KINEMATIC ANALYSIS OF CUT SHOT, HOOK SHOT AND SQUARE CUT SHOT IN CRICKET

P. Yadav¹ and I.S. Pal² ^{1,2}ASPESS, Amity University, Noida, India

pushkar.yadav@s.amity.edu,1 ispal@amity.edu2

ABSTRACT

Every batsman has a different style and technique which makes their shots look different to another player. The purpose of this study was to investigate the cut shot, square cut shot and hook shot in with the help of selected kinematic variables. The present study was delimited to angular kinematic variable (angle atelbow joint), linear kinematic variable (center of gravity), height of back lift (stance), height of contact with ball (execution) and distance between the feet. The slow motion also helps to understand the movement of various body parts and early or late reaction during anticipation of ball. So the results for the cut shot, square cut shot and hook shot revealed that the movement were generally supportive of the coaching literature, hence the Height of center of gravity at the time of stance- Height of center of gravity at the time of contact with ball (Execution)- Angle at joint during execution (left elbow)- Height of back lift during execution- Distance between the feet during execution, would certainly plays an effective role, in case of cut shot and hook shot in cricket, after giving the priorities to these kinematic variables, one can achieve the highest performance with less effort.

Keywords: Kinematics, center of gravity, cut shot; square cut shot, hook shot, angle at joints, evaluation of technique, ball contact, etc.

Introduction

Cricket or the gentleman's gameis a very old, widespread and uncomplicated pastime game. In the late 16thcentury, the sport of cricket was originated in the south-east England. It became the country's national sport in the 18th century and was developed globally in the 19thand 20th century.

In20-overs matches, the general opinion of several cricketing enthusiasts and experts was that the batting capability dominates over bowling capability; however 50in oversmatches, we cannot give such type of opinion. So, one of the attempts has been taken to analyze the performance of players in20and 50overmatches to draw the conclusion whether batting capability dominates over bowling capability in both the cases or not where renowned international cricketers come together to analyze.

The cricket team is a group of 11 (eleven) players consisting of batsmen, bowler and allrounder. The team should be balanced and diversified to enhance the probability of the success. In addition, the success can also depend on the type of pitch, winning of toss, and sequence of batting or bowling. Besides this, the performance of batsmen, bowlers as well as the fielding is the key factor of the results of a particular match.

In cricket, a batsman has two key roles to play - to score runs and to defend his wicket. Not all balls can be attacked nor all balls need to be defended. Depending on the type of delivery and the field placement, a batsman may have to make adjustments while playing the shot. The type of shot a batsman plays depends on the line and length of the ball. Some of the most common cricket shots are the drives, cuts, glances, pulls, hooks, or sweeps. In modern cricket, innovative shots like switch hit, scoops, or reverse sweep are also quite common. In cricket the performance of the players whether bowler or batsman is being analyzed with the help of very simple statistical tools. Mostly average scores, strike rate, average runs per wicket are being used.

Nowadays, research is going on to study the performance of such factor using different statistical approach. Kimber and Hansford studied batting average of batsmen with the help of different statistical technique.

This study was further extended by Barr and Kantor by providing a mathematical model/ method for comparing and selecting batsmen. Again, to win a particular game the main thing is to construct the 'strategy'. Preston and Thomas suggests an optimum batting strategy in limited over cricket games. Bailey and Clark studied the influence of various factors which affect the outcome of an ODI cricket match. Ledesma and Mora discussed the number of factors to retain in exploratory factor analysis. Swartz et al. predicted the

Number of runs of particular one-day cricket matches with the help of simulation technique-A graphical method was given by Van Staden for comparison of cricket player's batting and bowling performances. Norman and Clarke applied dynamic programming to determine optimal batting orders of a match.

today's In world, data is collected everywhere around us, whether it is collected manually or digitally. But in actual sense, data does not mean information. Data available is a great resource but it serves no use of it, without the people who can interpret and make use out of it. Data analysis helps us to unlock the information and insights to questions.



Cricketing shots

Methodology

Five male Indian trainees of a private academy, Rohini were selected as the subject for the present study; these cricketers have played at inter school and district level. The age was between 14 to 18 years. The analysis of each subject for cut shot, hook shot and square cut shot was on the basis of how cleanly and precisely he executes the technique. Only three shots were allowed to each subject for cinematographic analysis of technique wherein video was filmed at 100 Hz/240 fps to establish the kinematic factors involved in playing these shots

Experimental filming protocol

The recording was determined on artificial grass cricket wicket at VSPK Cricket academy, Rohini. The subject was asked to hit the fed ball first for each shot separately. The filming zone was set up with video camera placed in frontal plane at a distance of 15 feet from the subject. After video recording final position of each selected phase was obtained on the screen by trial and error method and kept in pause.

