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Kinematical Analysis of Under-Arm Throwing Techniques in Cricket at 45^0 Throwing Angle with 112^0 and 45^0 Approach of 10 Meter Distance

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Abstract:

For the purpose of the study ten male intervarsity cricket players were selected as the subjects. The purpose of this study is to analyze the kinematic variables of underarm throwing technique in cricket (ball velocity, accuracy, and segmental angular variables). Thrower performed under-arm throwing technique with 112^0 and 45^0 approach angle at 45^0 throwing angle of 10m distance. The mean age, height and body weight of the subjects were reported as 20.60 ± 2.91 years, 170.80 ± 4.02 cm and 60.80 ± 5.14 kg respectively. Canon Legria SF-10 Camcorders were used to record throwing movement, functioning at 120 Hz. The Silicon Coach Pro7 motion analysis software was used to analyze the identified clips. The result of study revealed that there is insignificant difference between ball velocity and accuracy.

Key words: kinematics, approach angle, wind-up, late-cocking and acceleration

Introduction

Throwing in a few games based on the basic skills class movement (Elliott et al. 1990 and Hussain et al. 2011), the motor movement of throwing skills, could be preponderating for some athletes. Analysis of throwing technique has been the basis for many studies across a range of sports that have served to identify important variables and characteristics of throwing performance. To facilitate analysis and understanding, many researchers have divided the throwing action into specific phases, each with its own biomechanical function (Elliott et al. 1990). Assessment of throwing technique in cricket has been the basis for previous studies across a range of sports; these have served to identify important variables and characteristics of throwing performance to facilitate analysis and understanding, many researchers having divided the throwing action into specific phases, each with its own biomechanical function (Elliott et al. 1990). Although the throw can be divided into specific phases, this does not infer a discontinuous action but serves only to aid subsequent analysis (Elliott et al. 1990).

The throwing motion can be broken down into several key temporal parameters based on distinct motions involved in every throw. Different studies use different temporal parameters based on the needs of the study: Werner et al. (2001) broke down the throwing motion into three phases: stride foot contact to the instant of maximum shoulder external rotation (cocking phase), maximum external rotation to the instant of ball release (acceleration phase), and from ball release until 500 milliseconds after the ball has been released (follow-through phase). 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.

The main aim of this study is find out best mechanical variation in under arm throwing technique with 112^0 and 45^0 approach angle at 45^0 throwing angle of 10m distance in respect to ball velocity and accuracy.

Methodology:

Methodology: Ten male cricket players from the University level offered to take part as subjects in this study. They executed underarm throws at maximum velocity toward 45^0 target/stump situated at a distance of 10 meters with 112^0 and 45^0 approach angles. The physical features of the subjects were: 20.60 ± 2.91 years, 170.80 ± 4.02 cm and 60.80 ± 5.14 kg respectively. Two Canon Legaria SF-10 cameras set at a frame rate of 60 frames per second were used to record kinematics data of entire throwing movement.

The throwing arm between their respective optical axes of the camera was almost as giving a 900 mediolateral axis (camera optical axes perpendicular on the sagittal plane) and in the sagittal plane it was erected in parallel. The camera was set-up on a rigid tripod and secured to the floor in the location at a distance of 10 meter from the point of throw. The camera was positioned perpendicular to the sagittal plane and parallel to the mediolateral axis (camera optical axes perpendicular on the sagittal plane) as their throwing arm giving approximately a 900 between their respective optical axes. The photographic camera was set at 95 cms height from the surface and tilted down in order to get the image of the subject as large as possible while all points of interested were kept within a frame.

The recorded throwing data were downloaded on personal computer, cut and edited with the help of STHVCD55 software. Digitization and data analysis were completed by the Silicon Coach Pro7 motion analysis software. The delimitation of the kinematic variables of this study were angles, displacement, time, speed, velocity and number of frames. Acquired data were subjected to statistical analysis. An independent t-test was used for the comparison of the kinematic parameters between under arm throws performed with two different approach angles, at 112^0 and $45^{0.}$ All statistical procedures were conducted using the SPSS 18.0 software at 0.05 level of confidant.

