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Three Dimensional Analysis of Drag-flick in The Field Hockey of University Players

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Abstract

The penalty corner one of the most important technique to score the goal in field hockey. The penalty corner depends upon three different technical applications like push, stop and drag. Technical application of drag flick in penalty corner covered maximum number of successful goal. The main aim of this study was to analyze spatial and temporal kinematics in the drag flick of elite field hockey players. Two main drag flickers from Aligarh Muslim University, Aligarh hockey team were selected as a subject for this study. The body weight, Height and Age of each subject ware recorded subsequently Sub_1=65 kg body weight, 180.50cm of height and 19 years of age and Sub_2= 60 kg body weight, 167.00 cm of height and 19 years of age. A static calibration method was used to capture drag flick by Two Cameras, sampling at 50 Hz. Six successful trials at target were selected from each subject for the study. Videos of selected trials were digitized by the Max Track 3D motion analysis software. The three dimensional (3D) motion was determined from digitized video analysis using **18-**point body model together. Results of this study shows that spatial / temporal variable between the players, there exist little difference in stance width in ball contact phase, recommended that little or no difference exist in techniques between both players.

Key points: spatial / temporal, kinematics, drag, digitized.

1. Introduction

The success of the penalty corners depend three main technical application i.e. pusher, stopper and drag flicker. Out of the three , the drag flicker contribute the most in the success of goals scored that have come from the penalty corner (Lees, 2002).

The most important scoring plays in the field hockey are the technique of penalty corner (Laird and Sunderland, 2003 and Pineiro, 2008). The drag-flick is used in the field hockey for shooting at goal with speed and desire accuracy as it is more scoring than other techniques such as hits and pushes during the penalty corner (Yusoff et al., 2008).

As per the rules book of hockey (FIH, 2009), there is no any set rules regarding the maximum and minimum height of the ball when the first shot to score a goal is a push or a drag-flick. Sports scientist, have focused on strike techniques in field hockey but a few have analysed the technical aspect of drag-flick (Yussoff et al., 2008), focus to analyzed biomechanical parameters in relation to the performance of the players.

Biomechanical analysis of the techniques have no any single definition, however it is scientifically agreed that technique analysis depend on the way in which skills are executed, from all parameters of biomechanics (Kinetics and kinematics) (O'Donoghue., 2010). Both Biomechanical studies were conducted a 2D or 3D motion analysis based on videography with a set specified sampling frequency. Biomechanics of throwing and hitting skills should be follow same pattern as drag flick in field hockey which aim to get higher speed and accuracy of the free end (distal) segment at release. In these techniques, back to back segments reach their maximum speed in the beginning of series with those utmost from the free end of the kinetic chain (Bartlett and Best, 1988).

Kinetics chain of segmental rotations of the pelvis, upper trunk, and stick occurred in the drag-flick (Hussain et. all. 2012). Kerr and Ness (2006) found that the movement pattern of the push is a compounding of consecutive and simultaneous segment rotations. Furthermore, during the drag-flick the major contribution to the ball velocity were stance, stance width, the distance between ball and front foot, the beginning of double foot contact, angular and linear velocity of different body segment at ball release (McLaughlin, 1997; Kerr and Ness, 2006).

The most of the previous researches have been conducted a 2D analysis, there is a dearth of research on the 3D analysis of the drag flick in the field hockey. However no 3D biomechanical study of the drag-flick techniques has been done in Indian players. Thus, the research has been proposed to carry out 3D analysis of elite specialized drag flicker from Aligarh Muslim University, Aligah.

2. Methodology

2.1 Selection of Subjects

Two specialized right handed drag flickers are current member of Aligarh Muslim University male hockey team has been selected as the subject. The measurements were recorded by using the standard equipment, which were presently available at hand. The body weight of each subject ware recorded in kilogram Sub_1=65 kg and Sub_2= 60 kg by using weighing machine (including player's kit, which was wearing during the videography session). Heights of each subject were recorded in centimeter (Sub_1=180.50cm and Sub_2=167.00 cm) by using stadiometer and age of both subjects were 19 years measured in chronological order.

2.2 Filming Procedure:

The film recording conducted on sunny and clear weather in the Astroturf Hockey field during regularly scheduled practice session. Subjects instructed to wear complete specified kit in order to perform successful drag flick requirement of the study. The target 1"×1" square fixed at upper left corner of the goal post. 06 successful drag flicks toward target of each drag flicker were selected for the analysis.

2.3 Variables: Kinematic / temporal variables, determined from the digitized 3D data, were used to describe five (04) key positions (a) approach(From to the last left foot contact before ball pick up) (b) ball Contact (c) drag Phase (From left foot contact to ball release) and (d) follow throw (From ball release to end of recovery) during drag flick.

