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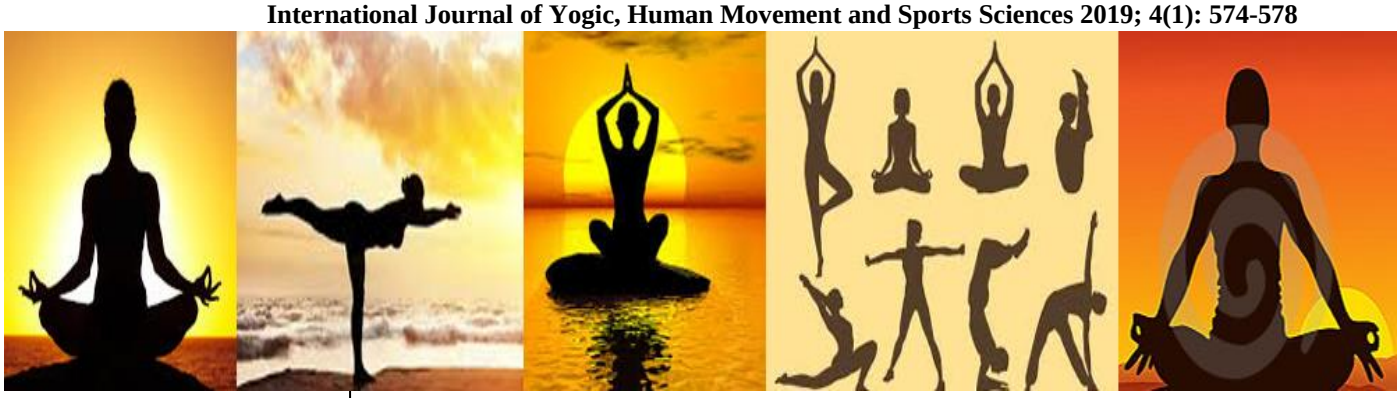

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Biomechanical analysis of selected kinematical variables of over-arm throwing technique in cricket

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Abstract
The purpose of the present study was to investigate Biomechanical analysis of selected kinematical variables of throwing technique in cricket. Total Two male cricket players were selected as a sample: Indian male cricket players who had represented at First-class cricket level were selected as a sample on the basis of performance in preceding competition. The age of both the subjects was ranged above 25 years. The kinematical variables were Horizontal velocity of wrist joint, vertical velocity of wrist joint, Horizontal velocity of Elbow joint, vertical velocity of Elbow join at the time of over-arm throwing technique and performance of cricket players. The Kinematic Analysis of Over-arm Throwing Technique mean, standard deviation and Karl Pearson's product moment coefficient correlation were employed with the help of statistical package of SPSS. The level of significance was set at 0.05. The outcome of the study shows that significant relationship with performance (.486, .451, .458, .580) of over-arm throwing technique in all variables.

Keywords: Biomechanics, horizontal velocity, vertical velocity, wrist joint, elbow joint

Introduction

Overarm throwing

A throw made with the arm moving above the shoulder line is called an over-arm throw/serve. Throwing in which at the instant of release the throw's trunk is tilted toward the non-throwing arm side of the body, and upper arm is pointing up to the right. Phases of over arm throwing: 1) fielding phase, 2) step phase, 3) cocking phase: stride foot contact to the instant of maximum shoulder external rotation, 4) acceleration phase: maximum external rotation to the instant of ball release and 5) follow through phase: from ball release until 500 milliseconds after the ball has been released. Subdivision of the throwing technique has enabled important variables of performance to be identified within each phase, in addition to an overview of technique in which the whole body can be seen to work in a coordinated fashion to achieve its goal. Altham, H. S. (1962) [1].

Fielding Phase: In this phase to execute an overarm throw, Eyes should be on the ball and the fielder must align himself to catch the ball, off the ground or in the air, typically with two hands, and generate controllable momentum towards the ball. The feet are positioned either side of the ball so that the athlete's trunk is perpendicular to the target for the following phases of the throw. (Fleisig, 2010) [4].

Step Phase: After fielding the ball, the fielder takes the steps towards the target so that the back foot is closer to the target than the front foot. Body position in this phase should be upright. (Fleisig, 2010) [4].