Results:

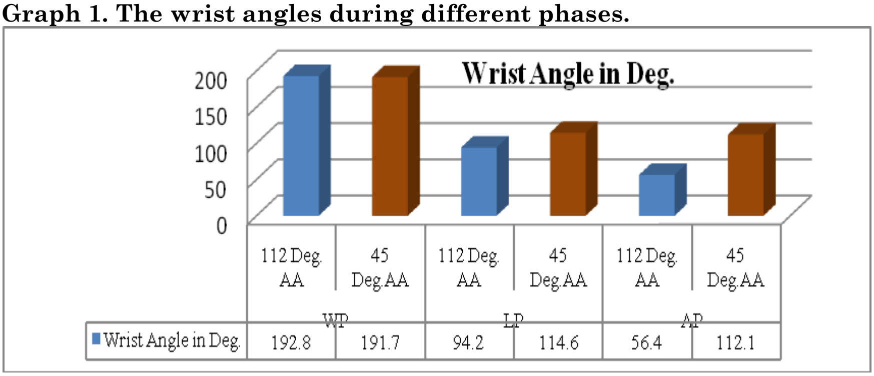
Table 1. Wrist joints angle differences between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance.

Variables	Phases	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
Wrist Angle	WP	112^0	10	192.80	12.51	18	1.10	0.18
		45^0	10	191.70	14.56			
	LP	112^0	10	94.20	15.49	18	20.40	2.46*
		45^0	10	114.60	21.19			
	AP	112^0	10	56.40	18.26	18	55.70	6.54*
		45^0	10	112.10	19.78			

Tab $t_{.0.05}$ (18) =2.10 *Significance at 0.05 levels.
WP=Wind-Up Phase; LP= Late Cocking Phase; AP= Acceleration Phase; AA= Approach Angle

The analysis of data in Table 1 shows that there is a significant difference of wrist joint angles between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their late-cocking and acceleration phase as the obtained 't' ratio is greater than the required 't' value of 2.10, whereas there are insignificant differences of wrist joints angle between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their wind-up phase.

Graph 1. The wrist angles during different phases.



SA=Side-Arm; OH= Over-Head; WP=Wind-Up Phase; LP= Late Cocking Phase; AP= Acceleration Phase

Table 2. Elbow joints angle differences between under-arm throwing at 112^0 and 45^0 approach angle at 45^0 throwing of 10 meter distance.

Variables	Phases	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
Elbow Angle	WP	112^0	10	222.40	13.28	18	28.30	3.23*
		45^0	10	194.10	24.24			
	LP	112^0	10	35.60	9.81	18	60.50	8.98*
		45^0	10	96.10	18.90			
	AP	112^0	10	146.80	15.85	18	42.80	4.50*
		45^0	10	104.00	25.56			

Tab $t_{.0.05}$ (18) =2.10 *Significance at 0.05 levels.

The analysis of data in Table 2 shows that there is a significant difference of elbow joints angle between under-arm throwing at

112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their wind-up, late-cocking and acceleration phase as obtained 't' ratio is greater than the required 't' value of 2.10.

Graph 2. The elbow angles during different phases.

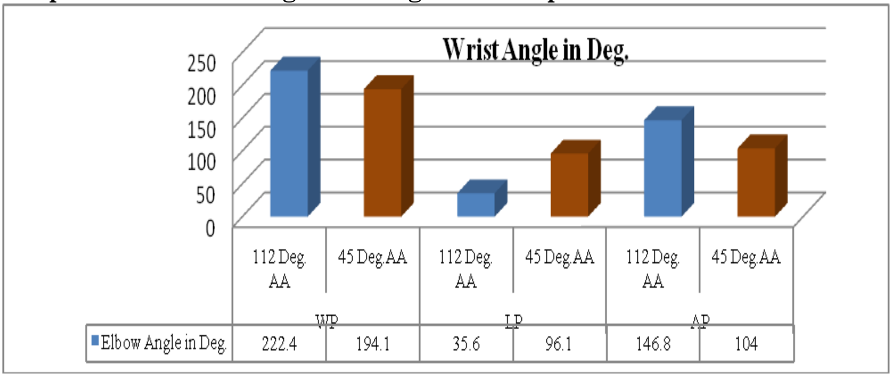


Table 3. Shoulder joints angle differences between under-arm throwing at 112^0 and 45^0 approach angle at 45^0 throwing of 10 meter distance.

