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Biomechanical analysis on drag flick at hockey indoor game

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Abstract

This research aims to identify the factors that influence ball speed in drag flicks in hockey. Samples were taken from amateur and professional male hockey players according to predetermined biomechanical variables. Using a type of quantitative research that focuses on observing the body mechanics of athletes from the hockey student activity unit at the Indonesian University of Education and senior athletes who have played at national and international levels. Divided into 2 group categories professional by senior athletes who have appeared in national and international events, and amateur groups by UKM HOKI UPI athletes. Each individual was allowed to carry out the movement 3 repetitions to achieve the best results, which were recorded and then analyzed via Kinovea - 0.9.5 software for each movement, then the average results for each movement phase were entered into SPSS 26 for sample testing. t test which is then compared between the influential variables obtained to find out the significant differences that exist between the processes and results of the professional and amateur groups. The results of this study show that factors that show differences in several phases that influence the results of professional teams are superior to amateur teams. Among them are total approach distance (TDA), length of pull (DL), angle of movement of the left leg knee during drag (LKA), width between two legs (SW), and stick speed (SV). The five selected independent variables show a significant correlated influence on the final speed of the ball when launched. In conclusion, this research highlights the importance of adjusting drag flick performance factors according to biomechanical variables to improve overall performance based on the results that have been analyzed in professional groups.

Keywords: Penalty Corner, Drag Flick, Biomechanical, Velocity, Hockey Indoor.

INTRODUCTION

During the 2023 Indoor Hockey World Cup in South Africa, 324 goals were recorded, and 95 occurred through corner penalties (International Hockey Federation, 2023). In the previous edition, namely the Hockey Indoor World Cup Berlin 2018, it was recorded that more goals were scored through corner penalties, 105 out of a total of 306 goals during the tournament (International Hockey Federation, 2018). This shows the big role corner penalties play in the percentage of goals scored in the 2 editions. finally, the FIH Hockey Indoor World Cup, which was 32%. In exploiting corner penalty opportunities, the drag flick technique is the most popular for use by players at all levels from amateurs to professionals (Vasiljev et al., 2021), especially in indoor hockey games, the technique that can be used is not as much as in outdoor hockey games, because That's why the drag flick is a perfect technique to use when shooting corner penalty opportunities, which is more effective than other techniques that can be used when ending a corner penalty position (Prawesti et al., 2022). The indicator that a team is successful in executing a corner kick is influenced by several things. These include precision inward pushing, reinforcement of the ball outside the circle by the stopper, analysis of the opponent's defense patterns, as well as timing and precision of execution (Palaniappan & Sundar, 2018), to get effective results with

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an efficient process in exploiting corner penalty opportunities, the drag flick is a perfect technique to carry out, for an athlete opportunities on the field can be predicted in advance or suddenly (Oktavia et al., 2023) of course by following the biomechanical pattern of throwing and hitting skills in a drag flick which aims to maximize the function of the distal segment, and when allowed so that the opportunity that has been obtained can be converted into a goal. In addition, this study also suggests that in the future investigate the kinematics and kinetics of the lower extremities and lumbar spine to provide information on factors related to potential injury during the drag flick movement (Ng et al., 2018).

If done correctly, the drag flick can produce more goals, because technically it is a hybrid stroke with the more common components of the flick and scoop stroke, making this technique impressive and creating a very large percentage of goals, so it is very effective if it can be done with the correct mechanical pattern. can maximize opportunities through drag flick. There is very little research on the biomechanical analysis of this movement in indoor hockey, even though one of the keys to victory for a team in an indoor hockey game is to maximize existing penalty corner opportunities as well as possible. In previous research, the results showed that, overall the movement at the level of correctness of the drag flick movement technique in PON regional training athletes was categorized as poor ((Rahayu & Daulay, 2021) but in this study it was not explained what variables were a deficiency that affected the final results. ball speed. Most previous studies only focused on analyzing drag flick kinematics but few have examined its kinetic profile (Aziz & Lee, 2018) drag flick contains four main phases, namely approach, contact, dragging, and follow-up (Bulgan & Aydin, 2019) thus indirectly showing the audience the beauty of art in the game of hockey. Penalty Corner in the game of hockey is a complex skill (Ansari et al., 2014), the drag flick technique is described as a series of coordinated body and muscle actions to achieve maximum head speed the stick creates an amazing acceleration when the ball is released. Axial rotation of the stick and lateral rotation towards the target, flexion of the right wrist, and extension of the left wrist are the main contributors to the final point speed of the stick (Ibrahim et al., 2017). As a good dragflicker, you certainly need certain strength, flexibility, and balance to support the moment. perform drag flick (VERMA, 2014). The ability to launch the ball with strength and accuracy also depends on the explosive power of the muscles of the body (Anggoro, 2023).