Cocking Phase: In the Cocking Phase positions of the body to enable all body segments to contribute to ball propulsion. It can be further divided into two sub-phases:

- Early cocking phase
- Late cocking phase

The wind up and cocking phase together constitutes 80% of the duration (approx. 1500 milliseconds) Cross, R. (2004) [3].

Acceleration

The Acceleration phase is extremely explosive. It consist of the rapid release of two forces – the stored elastic force of the tightly bound fibrous tissue of the capsule, and forceful internal rotation from the internal rotators (subscapularis, pectorals major, latissimus dorsi, teres major). This generates excessive forces at the glenohumeral articulation and thus the cuff musculature remains highly active to keep the humeral head relocated in the glenoid. The acceleration phase concludes with ball release, which occurs at approximately ear level. Acceleration phase lasts approximately 50 milliseconds which is 2% of overall time. (Fleisig, 2010) [4].

Deceleration/Follow Through: In the deceleration/ follow through phase very high forces pull forward on the glenohumeral joint following ball release, which places large stresses on posterior shoulder structures. The arm continues to extend at the elbow and internally rotate at the shoulder. The rotator cuff (external rotators) decelerates the rapid internal rotation of the shoulder, as does eccentric contraction of the scapular stabilizers and posterior deltoid fibres. The trunk is flexed eccentrically and the lead leg is extended pushing into the ground eccentrically to absorb energy. This phase places large stresses on the elbow flexors as well as the posterior shoulder structures. This phase lasts approximately 350 milliseconds and constitutes approximately 18% of the total time. (Garner, J. 2007) [6].

Various factors or components play vital role for individual's performance. The factor like Physiological, Psychological, Nutrition, Physical fitness, Biomechanical components etc. play significant role for the development of athlete's performance. In this study stress has been laid on Biomechanics. Biomechanics analysis defines the study of motion and its causes in living things. Biomechanics provides key information on the most effective and safest movement patterns; equipment, Techniques and related exercises to improve human movement for achieve Higher Performance. The biomechanical approach to movement analysis can be qualitative, with movement observed and described, meaning that some aspect of the movement measured. Human motion analysis is frequently used today for both clinical and research application the art and science of motion analysis has expanded beyond basic descriptions of ambulatory patterns to include front line clinical roles in rehabilitation, surgery, prosthetics, orthotics, Ergonomics and Athletics. (Husain & Bari, 2011) [5].

Statement of the problem

The Problem entitled as "Biomechanical analysis of selected kinematical variables of throwing technique in cricket".

Method and procedure

Selection of subjects

Total Two male first-class cricket players were select as a sample for the study. The age of the both subjects was above 25 years. Data was collected on different places for each sample and two sessions of each player.

Selection of variables

- (WHv) Horizontal velocity of wrist joint at the time of over-arm throwing.
- (WVv) Vertical velocity of wrist joint at the time of over-arm throwing.
- (EHv)Horizontal velocity of elbow joint at the time of over-arm throwing.
- (EVv)Vertical velocity of elbow joint at the time of over-arm throwing.

Criterion measure

The criterion measure for this study was the performance of the over arm throwing technique in cricket. The standardized pitch distance (20.12 meter) from cover position to stumps was used for the study. Semi-new English leather balls and flexible stumps were used in this study. Total 50 trials were given to each player and the performance of each trial was recorded. The height of the camera was set at 1.29 meters. Digital video camera was placed 7.60 meter away at the side of the Thrower (lateral axis).

The selected biomechanical variables such as Horizontal velocity of wrist joint at the time of throwing, vertical velocity of wrist joint at the time of throwing, horizontal velocity of elbow joint at the time of throwing, vertical velocity of elbow joint at the time of throwing were analysed.