2.4 Model of Dreg Arm

The dreg arm was modeled as two segment kinetic chain composed of (a) upper arm segment and (b) distal segment that include the forearm, hand and hockey stick. The distal segment was assumed to be a rigid body with its longitudinal axis led along the longitudinal axis of the forearm

2.5 Videographic Equipments and Location

The subject's drag flick movements were recorded using two Canon Legria SF-10, 8.1 video cameras in a field setting, operating with a specified shutter speed and frame rate. The cameras were set-up on a rigid tripod and secured to the floor in the location. The drag-flicks recorded with two cameras, sampling at 50 Hz. Both cameras intersect to each other at 60^0 angles. First camera place right side 34 ft from the ball points at 90^0 of mediolateral axis parallel to the ground, second camera placed laterally at the distance of 31.5ft and cameras were fielded synchronized, static calibration method was used to calibrate both the cameras.

Videos of all trials were digitized using the Max Track 3D motion analysis software. Digitization was done from right foot contact with the ground to eight frames after the ball leaving the stick.

The 3D motion of the drag flicker, stick and ball were determined from digitized video analysis using **18-**point body model together. The following points were digitised; Joint centers and points describing the stick and the ball were estimated.

3. Results

The main purpose of this study was to determine kinematical differences between two best drag flickers of Aligarh Muslim University, Aligarh and find out those variables which is given positive contribution in ball speed. If a common intersegment coordinative pattern existed between drag flickers, with the hopes of being able to make drag flick look the same kinetics. T-test and regression analysis were used to find out differences and relationship between drag flickers.

The analysis of data table-1 that there is an insignificant differences exist between both drag flicker in distance of left foot from ball (DLB_1) and stick velocity (SV_1) during approach phase as obtain 't' ratio is less than the required 't' value of 2.30

The analysis of data table-2 that there is a significant differences find between drag flicker in stance width (SW_2) during ball contact phase as obtain't' ratio is greater than the required 't' value of 2.30. Whereas no significance differences were found in the distance of right foot from ball (DLB_2), stick velocity (SV_2), shoulder axis orientation (SAO_2) and hip axis orientation (HAO_2) exist between drag flicker during ball contact phase.

The analysis of data table-3 that there is no significant differences were found between both drag flicker in drag distance (DD), left knee angle (LKA), stick velocity (SV_3), shoulder axis orientation (SAO_3) and hip axis orientation (HAO_3) during drag phase as obtain't' ratio is lesser than the required 't' value of 2.30.

The analysis of data table-4 that there is no significant differences exist between both university drag flicker in ball velocity (BV), stick velocity (SV_4), shoulder axis orientation (SAO_4) and hip axis orientation (HAO_4) during drag phase as obtain't' ratio is lesser than the required 't' value of 2.30.

The analysis of data table-5 that there is a significant relationship exist ball velocity after release with stick velocity final phase in both drag flickers. Whereas insignificance relationship exit ball velocity after ball release with drag distance, shoulder axis orientation and hip axis orientation in follow through phase.

4. Discussions

The technique analysis of drag flick in field hockey had aim to find out the biomechanical variation in techniques between two best drag flicker of Aligarh Muslim University hockey players. Results of this study show that, insignificantly differences exist in plantation of left foot behind the ball and stick velocity of between hockey players during approach. Plantation of left foot behind the ball play significant role in different aspect of drag flick like: it will demand of the flicker to reach behind the ball properly, force generation, it required to adjust body properly further will then the ball will be dragged over a greater distance (Subijana et al., 2011 and 2012) and to attain peak angular velocity of the sticks.

In ball Contact Phase significant differences exist between both drag flickers in stance width. In which the flicker average stance width subsequently are Sub_1=1.42m and Sub_2= 1.77m. Player Sub_1 was fulfilled the mostly criteria of international level athlete, reported as 1.42m (McLaughlin., 1997), 1.49m, 1.55m (Lopez de Subijana *et al.*, 2010) and 1.51m (Lopez de Subijana *et al.*, 2011). Player Sub_2 had greater stance width as compare to Sub_1 and reported studies. The variation in stance width may be due to anthropometrical difference exist between the athlete (Hussain et al., 2012). this extremely wide stance width enable the drag flicker to get the low hip and provided large distance of ball could be accelerate toward the target (Yusoff et al. 2002).

In drag phase insignificant differences exist between drag flicker players in drag distance, left knee angle, stick velocity during drag, shoulder axis orientation and hip axis orientation. As left foot contact with ground the ball has been dragged with hockey stick toward the target by the total drag distance mean consequently Sub_1=2.30m and Sub_2=2.33m with greater drag distance directly associated with greater resultant ball velocity (Yusoff et al. 2002). These statements support the result of this study as both players had insignificant differences in drag distance and resultant ball velocity.

