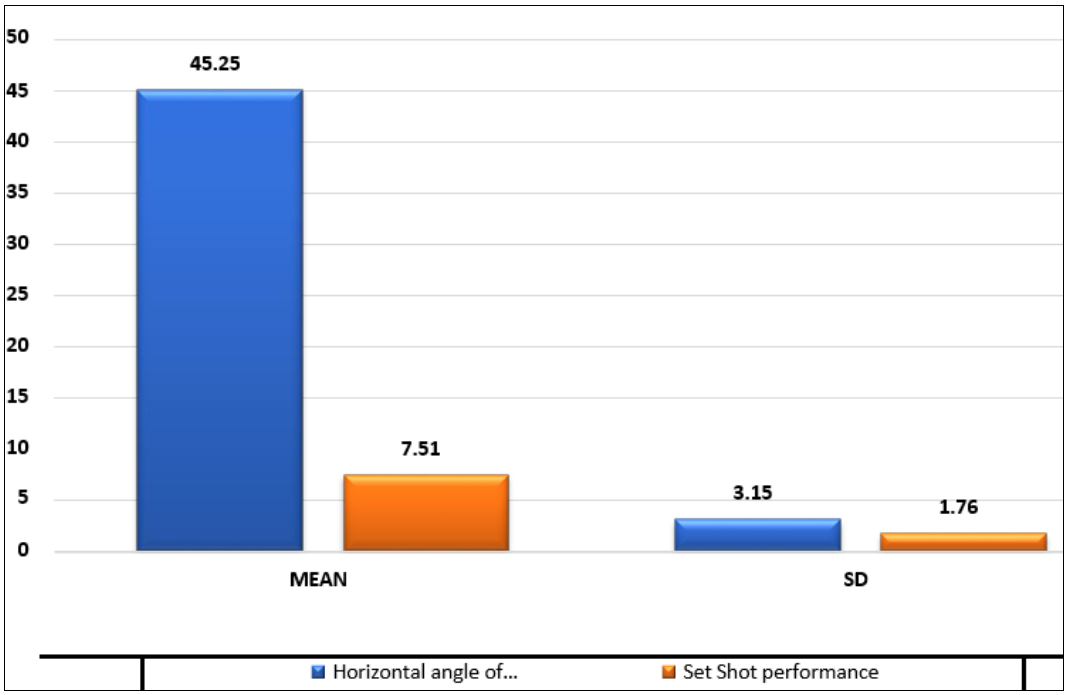

Fig 3: Relationship between horizontal angle of wrist joint and set shot performance in basketball

Relationship between kinematical variable (Horizontal angle of wrist joint) and Jump shot performance in basketball has been presented in table 4 and depicted in figure 4.

Table 4: Relationship between horizontal angle of wrist joint and jump shot performance in basketball

Trails	N	Variables	Mean	SD	coefficient of correlation (r)
100	20	Horizontal angle of wrist joint	46.02	1.21	-0.014
		Jump Shot performance	7.4	1.79	

$r_{.01}$ (18) = 0.542

It may be observed from table 4 that the mean value of Horizontal angle of wrist joint during Jump shot in basketball was 46.02º and standard deviation (SD) was 1.21º. Whereas mean value of Jump shot performance in basketball was 7.4 and standard deviation (SD) was 1.79.

The result further revealed that there were no significant relationship existed between the Horizontal angle of wrist joint and Jump shot performance in basketball as the calculated value of r = - 0.014 was less than the tabulated value of r = 0.542 at 0.01 level.