In this study, kinematic measurements were recorded from the initial phase to the advanced phase. Players use and rely on kinematic and non-kinematic resources when they engage in planning and carrying out actions (Loffing & Cañal-bruland, 2017). Biomechanical analysis is very important to be carried out to find out the key factors in the player's movements when performing the drag flick technique, biomechanical research is also to modify and improve previous drag flicks (Antonov, 2021). Understanding the biomechanics of the drag flick is useful in creating guidelines to assist coaches in monitoring processes aimed at improving performance in this particular technique (Augustus et al., 2017) (Ladru et al., 2019) The approach distance is measured manually; Pull length, pull time, pull speed, position width and ball speed are calculated and recorded via a Panasonic 4K Ultra HD Camcorder HC-VX 870 camera and using KINOVEA – 0.9.5 software to provide motion kinematic patterns that help increase speed and accuracy drag flick in indoor hockey games because this technique is an effective technique for scoring goals during a match. To characterize the main motor moments of the "body stick" system, and know the existence of different forces (Antonov, 2021) so that you can modify the technique as needed to maximize movement.

METHOD

This research uses quantitative methods. A cross-sectional study approach, namely a correlation approach aims to find out the relationship and degree of relationship between two or more variables without any attempt to influence these variables so that variable manipulation does not occur. It was carried out during a break in preparations for the National Sports Week carried out by the West Java team, located at the indoor hockey field at the Indonesian Education University Gymnasium.

Participant

15 active students from the Indonesian University of Education who are active and are members of the UPI Hockey Student Activity Unit and alumni who have had careers at the level of the Indonesian national indoor hockey team. The subjects consisted of 8 active students who had played at the National level (Kejurnas) and 6 people at the Regional level (Kejurda) as well as athletes who played at the International level (Sea and Asian Games).

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Research Procedure

Drag flick videos of the subjects were taken on the indoor hockey field at the Indonesian Education University Gymnasium with international standards with a width of 18 – 22 m and 36 – 44 m (Rahman, 2017) and sufficient lighting. Using 2 Panasonic 4K Ultra HD Camcorder HC-VX 870 cameras, each positioned in the sagittal plane using sport mode.

