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RELATIONSHIP OF SELECTED KINEMATIC VARIABLES WITH THE PERFORMANCE OF RELEASING PHASE OUT-SWING IN FAST BOWLING

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Abstract
***Aim**: To assess the relationship between selected kinematic variables with the performance of Releasing phase in out-swing bowling. Material and Methods: Twelve randomly selected male students aged 19-28 years from Ranji Trophy from U.P Team, Players of Combine University Camp and the players of Under 22 national Cricket volunteered to participate in the study. The data was collected by the help of Siliconcoach pro-07 motion analysis solution software. The Pearson's product moment correlation coefficient method was used to measure the relationship between selected biomechanical variables with the performance of out-swing bowling in cricket. The level of significance was set at 0.05. Results: The results have shown the values of coefficients of correlation of selected angular kinematics variables at releasing phase and Out-Swing bowling performance. Elbow joint(Right), Wrist joint (Right), Ankle joint (Left), Knee joint (Left) Elbow joint (Left) & Wrist joint (Left) in releasing phase. Conclusion: The Elbow joint(Right), Wrist joint (Right), Ankle joint (Left), Knee joint (Left) Elbow joint (Left) & Wrist joint (Left) has positive effect on the performance of Out-Swing bowling at releasing phase.*

Key Words: Biomechanics, Silicon Coach Motion Analysis, Out-Swing.

Introduction

In modern times, the spirit of extreme competition has changed the entire scenario in sports. The craze for winning medals in the Olympics and in other international competitions has catalyzed the sport scientists to take interest in exploring all the aspects and possibilities which can contribute to enhance sports performance to undreamt heights.

The role of biomechanics in attaining high performance cannot be overlooked, since it is the only science which helps in identifying the faults of performing technique very precisely. There are basically two methods by which skill can be analyzed. They are qualitative and quantitative. High speed module film for exactness has been used extensively to examine in great details of the movements which occur too fast for the human eye to detect. In many of elite sport training and research institution around the world, force applied during high caliber sporting event, while the analysis test have done much to improve understanding of movement and the performance of elite athletes, the analysis task faced by the coach are predominantly qualitative in nature.

Cricket has become one of the most popular in the world of all major games in India. It is the only one that has been zealously preserved by all those who play or support it. There are various departments in cricket i.e. Batting, Bowling, fielding and no other takes preference over the other, and they are all, of course, of equal importance.

The objective in any cricket match is to score as many run as possible, but equally important is to take wickets and to keep your opponent scoring rate down. As result so much depend on team bowlers. Fast bowlers are used as front line of attack who help the team by keeping the opponent run rate checked and by taking the opponents wickets at regular interval.

Objectives

The purpose of this study was find out the performance between selected kinematic variables at releasing phase and Out-swing bowling.

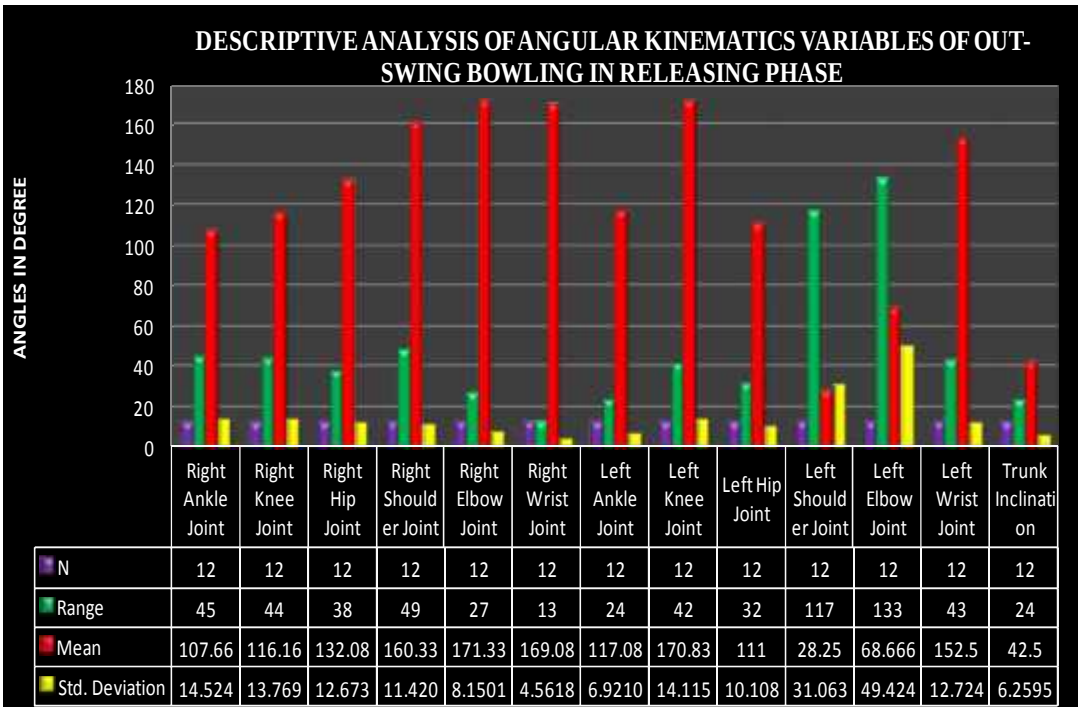
Methods

Twelve male cricket players aged between 19 to 28 years were selected for the purpose of this study. These subjects participated in the Ranji Trophy from U.P Team, Players of Combine University Camp and the players of Under 22 national Cricket Championship were selected as subjects for this study.