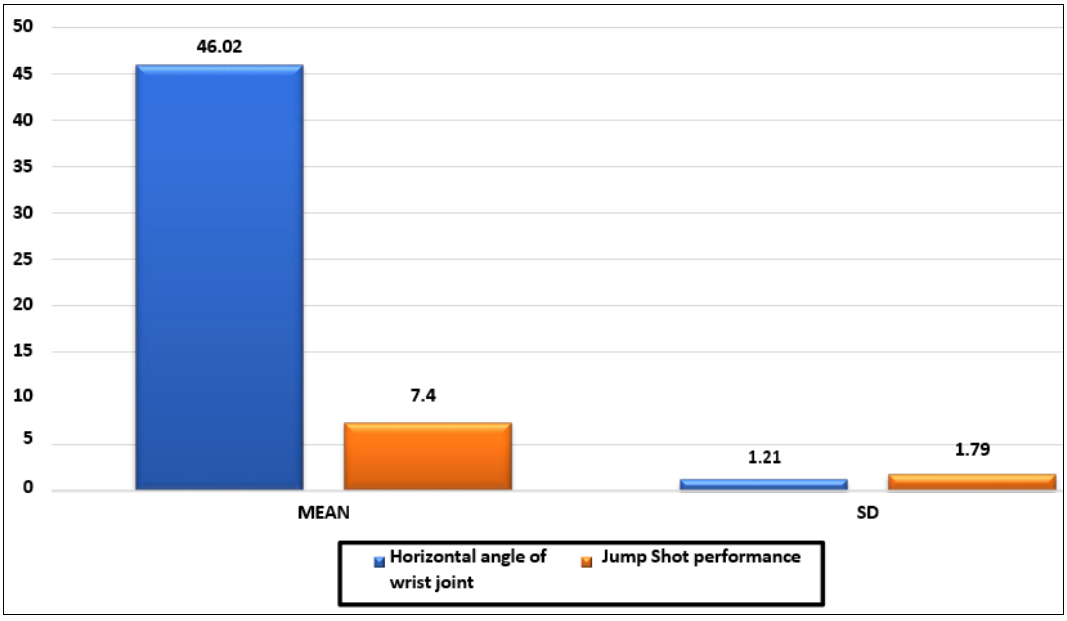

Fig 4: Relationship between horizontal angle of wrist joint and jump shot performance in basketball

Relationship between kinematical variable (Horizontal angle of elbow joint) and set shot performance in basketball has been presented in table 5 and depicted in figure 5.

Table 5: Relationship between horizontal angle of elbow joint and set shot performance in basketball

Trails	N	Variables	Mean	SD	coefficient of correlation (r)
100	20	Horizontal angle of elbow joint	95.9	3.14	-0.088
		Set Shot performance	7.51	1.76	

$r_{.01}$ (18) = 0.542

It may be observed from table 5 that the mean value of Horizontal angle of Elbow joint during set shot in basketball was 95.9º and standard deviation (SD) was 3.14º. Whereas, mean value of set shot performance in basketball was 7.51 and standard deviation (SD) was 1.76.

The result further revealed that there were no significant relationship existed between the Horizontal angle of Elbow joint and set shot performance in basketball as the calculated value of r = - 0.088 was less than the tabulated value of r = 0.542 at 0.01 level

