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Biomechanical Analysis of Penalty Corner Push-In

Physical Education

KEYWORDS : Biomechanics, Max traq, Penalty corner, Push-in

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ABSTRACT

The aim of this study was to analyse the selected biomechanical factors in penalty corner push- in. Men (n=24) Hockey players represented university were purposively selected from Tamil Nadu state, India for this study, the age of the subjects ranged from 18 to 28 years. The subjects had past playing experience of at least four years in hockey. Written informed consent was obtained from players. The ethical clearance for this project was obtained from the Human Research Ethics Committee of the Bharathidasan University. The high definition camera (Casio EX 10) was used to record the performances that were approximately transverse to the trajectory of the ball of the push in; camera operating at shutter speed of 1/8000, with a frame rate of 240 frames per second was used. Video footage was digitized using Max traq software for data analysis of stance width, relative stance width, ball to front foot distance, stick angle, drag distance, drag acceleration, stick velocity and ball speed. The collected data was statistically analysed by using descriptive statistics and pearson's correlation coefficients. The finding reveals that the stance width has significant relationship with ball speed. Among the selected variables stance width and drag distance having highest relationship.

INTRODUCTION

In modern hockey, there is increased in the number of set plays performed during the game (Patrick 1997). The penalty corner is one of the most important tactical situations in field hockey (Laird and Sutherland, 2003; Pineiro, 2008). The Penalty Corner was introduced in 1908. Penalty corner is awarded for foul committed by the defending team in its own entire 23 meters area. Depending upon the nature of foul penalty corner is awarded, with penalty corner one has greater scoring opportunities, because at time of start of penalty corner only five defenders will be permitted within the circle but all the attackers are permitted. The champions of today are seen perfect in the conversion of penalty corners. It is seen that different variations in penalty corner are being adopted and executed successfully. This requires lot of understanding among the specialized players. (Viswanath and Kalidasan 2012).

According to Bhangu (1997) stated that highest 35 percentage of the goal were scored through the Penalty corner by the Netherland team in Atlanta Olympics, which was the highest by a nation. In 1994 world cup the Australian team scored only 4 goals from 28 opportunities when compared to Dutch they have higher conversion of 7 goals form 17 opportunity (Patrick 1997). Penalty corner execution can be separated into three progressive phases: the push -in, the trap and the strike. Kerr and Kevin (2002) opined that all over the entire penalty corner takes about 1.9 seconds and 2.3 seconds respectively for male and female players of national standards of Australia. It is essential that it is performed precisely as it offers an excellent scoring opportunity during the game.

Biomechanics is the study of the mechanics of living things. It demands knowledge of both biology and various branches of physics and engineering which comprises of mechanics. Biomechanics is a sciences that examined the internal and external forces acting on a human body and the effects produced by these forces. The push starts with an attacker standing close to the goal line with at least one foot outside the field of play. The left shoulder points in the direction of the push. The hook of the stick rest against the ball. The push-in movements involves a rapid rotation of the hip, shoulders and arms in the direction of the trapper while the body weight is being transferred from the back foot to the front foot. The ball is dragged or pushed over the playing surface by the Hockey stick for some distance and then released in the direction of the trapper. In the artificial surface dragging action is used frequently. The trap phase follows when the ball reaches top of the circles and is trapped by another attacking player just outside the circle the trapper propels the ball back into the circles for the phase three to commence, the phase three consists of a third attacker striking the moving ball towards the goal or another attacking player. Some researchers have focused on penalty corner push-in techniques in field hockey (Kerr and Ness, 2006 and Viswanath and Kalidasan 2012). Push-in part in penalty corner plays critical role in conversion of penalty corner. If push-in is with great speed, the striker has extra time before defender reach the penalty circle. However there is a paucity of research on the kinematics of the penalty corner push-in execution, for this purpose successful execution of the push-in is defined as pushing the ball accurately with in the 0.60 meters line in front of the first post and the unsuccessful execution is defined as ball which deviate beyond the 0.60 meters and limited to 2 meters is referred as a unsuccessful penalty corner push-in. The purpose of the study was to analyse the biomechanical factors in penalty corner push- in.

METHODS

Twenty four Men Hockey players those who represented university were purposively selected from Tamil Nadu state for the study. The age of the subjects ranged from 18 to 28 years. The subjects had past playing experience of at least four years in hockey. To acquire biomechanical data, with the assistance of technical person the high definition camera (Casio EX 10) was used to capture movements of push-in. The camcorder mounted at the height of one meter, placed 6 meters away perpendicular to the trajectory of the ball of the push in. The shutter speed of the camcorder was adjusted at (1/8000 of a second) in order to eliminate the blurring effects while processing the recordings and with a frame rate of 240 frames per second was used. A cage with the dimensions of 1.0x1.0m at 4 control points was used to calibrate the space, in which the push-in was performed. After a 15-minute standard warm-up session, participants perform the push-in from the right side of the field, three successful push-in was recorded that is within 0.60 m each side of the trapper were performed. The accurate trial with the greatest ball speed was deemed as the best push-in trial for each player. Players were told to push the ball as fast as they could, as if they were in actual game conditions. The stance width, relative stance width, ball to front foot distance, Stick angle, drag distance, drag acceleration, stick velocity and ball speed were taken as variable and the best push-in trial was analysed through the Max traq software.