The performance of out-swing bowling of each selected subject was taken as the criterion measure for the purpose of the present study. The skills performance of subjects was evaluated by subjective judgment by a panel of three judges,

For the Kinematic analysis out-swing in Fast Bowling in cricket High speed videography technique was employed. The two Casio Exilim EX-F1 high speed cameras used for this purpose. Performance of subjects was recorded in control and favorable conditions. The data were recorded from both planes i.e. sagittal plane and frontal plane. Further out-Swing Bowling divided into five phases such as gather phase, back foot impact, delivery stride, releasing phase and follow through.

The center of gravity was calculated at selected moments, by using segmentation method. The Pearson's product moment correlations, was calculated between selected kinematic variables and performance of the subjects in out-Swing Bowling performance. The biomechanical variables were consisted of selected angular kinematic variables i.e. the measurements of angles at various joints of ankle joints (Right & Left), knee joints(Right & Left), hip joints (Right & Left), Shoulder joints (Right & Left), elbow joints (Right & Left), wrist joints (Right & Left) and Trunk inclination.



	Right Ankle Joint	Right Knee Joint	Right Hip Joint	Right Shoulder Joint	Right Elbow Joint	Right Wrist Joint	Left Ankle Joint	Left Knee Joint	Left Hip Joint	Left Shoulder Joint	Left Elbow Joint	Left Wrist Joint	Trunk Inclination
N	12	12	12	12	12	12	12	12	12	12	12	12	12
Range	45	44	38	49	27	13	24	42	32	117	133	43	24
Mean	107.66	116.16	132.08	160.33	171.33	169.08	117.08	170.83	111	28.25	68.666	152.5	42.5
Std. Deviation	14.524	13.769	12.673	11.420	8.1501	4.5618	6.9210	14.115	10.108	31.063	49.424	12.724	6.2595

Fig-1: Descriptive Analysis of Angular Kinematics Variables of Out- Swing Bowling In Releasing Phase

The mean, standard deviation and range of angular kinematics of out- swing bowling in releasing phase are presented in Fig.1.

The mean, standard deviation and range of angles for angular kinematics for different variables in degree are as follows: Right Ankle Joint (107.67± 14.52), range of angle is 45, Right Knee Joint (116.17± 13.77), range of angle is 44, Right Hip Joint (132.08 ± 12.67), range of angle is 38, Right Shoulder Joint (160.33 ± 11.42), range of angle is 49, Right Elbow Joint (171.33 ± 8.15), range of angle is 27, Right Wrist Joint (169.08 ± 4.56), range of angle is 13, Left Ankle Joint (117.08 ± 6.92), range of angle is 24, Left Knee Joint (170.83 ± 14.11), range of angle is 42, Left Hip Joint (111.00 ± 10.10), range of angle is 32, Left Shoulder Joint (28.25 ± 31.06), range of angle is 117, Left Elbow Joint (68.66 ± 49.42), range of angle is 133, Left Wrist Joint (152.5 ± 12.72), range of angle is 43, Trunk inclination (42.5 ± 6.25) range of angle is 24.

Table-1, Correlation Between *Out-Swing Bowling Performance* And Angular Kinematics Variables At Release Phase

Independent Variables	Correlation coefficient
Ankle Joint (Right)	.130
Knee joint (Right)	-.162
Hip joint (Right)	.516
Shoulder joint (Right)	.615*
Elbow joint (Right)	.585*
Wrist joint (Right)	-.625*
Ankle joint (Left)	.142
Knee joint (Left)	.102
Hip joint (Left)	-.718*
Shoulder joint (Left)	.217
Elbow joint (Left)	-.142
Wrist joint (Left)	.231
Body Inclination	-.509