In follow-through phase insignificant differences exist between both university players in ball velocity, stick velocity, shoulder axis orientation and hip axis orientation. Ball velocity at ball release mean range between drag flickers is 18.09 – 21.39 m/s. Highest ball velocity play significant contribution in scoring of goal. When ball travelled toward the target with greater speed, the goal keeper has little time to change our body position to safe the goal (Yusoff et al. 2002).

Both drag flicker ball velocity after the ball release has significant positive correlated with stick velocity in final phase. Sub_1 and Sub_2 stick velocity in final phase has 77% and 92% subsequently contribute on ball velocity after ball release. Highest stick velocity help to generate greater momentum force and greater stick velocity both are directly associated with resultant ball velocity (Bartlet, 2007). The player Sub_1: Drag distance and shoulder axis orientation has insignificant positive relationship and hip axis orientation has insignificant negative relationship with ball velocity. Player Sub_2: Drag distance, shoulder axis orientation and hip axis orientation in follow through phase has insignificant positive relation with ball velocity. Finally, the drag flicker of Aligarh Muslim University had a greater stance, long drag, and proper leg flexed than previous study reported by (Bartlett, 2012, Nichol, 2005, and Mosquera et al, 2007) indicate approximately good technique. When comparing biomechanical variable between the players, there exist little difference in stance width in ball contact phase, recommended that little or no difference exist in techniques between both players.

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Table:01 Approach (From to the last left foot contact before ball pick up)

Variables	Subjects	Sub_1	Sub_2	t- value
DLB_1	Mean	0.17	0.40	1.01
	SD	0.02	0.54	
SV_1	Mean	0.80	0.86	0.14
	SD	0.24	0.17	

DLB_1= Distance of left foot from ball in approach (m).

SV_1= Stick velocity in approach (m/s)

Table:02 Ball Contact

Variables	Subjects	Sub_1	Sub_2	t- value
DLB_2	Mean	0.47	0.62	2.05
	SD	0.08	0.16	
SW_2	Mean	1.42	1.77	2.89*
	SD	0.08	0.29	
SV_2	Mean	1.46	1.50	0.21
	SD	0.36	0.31	
SAO_2	Mean	-5.33	-5.16	0.08
	SD	4.03	3.19	
HAO_2	Mean	-5.33	-5.17	0.64
	SD	4.03	3.19	

Tab $t_{0.05}$ (10) =2.30 *Significance at 0.05 levels.
DLB_2= Distance of right foot from ball in ball contact phase (m)
SW_2= Stance width in ball contact phase (m)
SV_2= Stick velocity in ball contact phase (m/s)
SAO_2= Shoulder axis orientation in ball contact phase
HAO_2= Hip axis orientation in ball contact phase

Table: 03 Drag Phase

Variables	Subjects	Sub_1	Sub_2	t- value
DD	Mean	2.30	2.33	0.10
	SD	0.52	0.48	
LKA	Mean	113.83	117.83	0.59
	SD	10.74	12.62	
SV_3	Mean	6.99	6.93	0.00
	SD	1.53	1.47	
SAO_3	Mean	-2.83	-6.83	1.79
	SD	2.93	4.62	
HAO_3	Mean	25.50	25.83	0.07
	SD	8.36	9.13	

DD= Drag distance
LKA= Left knee angle
SV_3= Stick velocity in drag phase
SAO_3= Shoulder axis orientation in drag phase
HAO_3= Hip axis orientation in drag phase

Table: 04 Follow- through

Variables	Subjects	Sub_1	Sub_2	t- value
BV	Mean	21.39	18.09	1.40
	SD	4.41	3.73	
SV4	Mean	18.91	15.39	1.55
	SD	3.83	4.04	
SAO4	Mean	63.83	67.67	0.67
	SD	11.44	8.16	
HAO4	Mean	51.50	51.83	0.06
	SD	10.21	10.42	