Variables	Phases	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
Shoulder Angle	WP	112^0	10	168.00	11.05	18	5.20	0.98
		45^0	10	173.20	12.52			
	LP	112^0	10	48.30	15.84	18	14.30	2.55*
		45^0	10	34.00	7.96			
	AP	112^0	10	137.00	12.27	18	7.40	0.67
		45^0	10	129.60	33.00			

Tab $t_{.0.05}$ (18) =2.10 *Significance at 0.05 levels.

The analysis of data in Table 3 shows that there is a significant difference of shoulder joints angle between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their late-cocking as obtained 't' ratio is greater than the required 't' value of 2.10 whereas there are insignificance differences of shoulder joints angle between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their wind-up and acceleration phase.

Graph 3. The shoulder angles during different phases.

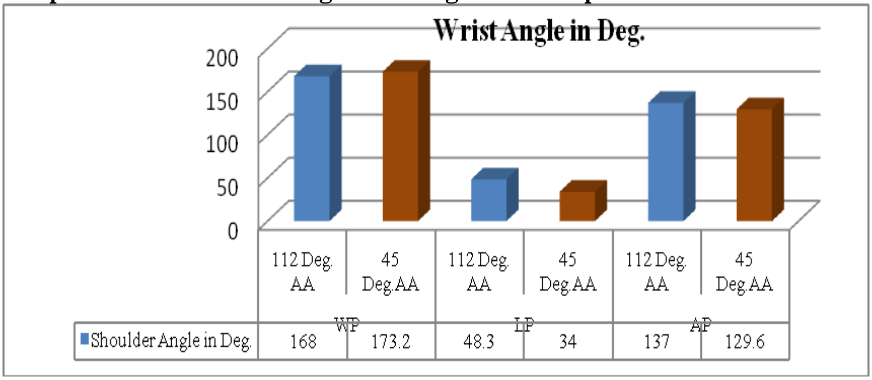


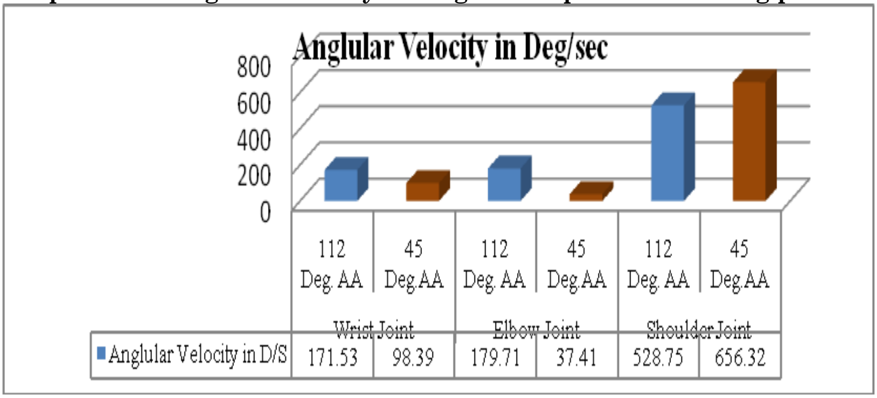
Table 4. Angular kinematics differences between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance during wind-up to late-cocking phase.

Variables	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
wrist joint	112^0	10	171.53	125.11	18	73.14	1.64
	45^0	10	98.39	64.97			
Elbow joint	112^0	10	179.71	78.85	18	142.30	5.41*
	45^0	10	37.41	26.51			
Shoulder joint	112^0	10	528.75	103.18	18	127.58	1.94
	45^0	10	656.32	180.54			

Tab $t_{.0.05}$ (18) =2.10 *Significance at 0.05 levels.