Cut shot (stance)



Fig 1: Cut shot (stance)

Figure 1 shows wide base of support while approaching for cut shot (Stance). The angle of joint is 126° (in this angle the player is able to hit the ball with more effectively with better result) COG is low and falling exactly within the base of support with torso bending forward

and distributed on both the feet with a distance of 29.14 cm, which was found very comfortable for the player at the time of cut shot with a height of 87.82 cm in the game of cricket.





Fig2: Cut shot (execution)

Figure 2 shows wide base of support while approaching for cut shot (Stance Execution). The angle of joint is 165° (in this angle the player is able to hit the ball with more effectively with better result) COG is low and falling exactly within the base of support and

distributed on both the feet with a distance of 34.54 cm, which was found very comfortable for the player at the time of cut shot with a visual height of bat just in contact with ball 107.60 cm in the game of cricket.



(*Cut shot stance and execution figures for reference*)

Square cut (Stance)



Fig 3: Square cut (Stance)

Figure 3 shows wide base of support while approaching for square cut (Stance). The angle of joint is 140° (in this angle the player is able to hit the ball with more effectively with better result) COG is low and falling exactly

within the base of support with torso bending forward and distributed on both the feet with a distance of 28.05 cm, which was found very comfortable for the player at the time of cut shot with a height of back lift 135.22 cm.



Square cut shot (execution)

Fig 4: Square cut shot (execution)

Figure 4 visualizes execution of shot with very low center of gravity to the base of support for square cut (Execution). The elbow is raised with relatively less angle at joint of 119^{0} (in this angle the player is able to hit the ball with more effectively with better result). COG is low along with forward bending torso and falling exactly within the base of support and distributed on both the feet with a distance of 22.47 cm with flexed knee, which was found very comfortable for the player at the time of shot with a visual height of bat just in contact with ball 25.24 cm.





(Square Cut shot stance and execution figures for reference)



hook shot (stance)



Figure 5 shows wide base of support while approaching for hook shot (Stance). The angle of joint is 135° (in this angle the player is able to hit the ball with more effectively with better result) COG is 88.80 cm and falling exactly within the base of support with torso bending

slightly forward and distributed on both the feet with a distance of 28.07 cm, which was found very comfortable for the player at the time of cut shot with a height of back lift 112.56 cm.



Hook shot (execution)

Fig 6: Hook shot (execution)

Figure 6 visualizes execution of shot with very low center of gravity to the base of support forhook shot (Execution). The angle at joint of 166° (in this angle the player is able to hit the ball with more effectively with better result). COG is relatively high which is 114.06 cm falling near to front feet with rotation of upper body. The distance between the feet is increased to 51.80 cm (in order to increase the base of support) along with heel raise of trailing feet with flexed knee, which was found very comfortable for the player at the time of shot with a visual height of bat just in contact with ball 114.09 cm.

Cut Short				Hook Short				Square Cut			
Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Back lift (cm)	Dt. B/w foot (cm)	Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Back lift (cm)	Dt. B/w foot (cm)	Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Back lift (cm)	Dt. B/w foot (cm)
126	82.82	150	29.14	135	88.8	112.56	28.07	133	79.5	119.65	25.15
128	100.4	145	44.23	133	87.02	113.35	29.36	140	93.1	135.22	38.05
123	88.12	148	30.2	131	86.87	110.1	27.59	138	91.2	133.25	35.98
128	85.56	147	39.02	140	89.21	112.54	29.58	135	89.65	130.54	33.33
126	83.57	146	38.98	138	87.57	110.59	29.64	134	90.57	132.95	34.12

Table – 1: Data for Stance



 Table – 2: Data for Execution

Cut Short				Hook Short				Square Cut			
Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Bat (cm)	Dt. B/w foot (cm)	Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Bat (cm)	Dt. B/w foot (cm)	Angle of Joint (Elbow) (Deg)	COG (cm)	Ht. Bat (cm)	Dt. B/w foot (cm)
165	88.46	107.6	34.54	166	99.26	114.09	51.8	127	49.27	26.21	34.6
155	83.21	100.1	23.37	164	97.23	115.54	52.23	119	59.12	25.24	22.47
153	82.51	97.01	22.54	165	98.25	113.98	51.24	120	55.3	24.36	23.65
157	83.65	98.31	24.65	164	98.68	115.68	51.49	123	54.68	24.19	22.91
158	84.98	96.26	23.42	168	99.12	117.21	53.19	128	58.38	25.12	33.19