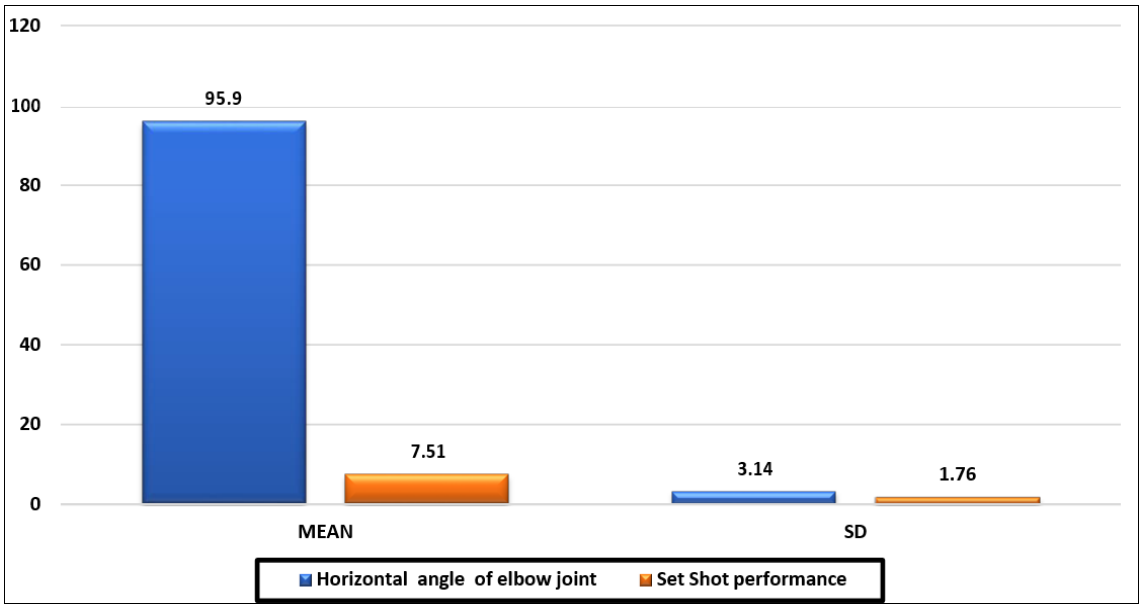

Fig 5: Relationship between horizontal angle of elbow joint and set shot performance in basketball

Relationship between kinematical variable (Horizontal angle of elbow joint) and Jump shot performance in basketball has been presented in table 6 and depicted in figure 6.

Table 6: Relationship between horizontal angle of elbow joint and jump shot performance in basketball

Trails	Variables	Mean	SD	coefficient of correlation (r)
100	Horizontal angle of elbow joint	98.17	1.77	0.037
	Jump Shot performance	7.4	1.79	

$r_{.01}$ (18) = 0.542

It may be observed from table 6 that the mean value of Horizontal angle of elbow joint during Jump shot in basketball was 98.17o and standard deviation (SD) was 1.77o. Whereas, mean value of Jump shot performance in basketball was 7.4 and standard deviation (SD) was 1.79.

The result further revealed that there were no significant relationship existed between the Horizontal angle of elbow joint and Jump shot performance in basketball as the calculated value of r = - 0.037 was less than the tabulated value of r = 0.542 at 0.01 level.

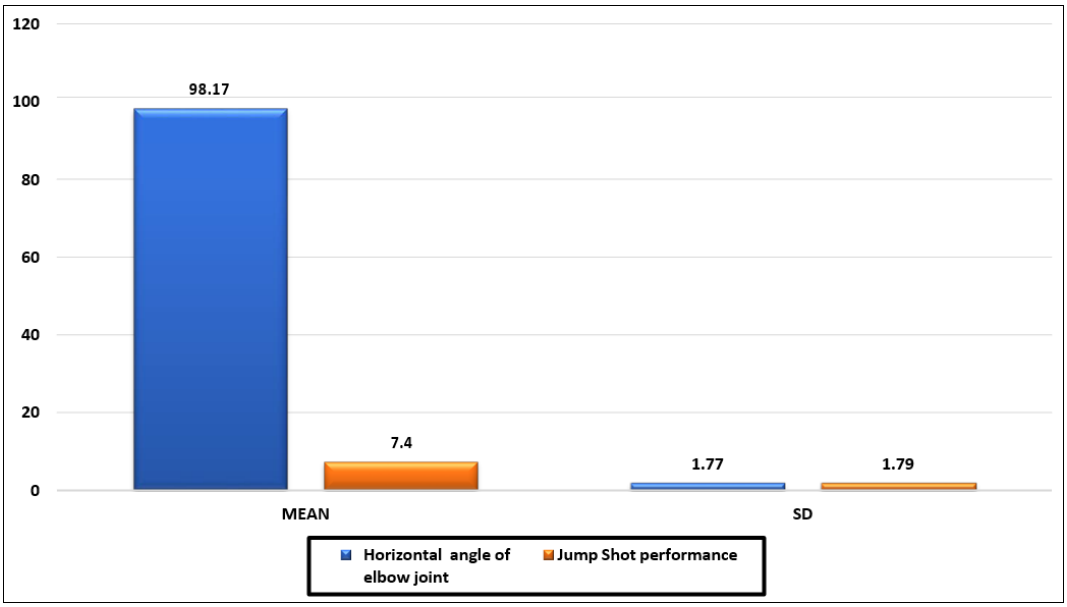

Fig 6: Relationship between horizontal angle of elbow joint and jump shot performance in basketball