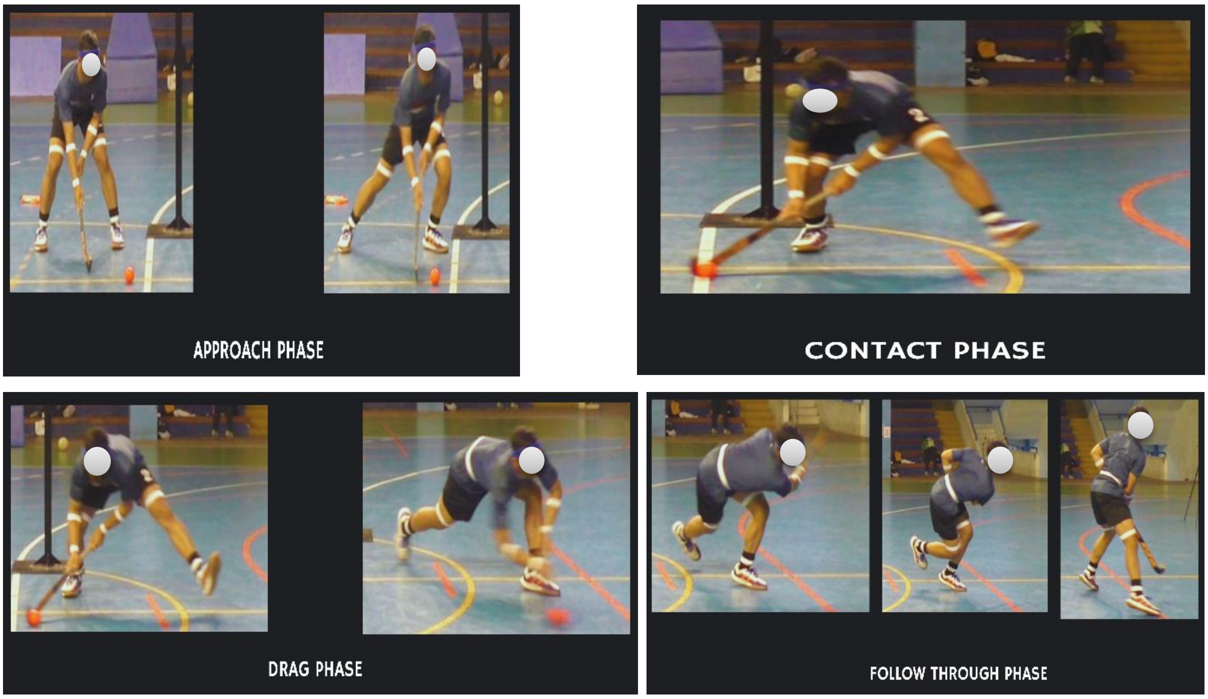

Figure 1. Phases of each drag flick movement

Kinematics criteria are measured in all movement phases, approach phase (starting position), stick contact phase, drag phase, and continuation phase. Time of Approach (TOA) and total Distance Approach (TDA) are analyzed in the approach phase (starting position), Time of Stick Contact With Ball (TSCB), Time of Left Foot with Ground (TLFCG) including the stick contact phase variable, Drag Length (DL), Drag Time (DT), Drag Velocity (DV), Left Knee Angle (LKA), Stance Width (SW) are analyzed in the main phase, namely drag, Stick Velocity (SV), Distance of Left Foot from Ball (DLFB), Time of Ball Release (TBR), Total Time of Drag Flick (TTDF) are analyzed in the final phase of follow through (continued) (Palaniappan & Sundar, 2018). The time for making contact with the ball starts from the initial position (TOA), the distance between the initial position and the position when contacting the ball (TDA). Duration of stick contact with the ball (TSCB), duration of left foot contact with the surface during the drag phase (TLFCG). Distance of the ball during drag (DL), total time during drag (DT), length of drag divided by total time of drag (DV), knee movement angle during drag (LKA), and distance between two legs (SW). Total distance traveled divided by total stick travel time (SV), distance between the left foot and the point of release of the ball during the final drag phase (DLFB), duration between left foot contact with the surface and release of the ball from the stick (TBR), duration of stick contact time with the ball until the ball is released from the stick until the follow through phase (TTDF).

Statistic Analysis

Then the results of the subjects' drag flick tests, which had been documented according to the standards we tested, were analyzed using the biomechanical software KINOVEA – 0.9.5. After obtaining the values for each phase that had been investigated, the data was processed using IBM SPSS STATISTICS 26 software.

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RESULTS AND DISCUSSION

Results

This research was carried out by collecting data via video on indoor hockey drag flick technique skills. Next, the results of data collection were analyzed using a statistical approach, namely through IBM SPSS v.26 software. The results analyzed are data obtained from samples who are UPI student activity unit hockey players and Indonesian national indoor hockey players.