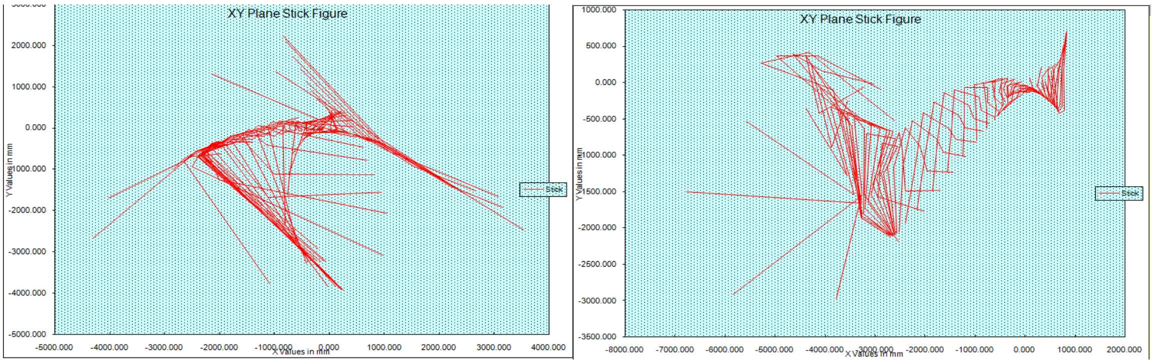
BV= Ball velocity
SV_4=Drag distance in follow-through
SAO_4= Shoulder axis orientation in follow-through
HAO_4= Hip axis orientation in follow-through

Table: 5 Regressions

Subjects	Dependent variable	Predictors	R	R Square	Adjusted R Square
Sub_1	Ball velocity after ball release	SV4	0.85*	0.77	0.65
		DD	0.45	0.21	0.01
		SAO4	0.00	0.00	-0.25
		HAO4	-0.16	0.02	-0.22
Sub_2	Ball velocity after ball release	SV4	0.96*	0.92	0.90
		DD	0.30	0.09	-0.14
		SAO4	0.62	0.38	0.23
		HAO4	0.49	0.23	0.05

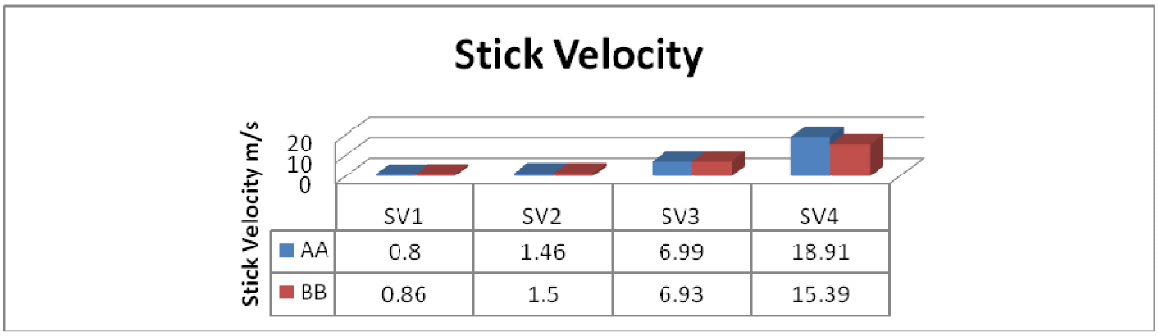
*Significance at 0.05 levels.
SV_4= Stick velocity
DD=Drag distance
SAO_4= Shoulder axis orientation in follow-through
HAO_4= Hip axis orientation in follow-through

Figure 01- Drag flick Phase from ground contact to ball release.



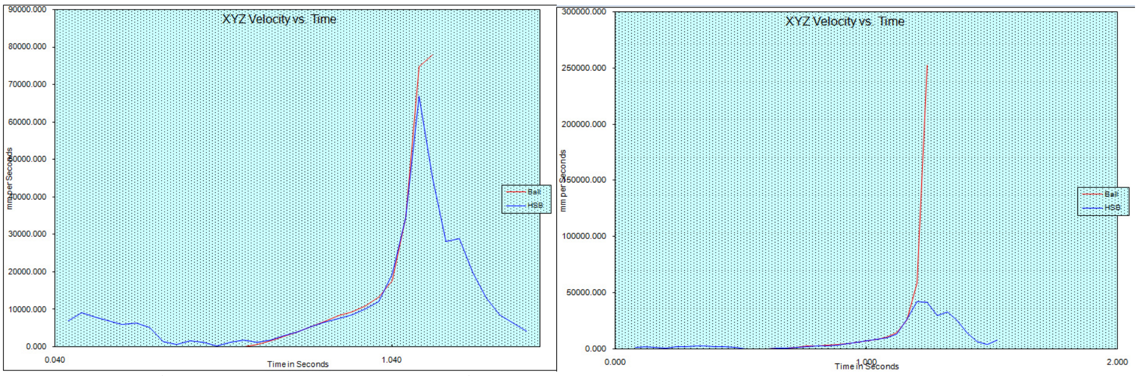
Subject: Sub_1 Subject: Sub_2

Figure 02- Stick figure whole drag phase:



	SV1	SV2	SV3	SV4
AA	0.8	1.46	6.99	18.91
BB	0.86	1.5	6.93	15.39

Graph 01: Stick velocity m/s Phase by phase



Sub_1 Sub_2

Graph 02 : (Hockey and Ball) velocity v/s time graph