Filming Protocol

Through Quintic coaching v-17 software motion capture technique was used in this study. To record the video of over-arm throwing technique in cricket, while performing the technique, digital video camera (50 fps) was used by a professional photographer. After obtaining the recorded video, the video was analyzed through Quintic Coaching v-17 software approved by Human kinetics. First video was digitized through Quintic coaching v-17 software. After the procedure of digitizing, the video was calibrated. The calibrated video gave the results through makers, stroboscopic effect technique, stick figures, stopwatch programming, angle manual (horizontal, vertical, and draws angles), linear and angular analysis manual. Motion capture technique/Digital videography was used to analysis the selected kinematical variables of over arm throw in cricket for male players. Digital video camera CASIO EX-FH 100 (50 fps) was used for videography of over-arm throw for cricket player performance. The performance of the subjects was recorded with stroboscopic effect from approach to throw toward the target. Digital video camera was placed 7.60 meter away at the side of the Thrower (lateral axis). The height of the camera was set at 1.29 meters.

Administration of the test

Two male cricket players were purposive selected as sample from Patiala for the study. The standardized pitch distance (20.12 meter) from cover position to stumps was used for the study. Semi-new English leather balls and flexible stumps were used in this study. The separate data were collected as for both cricket players. All the selected subjects were asked to perform over arm throws with their full potential and accuracy technique. It was ascertained that subjects possess reasonable level of technique. The subjects were explained about the objective of the study. The entire selected player have readily agreed and volunteered to act as subject for the study. The selected subjects were initiated through concerned coaches, and later direct contacts were made. The coaches provided names of the potential players who will be free of any type of injury in the upper and lower extremities as well as psycho-physiological problems. Fifty (50) attempts were given to each player to perform over- arm throw. The data was collected at two sessions of each player. Digital video

camera was placed 7.60 meter away at the side of the player (lateral axis). The height of the camera was set at1.29 meter.

Statistical Procedure

With regard to purpose of the study Karl Pearson's Product Moment Coefficient Correlation Statistical technique test was used with the help of SPSS software was calculate between selected kinematical variables with performance of male cricket players. In order to check the significance, level of significance was set at 0.05.

Table 1: Shows relationship between horizontal velocity of wrist joint and performance in over-arm throwing technique in cricket.

Trails	Variables	Mean	Standard Deviation	Correlation (R) Value
100	Horizontal velocity of wrist joint	7.10	3.41	.486*
100	Performance	5.2	5.40	

'r'$_{0.05}(90)$= 0.205

* Significant at .05 level of significance

Table & figure 1 shows that the Mean & S.D value of Horizontal Velocity of Wrist Joint of Cricket Players was 7.10 and ± 3.41 respectively. The tabulated value of 'r' is 0.205 whereas the calculated value of 'r' is 0.486, which is more than the tabulated value. Hence, it moves that there is significant relationship between Horizontal Velocity of Wrist Joint with their performance.

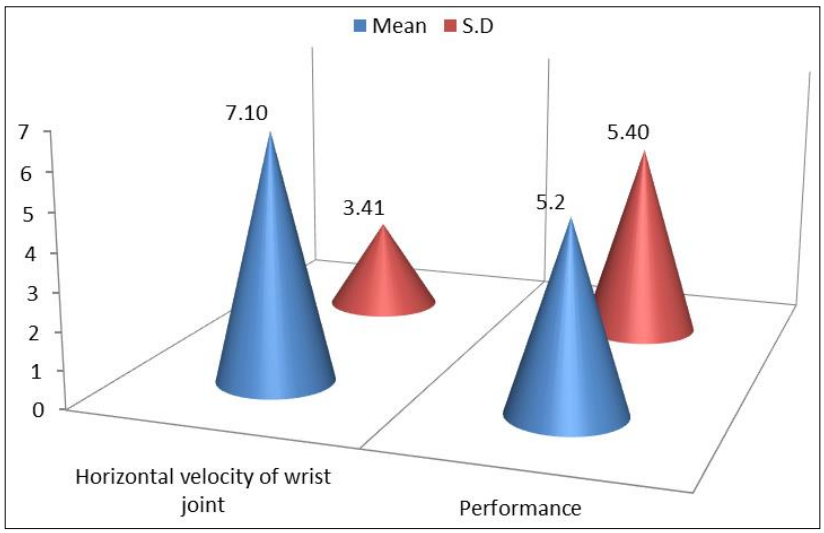

Fig 1: Shows the mean and standard deviation values of horizontal velocity of wrist joint and performance of over-arm throwing technique.