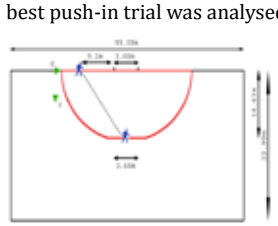

Figure 1 shows the position of the camera

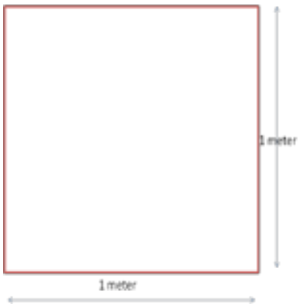

Figure 2 Calibration cage

Statistical technique

Descriptive statistics and pearson's correlation coefficients were applied to establish the relationships among the variables measured. Data were analyzed using SPSS (Statistical Package for Social Science) version 15.0. The level of significance was fixed at 0.05.

RESULTS AND DISCUSSION

The descriptive statistics for biomechanical characteristics for all players are presented in the table below

TABLE 1 DESCRIPTIVE STATISTICS OF BIOMECHANICAL CHARACTERISTICS AND PUSH-IN BALL SPEED OF UNIVERSITY HOCKEY PLAYERS

Variables	N	Minimum	Maximum	Mean	SD (±)
Stance width (mts)	24	.80	1.21	1.0192	.14563
Relative stance width (mts)	24	.47	.69	.5708	.07695
Ball to front foot (mts)	24	.90	1.50	1.2667	.14646
Stick angle(degree)	24	16.10	31.00	23.8750	4.55786
Drag distance (mts)	24	1.20	1.80	1.5667	.16330
Drag acceleration (sec)	24	11.80	19.60	14.8408	2.42989
Stick velocity (sec)	24	3.90	5.50	4.8667	.45365
Ball speed (m/s)	24	14.99	17.88	16.0683	.94836

The table 1 explains the mean and standard deviation of biomechanical characteristics and push-in ball speed of university hockey players.

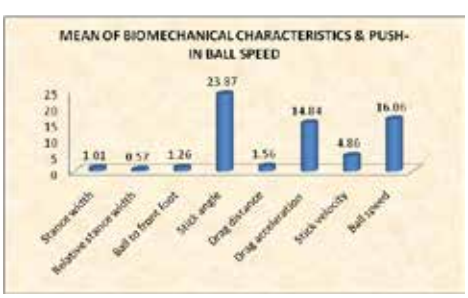

FIGURE: I MEAN VALUES OF BIOMECHANICAL CHARACTERISTICS ON UNIVERSITY HOCKEY PLAYERS

TABLE II INTER-RELATIONSHIP OF SELECTED BIOMECHANICAL VARIABLES AND PUSH-IN BALL SPEED IN MALE HOCKEY PLAYERS

VARIABLES	SW	RSW	BFFD	SA	DS	DA	SV	BS
SW	1	.352	.447*	-.486*	.701**	.009	.331	.653**
RSW		1	.612**	-.353	.300	.275	.300	-.177
BFFD			1	-.393	.679**	.121	.349	.085
SA				1	-.358	.036	-.168	-.230
DS					1	.279	.383	.397
DA						1	.511*	-.277
SV							1	.095
BS								1

***Significant at 0.05 level ** significant at the 0.01 level**

SW. – Stance width, RSW.-Relative stance width, BFFD – Ball to front foot distance, SA – Stick angle, DS – Drag distance, DA – Drag acceleration, SV- Stick velocity, B.S- Ball Speed.

It was evident from the above table –II relationship exists among the Hockey players, the result of the study reveals that the university hockey players, the stance width has significant relationship with ball speed. Among the selected variables stance width and drag distance having high relationship followed by ball to front foot distance & drag distance, relative stance width & ball to front foot distance, drag acceleration & stick velocity.

Ball speed, stance width and drag distance in penalty corner push-in play an important role in the success of the penalty corner execution. During the push-in, the body should be moved in a well developed kinematic chain in order to generate the necessary power. Even small changes in the ball speed and drag time can cause the ball to deviate beyond the accurate area. A wrong technique may also play an important role in increasing the risk factors for the injury. The results of the statistical analyses showed stance width has significant relationship with push-in ball speed. The findings were found to be consistent with the previous results of a study conducted by Kerr and Kevin (2002) in which significant contribution was found for the ball speed and stance width in execution of penalty corner push-in. Compared with previous research the push-in ball speed were faster than the push and slower than the drag flick. (McLaughlin 1997). Thus, when stance width increases, the distance between the ball and front heel should be maximized resulting in increased drag distance. This, in turn, increases in push-in ball speed.

CONCLUSIONS

From the present study it is concluded that, the stance width has significant relationship with ball speed. Among the selected variables stance width and drag distance having highest relationship.

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