*** Significant at .05 level**
r.05 (10) = .576

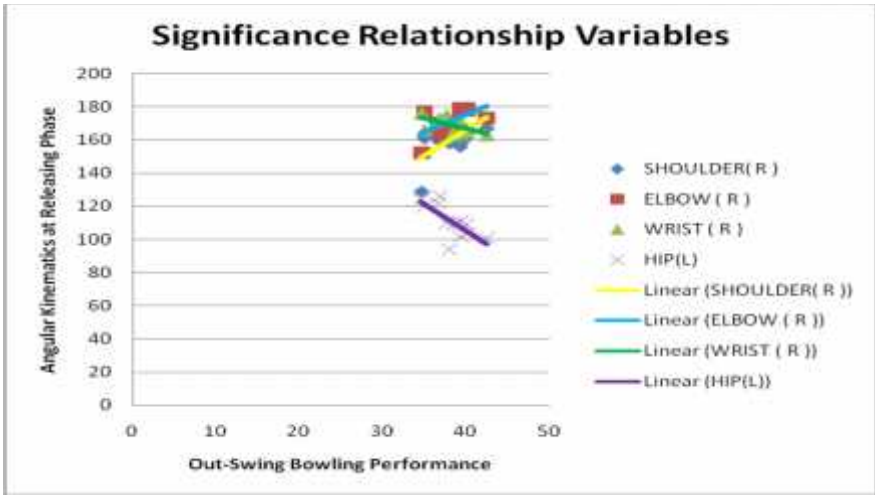


Fig-2: Significant Relationship Variables at Releasing Phase in Out-Swing Bowling

Table-1 clearly indicates that there exists a significant relationship between *Out-Swing Bowling Performance and* Shoulder joint (Right), Elbow joint (Right), Wrist joint (Right) & Hip joint (Left) as the correlation coefficient values were found higher than the tabulated value. at .05 level of significance.

On the other hand, there exists an insignificant relationship between *Out-Swing Bowling Performance and* Ankle joint (Right), Knee joint (Right), Hip joint (Right), Ankle Joint (Left), Knee joint (Left), Shoulder joint (Left), Elbow joint (Left), Wrist joint (Left) & Body Inclination as the correlation coefficient values were found less than the tabulated value. at .05 level of significance.

Discussion of Findings

The statistical analysis data clearly indicated that there exists a significant relationship between *Out-Swing Bowling performance and Shoulder joint (Right) 160.33*^{o} $\pm$11.42^{o}, Elbow joint (Right) 171.33^{o} $\pm$8.15^{o}, Wrist joint (Right) 169.08^{o} $\pm$4.56^{o} and Hip joint (Left) 111^{o} $\pm$10.10^{o}. This could be due to the fact that they maximise the efficiency of the action and increase range of application of forces generated from body and ground. These variables are also helps to achieve maximum height for releasing the ball and acted as a speed lever. Wrist joint (Right) and Elbow joint (Right) is playing important role for giving direction to the seam of ball for out-swing and also provide back spin to ball so that out-swing took place.

The releasing phase was also known as "the moment of truth" for the bowler and is taken with the right foot. This step is the moment when the bowler releases the ball. The fourth step begins the power phase in bowling because until now the bowler has just been walking with the ball freely swinging. At the fourth step, the arm swing should have reached the highest point or peak of the back swing. The height of the back swing is determined by several factors to include shoulder and chest flexibility, excessive adipose tissue, amount of trunk flexion, and whether or not the shoulder joint externally rotates.

On the other hand, there exists an insignificant relationship between *Out-swing Bowling performance and rest of the* angular kinematics variables. This could be due to the fact that most of these variables might have contributed in the Out-swing bowling performance; however the individual contribution was insignificant.

The laws of cricket limit the action of the bowling arm to circumduction of the upper arm about the gleno-humeral joint and the extension and flexion of the wrist and finger joints (though it is recognised that the wrist could also abduct and adduct, the radio-ulnar joints could supinate/pronate and the carpal joints can move) [Barlett et al., 1996]. The circumduction of the upper arm with the elbow either fully extended or at least a constant angle starts from a position close to the hip joint. Initiation of upper arm circumduction usually occurs between back foot and front foot strikes. The literature suggests that the degree of circumduction between front footstrike and ball release varies and that it is dependant not only on the position of the arm at release, but also on its position as the front foot lands (Barlett et al. 1996). Elliot and Foster (1989) suggested that the arm should be almost vertical at release and the angle between the trunk and the arm approximately 200^{o}. The wrist and fingers are the most distal joints of the body to add velocity to the ball however because each bowler seems to have their own unique way of flexing their wrist and fingers when releasing the ball, there are no studies suggesting the most correct method. There is a lack of data relating the degree of wrist and finger flexion to ball release speeds as the large standard deviations indicate a large degree of inter-subject variability. Literature, however, suggests that wrist and finger flexion may play a role, if only minor (at least 5%), in increasing ball releasing speed (Barlett et al., 1996).

Present Study supported the findings of the study conducted by Berglund Dave and Dr Paul Hurrion.

Discussion of Hypothesis

The hypothesis stated earlier that there would be no significance relationship between selected kinematic variables and the performance in out-Swing bowling were partially accepted and partially rejected.

Conclusion

The Shoulder joint (Right), Elbow joint (Right), Wrist joint (Right) & Hip joint (Left) has positive effect on the performance of Out-Swing bowling at releasing phase. On the other hand the other selected angular kinematics variables did not have significant relationship with Out-Swing bowling at releasing phase.

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