Table 2: Shows relationship between vertical velocity of wrist joint and performance in over-arm throwing technique in cricket.

Trails	Variables	Mean	Standard Deviation	Correlation (R) Value
100	Vertical velocity of wrist joint	4.88	3.08	.451*
100	Performance	5.2	5.40	

'r'$_{0.05}(90)$= 0.205 * Significant at .05 level of significance

Table & figure 2 shows that the Mean & S.D value of Vertical Velocity of Wrist Joint of Cricket Players was 4.88 and ± 3.08 respectively. The tabulated value of 'r' is 0.205 whereas the calculated value of 'r' is 0.451, which is more than the tabulated value. Hence, it moves that there is significant relationship between Vertical Velocity of Wrist Joint with their performance.

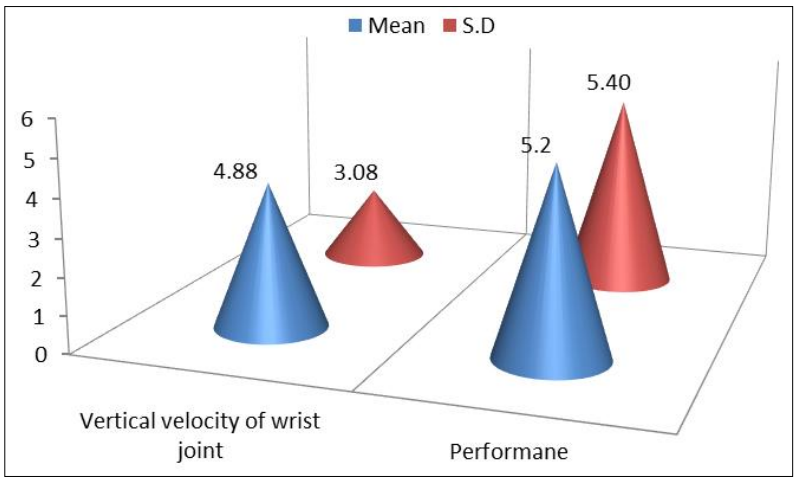

Fig 2: Shows the mean and standard deviation values of vertical velocity of wrist joint and performance of over-arm throwing technique.

Table 3: Shows relationship between horizontal velocity of elbow joint and performance in over-arm throwing technique in cricket.

Trails	Variables	Mean	Standard deviation	Correlation (r) Value
100	Horizontal velocity of Elbow joint	9.12	4.50	.458*
100	Performance	5.2	5.40	

'r'$_{0.05}(90)$= 0.205

* Significant at .05 level of significance

Table & figure 3 shows that the Mean & S.D value of Horizontal Velocity of Elbow Joint of Cricket Players was 9.12 and ± 4.50 respectively. The tabulated value of 'r' is 0.205 whereas the calculated value of 'r' is 0.458, which is more than the tabulated value. Hence, it moves that there is significant relationship between Horizontal Velocity of Elbow Joint with their performance.