The analysis of data in Table 4 shows that there are significant differences between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance during wind-up to late-cocking phase in their angular velocity of elbow joint as obtained ‘t’ ratio is greater than the required ‘t’ value of 2.10, whereas insignificance differences exist in angular velocity of wrist and shoulder joints.

Graph 4. The Angular velocity during wind-up to late-cocking phases



WJ=Wrist Joint EJ=Elbow joint SJ= Shoulder Joint

Table 5. Angular kinematics differences between under-arm throwing at 112⁰ and 45⁰ approach angles at 45⁰ throwing of 10 meter distance during late-cocking phase to acceleration phase.

Variables	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
wrist joint	112⁰	10	513.91	190.77	18	325.01	3.78 *
	45⁰	10	188.90	194.17			
Elbow joint	112⁰	10	167.04	118.84	18	112.64	2.90 *
	45⁰	10	54.40	30.77			
Shoulder joint	112⁰	10	771.27	194.28	18	140.80	1.45
	45⁰	10	912.07	238.68			

Tab $t_{0.05}$ (18) =2.10 *Significance at 0.05 levels.

The analysis of data in Table 5 show that there are significant differences between under-arm throwing at 112⁰ and 45⁰ approach angles at 45⁰ throwing of 10 meter distance during late-cocking to acceleration phase in their angular velocity of wrist and elbow joint as obtained 't' ratio is greater than the required 't' value of 2.10, whereas insignificance differences exist in angular velocity of shoulder joints.

Graph 5. The Angular velocity during late-cocking to acceleration phases.

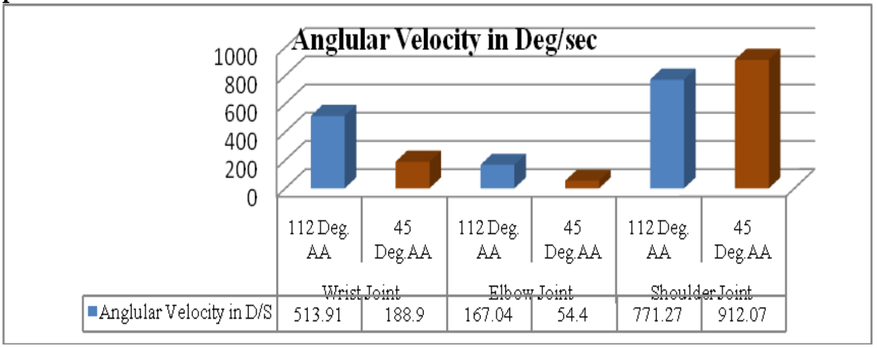


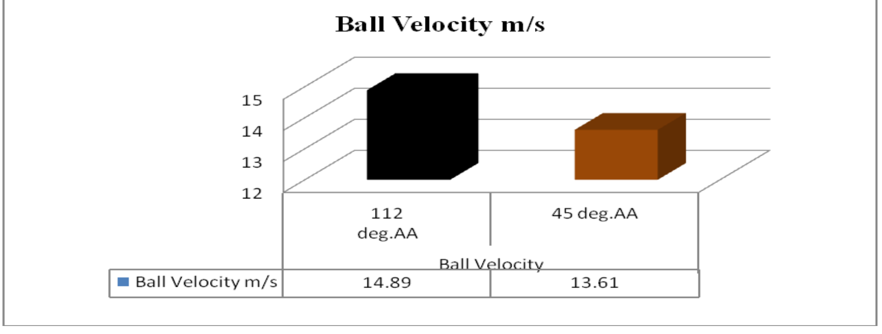
Table 6. Ball velocity and accuracy differences between under-arm throwing at 112⁰ and 45⁰ approach angles at 45⁰ throwing of 10 meter distance.