Discussion of findings

Projection Angle

The mean projection angle in case of Set shot was 55.62º while that of Jump shot was 48.69º. Miller & Bartlett (1996) [19] also conducted a study on release angle of Shooters, Guards and defenders and found that the shooting range of shooters varies between 52º to 55º. The findings of the present study coincide with their findings. However in case of Jump shot the angle of release i.e. projection angle decreases as the player gains height due to the jump. Okazak & Rodacki (2012) [20] in their studies have reported an average release angle of 65º for Jump shot from a closer distance. Such variation can be attributed to the Anthropometric height and length of arm. The correlation value between Projection angle and Set shot performance was -0.036 and that of Jump shot performance was -0.028, which was less than the tabulated Correlation value (0.542) at 0.01 level of significance. The result revealed that there was no significant relationship between Projection angle and Performance of Set Shot as well as that of Jump shot. Such findings can be attributed to the Anthropometric measurements, release velocity, type of spin given to the ball, air resistance etc.

Horizontal Angle of Wrist

The mean 'Horizontal angle of Wrist' in case of Set shot was 45.25º while that of Jump shot was 46.02º. The correlation value between 'Horizontal angle of Wrist' and Set shot performance was -0.017 and that of Jump shot performance was -0.014, which was less than the tabulated Correlation value (0.542) at 0.01 level of significance. The result showed that there was no significant relationship between 'Horizontal angle of Wrist' and Performance of Set Shot as well as that of Jump shot. Thus the finding of the study is in concurrent with the prevailing literature. The studies conducted by Raza S. *et al*. (2013) [21] on Set shot performance and Birendra Jhajharia *et al*. (2012) [5] on 3 point shooting also reported insignificant relationship of Wrist joint angle with conversion of shots and has been attributed to the difference in Anthropometric measurements, release velocity, type of spin given to the ball, air resistance etc.

Horizontal Angle of Elbow

The mean 'Horizontal angle of Elbow' in case of Set shot was 95.90º while that of Jump shot was 98.17º. The correlation value between 'Horizontal angle of Wrist' and Set shot performance was -0.088 and that of Jump shot performance was 0.037, which was less than the tabulated Correlation value (0.542) at 0.01 level of significance. The result indicated that there was no significant relationship between Horizontal angle of Elbow and Performance of Set Shot as well as that of Jump shot. The studies conducted by Raza S. *et al*. (2013) [21] on Set shot performance and Birendra Jhajharia *et al*. (2012) [5] on 3 point shooting also reported insignificant relationship of Elbow joint angle with conversion of shots and has been attributed to the difference in Anthropometric measurements, release velocity, type of spin given to the ball, air resistance etc. However, shoulder angle was reported to significant contributor in comparison with the other variables. Dr. Baljinder Singh Bal et. al. (2009) [22] also conducted a similar study on layup shot and reported insignificant relationship of joint angles with performance. The study by Achrad, Ammar et. al. (2015) [23] reported similar findings. Their study have reported only the Knee joint as the significant contributor.

Conclusions

Within the limitations of the present study the following conclusions were drawn:

- The correlation between projection angle and set shot performance was -0.036, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result showed that there was no significant relationship between the selected kinematic variable with performance in set shot.
- The correlation between projection angle and jump shot performance was -0.028, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result revealed that there was no significant relationship between the selected kinematic variable with performance in jump shot.
- The correlation between horizontal angle of wrist joint and set shot performance was -0.017, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result showed that there was no significant relationship between the selected kinematic variable with performance in set shot.

- The correlation value between horizontal angle of wrist joint and jump shot performance was -0.014, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result indicated that no significant relationship between the selected kinematic variable with performance in jump shot.
- The correlation value between horizontal angle of elbow joint and set shot performance was -0.088, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result showed that there was no significant relationship between the selected kinematic variable with performance in set shot.
- The correlation value between horizontal angle of elbow joint and jump shot performance was 0.037, which was less than the tabulated value of correlation r = 0.542 at 0.01 level of significance. The result revealed that there was no significant relationship between the selected kinematic variable with performance in jump shot.

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