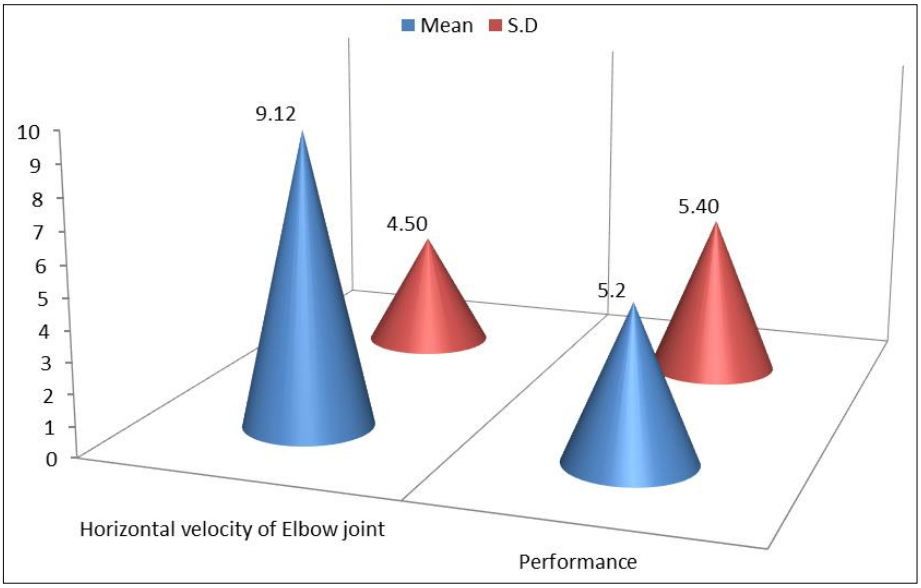

Fig 3: Shows the mean and standard deviation values of horizontal velocity of elbow joint and performance of over-arm throwing technique

Table 4: Shows relationship between vertical velocity of elbow joint and performance in over-arm throwing technique in cricket.

Trails	Variables	Mean	Standard Deviation	Correlation (R) Value
100	Vertical velocity of Elbow joint	3.03	2.25	.580*
100	Performance	5.2	5.40	

'r'$_{0.05}(90)$= 0.205

* Significant at .05 level of significance

Table & figure 4 shows that the Mean & S.D value of Vertical Velocity of Elbow Joint of Cricket Players was 3.03 and ± 2.25 respectively, The tabulated value of 'r' is 0.205 whereas the calculated value of 'r' is 0.580, which is more than the tabulated value. Hence, it moves that there is significant relationship between Vertical Velocity of Elbow Joint with the performance.

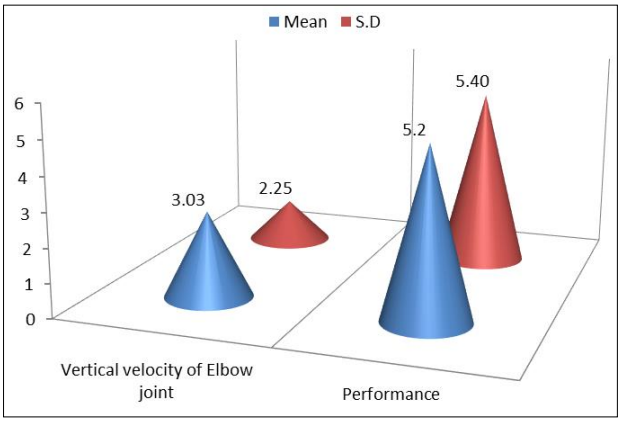

Fig 4: Shows the Mean and Standard Deviation values of Vertical Velocity of Elbow Joint and Performance of Over-Arm Throwing technique.

Discussion of the Findings

i. **Horizontal Velocity of Wrist joint:** The result of the study informs that there is significant relationship between Horizontal Velocity of Wrist Joint of Cricket Players with Performance. On the basis of analysis of data, investigator found that the earlier study of Singh, H. and Singh, D. (2017). "Biomechanical analysis of spiking skill in volleyball" Supported the present study".

ii. **Vertical Velocity of Wrist joint:** The result of the study informs that there is significant relationship between Vertical Velocity of Wrist Joint of Cricket Players with Performance. On the basis of analysis of data, investigator found that the earlier study of Singh, H. and Singh, D. (2017). "Biomechanical analysis of spiking skill in volleyball" Supported the present study".

iii. **Horizontal Velocity of Elbow joint:** The result of the study informs that there is significant relationship between Horizontal Velocity of Elbow Joint of Cricket Players with Performance. On the basis of analysis of data, investigator found that the earlier study of Glenn S. Fleisig, Steve W. Barrentine, Nigel Zheng, Rafael F. Escamilla, James R. Andrews. (1999). "Kinematic and kinetic comparison of baseball pitching among various levels of development" Supported the present study".

iv. **Vertical Velocity of Elbow joint:** The result of the study

informs that there is significant relationship between vertical velocity of wrist joint of cricket players with performance. On the basis of analysis of data, investigator found that the earlier study of Glenn S. Fleisig, Steve W. Barrentine, Nigel Zheng, Rafael F. Escamilla, James R. Andrews (1999). "Kinematic and kinetic comparison of baseball pitching among various levels of development" Supported the present study".

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