Graph 2

Conclusion

Based on the analysis and within the delimitation of present study following conclusion were drawn:-

- 1. In Fig. 1, 2, 3, 4 & 5 the center of gravity was falling between the feet (within the base of support) as a result the bats man certainly had more stability, which helps him before hitting the ball and even at the time of execution of the movement. Also the back lift gives stored potential energy that transforms to kinetic energy during execution. The angle at elbow joint may vary due to height of batsmen or back lift but more or less falls in same range for every particular shot to be executed.
- 2. In Fig. 6, 7 & 8 the center of gravity rises slightly due the ball coming above waist level for cut shot and hook shot. Though the center of gravity remains between the base of support but in hook shot it shifts towards front feet due upper body rotation and pivot of trailing feet. Both the shots are results of extended elbow (higher angle at elbow joint). The point of contact of ball is also higher.
- 3. In Fig 9&10 the stride or distance between the feet is increased by lunging forward and increasing the base of support, thus increasing equilibrium. The angle at elbow joint is similar to that of stance but there is raise and change in orientation of elbow.
- 4. The difference between the strokes is where the ball is hit or on contact with bat.
- 5. In square cut shot the ball was hit when it comes away from the virtual mid line of stumps, towards off side.
- 6. The square cut shot was executed with a follow through of bat swinging forward and upward.

- 7. In square cut shot the face of bat is downward while in contact with ball otherwise ball will fly off or airborne.
- **8.** In cut shot the bat swings laterally with slight tilt from the edge to give slice cut or spin to the ball being hit and not to fly off.
- **9.** In hook shot the face of bat can be open or straight to pull the raised ball and lift it slightly more.
- 10. Results for the cut shot , square cut shot and hook shot revealed that the movement were generally supportive of the coaching literature, hence the Height of center of gravity at the time of stance- Height of center of gravity at the time of contact with ball (Execution)- Angle at joint during execution (left elbow)- Height of back lift during execution- Distance between the feet during execution, would certainly plays an effective role, in case of cut shot and hook shot in cricket, after giving the priorities to these kinematic variables, one can achieve the highest performance with less effort.

Recommendation

The present study may contribute in following way

- 1. Helpful to the physical education teacher, coaches and players to evaluate hitting performance.
- 2. Help coaches to identify technical faults while teaching cut shot, hook shot and square cut shot technique to fresher.
- **3.** A mathematical model of these shots may be drawn on the basis of this study.
- **4.** This study may be under taken to analyze others elements in other games and sports.
- 5. Similar study can be conducted on different age group, level of player and gender.

References

- 1. T.N., Savage, & M,R,. Portus, (2011). A Kinematic Analysis of Fast Bowling Techniques Used by Elite Female Cricketers, (25-31)
- Samuel, J. Callaghan, Matthew.-D, Jeffriess, Robert, G,.Lockie.(2001)The Kinematic Variations between Batsmen

and Fast Bowlers When Completing a Quick Single in Cricket, (23-30)

 Callaghan, S.J, Lockie, G., & Jeffriess, M., D., (2014). The Acceleration Kinematics of Cricket-Specific Starts when Completing a Quick Single. Sports Technology, 7(1-2), 39-51.

- Fosang, A., & Baker, R. (2006). A Method for Comparing Manual Muscle Strength Measurements with Joint Moments during Walking. Gait and Posture, 24, 406-411.
- Hinrichs, R. N. (1992). Case Studies of Asymmetrical Arm Action in Running,. International Journal of Sport Biomechanics, 8, 111-128.
- Houghton, L,. A. (2010). Running Between The Wickets In Cricket: What Is The Fastest Technique? International Journal of Sports Science and Coaching, 5(1), 101-107.
- Hurrion, P,. D, Dyson, R, & Hale, T,. (2000). Simultaneous Measurement of Back and Front Foot Ground Reaction Forces During the Same Delivery Stride of

the Fast-Medium Bowler, Journal of Sports Sciences, 18, 993-997.

- Petersen, C.A., Pyne, D. B., Portus, M.R. & Dawson, B. (2008). Analysis of Twenty/20 Cricket Performance during the 2008 Indian Premier League. International Journal of Performance Analysis of Sport, 8(3), 63-69.
- Webster, J. & Roberts, J. (2011). Determining the effects of cricket leg guards on running performance. Journal of Sports Sciences, 29, 749-760.
- Poole, J.R. (1970). A Cinematographic Analysis of upper extremity movements of upper class Players executing Basic badminton Strokes.LSU Historical Dissertation and thesis.