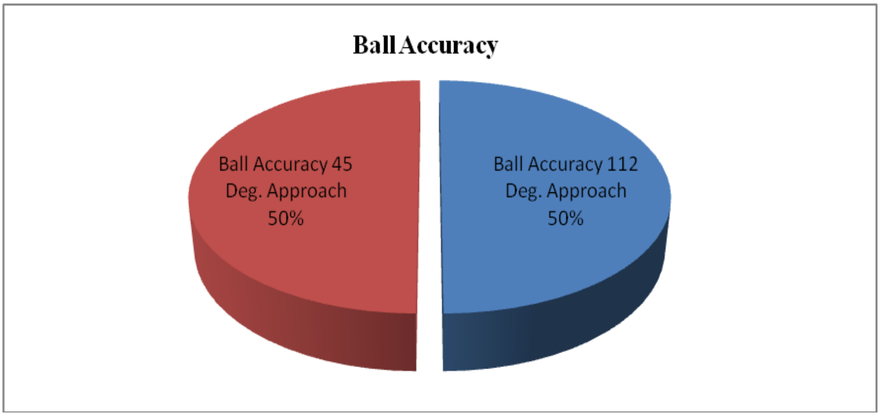
Variables	AA	No.	Mean	SD (±)	df	Mean Difference	Calculated t
Ball Velocity	112⁰	10	14.89	3.39	18	1.28	0.95
	45⁰	10	13.61	2.58			
Ball Accuracy	112⁰	10	0.30	0.48	18	0.00	0.00
	45⁰	10	0.30	0.48			

Tab $t_{.0.05}$ (18) =2.10 *Significance at 0.05 levels.

The analysis of data in Table 6 show that there are insignificant differences between under-arm throwing at 112⁰ and 45⁰ approach angles at 45⁰ throwing of 10 meter distance in their ball velocity and accuracy of cricket ball throwing as obtained 't' ratio is less than the required 't' value of 2.10.

Graph 6. The ball velocity and accuracy under-arm throwing at 112⁰ and 45⁰ approach angles at 45⁰ throwing of 10 meter distance.





Discussion:

One of the purposes of this study has been to compare the under arm throwing techniques with two different approach angle. Throwing approach determines if there are any significant differences or not. The second purpose of this study has been to find out the best throwing mechanics of under arm throws at different approaches in view of achieving the highest accuracy and velocity. Putnam (1993) noted that the way segments move in sequence and the way their motions are timed may vary across skills, suggesting as possible causes the different task demands of speed and accuracy.

The result shows that the ball velocity and accuracy of underarm throws with 45^0 throwing angle at 112^0 and 45^0 approach angles of 10 m distances differ insignificantly when the ball velocity was analyzed in term of joint angles of under arm throws at wind-up, late-cocking and acceleration phase with 112^0 and 45^0 approach angle at 45^0 throwing angles of 10 distances. At the wind up phase or ball contact phase, the wrist and shoulder joint show no difference in their mechanics due to the same throwing angle at a same preferred distance.

At the late cocking phase, the wrist elbow and shoulder joint display a difference in their mechanics due to the different approach angle at a same preferred distance. The upper arm was also experiencing horizontal adduction angular acceleration (Hussain et al. 2011; Felter et al. 1986). At the acceleration phase, wrist and elbow joints angle have significant mean differences except shoulder joint angle. The changes at wrist and elbow joint may be due to changes of body position. Throwing arm comes to the final phase of throwing from late cocking phase at different angle of approach 112^0 and 45^0 , this probably being the main reason why the results of the study show significant mean differences.

There are insignificant differences between under-arm throwing at 112^0 and 45^0 approach angles at 45^0 throwing of 10 meter distance in their angular velocity of elbow joints during first phase and shoulder joint during the second phase of performing the throws.

The present study showed that angular velocity of elbow joint during first phase and shoulder joints during second phase of throwing are different at 112^0 and 45^0 approach angle at 45^0 throwing angle of 10m distance. Dun et al. (2007) investigated that ball velocity and body segment velocity variables showed no significant differences between the two groups. The angular velocities of elbow and shoulder joints are a factor to cause variation in the ball velocity as well as differences in approach angle for under arm throwing techniques.

Conclusion:

The 112^0 approach angle at 45^0 throwing angles of 10m distance; the under arm throw was an answerable factor to achieving greater ball velocity as compared to 45^0 approach angle.

In the case of 112^0 and 45^0 approach angle at 45^0 throwing angle of 10m distance, the side arm throw achieved equal percentage of ball accuracy.

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