1. Anthropometric

Before data collection, the samples were individually measured first. The results can be seen in Table 1 below:

Table 1. Anthropometers

No	Item	Mean	Stdv
1	Age (years)	22.32	2.67
2	Body Height (cm)	168.80	2.40
3	Weight (kg)	62.10	2.26
4	BMI (kg/(m)^2)	22.02	1.45
5	V02max (ml/kg /min)	52.65	3.32

In the table above, you can see that 5 items make up the subtest. With the results of an average age of 22.32 (years), then height 168.80 (cm), weight 62.10 (kg), BMI (body mass index) 22.02 (kg(m)2), Vo2 Max 52.65 (ml/kg/min), it is very important to meet aerobic capacity standards because indoor hockey requires maximum Vo2 from players due to involvement in games with a large amount of high intensity (Article et al., 2016). It seems logical that Vo2 Max is correlated because players with higher aerobic capacity will be able to perform next at a level closer to their maximum effort (Bishop et al., 2015) thus players who have a good level of aerobic capacity, here seen through Vo2 Max gains have better ability in doing drag flicks in indoor hockey games because the ability is done in the game repeatedly. There is a relationship between greater arm muscle power which influences shooting accuracy and the more accurate drag flick technique (Septianingrum et al., 2018) as well as grip power and shooting accuracy which influence each other.

2. Approach and Contact Phase

A description of the data from the recapitulation results during the approach phase to the contact phase is presented in the form of Table 2 as follows:

Table. 2 Approach – Contact Phase

No	Variable	Professional		Amateur		*t-score*	*sig*
	Drag Flick Approach	Mean	Stdv	Mean	Stdv		
1	Time Of Approach (Sec)	1.13	0.28	1.24	0.45	-2.255	0.09
2	Total Distance Approach	54.04	2.45	38.88	3.48	3.044	0.007*
3	Time Of Stick Contact With Ball (Sec)	0,71	0,07	0,53	0,26	1.108	.519
4	Time Of Left Foot Contact With Ground (Sec)	0,41	0,22	0,39	0,12	-2.230	.074

The total approach distance influences the coefficient of the final drag result because one of the determinants of the success of the drag flick is the starting position of the drag flick. In the average value of the professional group, it was found that the score was 54.04 (cm) higher than 38.88 (cm) in the amateur group. This result shows a significant average value between the 2 groups which influences the final speed of the ball when launched from the stick in the final phase of the drag flick.

3. Drag Flick and Follow Trough Phase

Data descriptions of the accuracy of each drag flick step and advanced phases are presented in the form of Table 1.3 as follows:

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Table 3. Drag – Follow Through Phase

No	Variable	Professional		Amateur		*t-score*	*sig*
	Drag Phase	Mean	Stdv	Mean	Stdv		
5	Drag Length (Cm)	307.60	12.72	130.81	17.83	24.217	.018*
6	Drag Velocity (M/S)	3.60	0.45	2.14	0.75	6.408	.869
7	Left Knee Angle (Degree)	45.47	1.96	49.14	2.72	-1.705	.001*
8	Stance Width (Cm)	135.77	4.48	86.78	5.29	21.200	.646
9	Stick Velocity (m/s)	18.18	2.30	12.21	21.11	.843	.002*
10	Time Of Ball Release (Sec)	0.36	0.00	0.67	0.34	-1.567	.027
11	Total Time Of Drag Flick (Sec)	1.99	0.24	1.90	0.29	1.226	.802

Discussion

If the drag coefficient increases with a low drag time, the drag coefficient will also increase to produce a higher ball speed. The drag length has a relationship with ball speed which here in the professional group has an average of 307.60, far above the amateur group which only has an average of 130.81. So the drag velocity which is also influenced by the length of the drag flick of the professional group with members of the Indonesian and West Java indoor hockey national teams produces 3.60 m/s compared to amateurs who only get 2.14 m/s. The width of contact of the left foot with the ground (mean 1.37m, SD+ 0.08m) was higher than 1.42m, 1.49m, 1.51m, 1.42m, and 1.5 m to 1.81m (De Subijana et al., 2012) The width of the stance has a high correlation with the speed of the ball. The player's stance depends on the player's anthropometry, drag technique, and physical characteristics. In general, the athlete's foot position and posture change between each shooting activity (Dinu et al., 2016). The wider the stance that can be produced by the step (Stance Width), the professional group has a very large average stance width (width between two feet) (135.77) when compared to the amateur group which has an average of (86.78) so this affects the speed of the ball when it releases from the stick. The professional group has an average final ball release (0.36) that is faster than the amateur group which has an average of (0.67).

Lowering most body positions and concentrating low mass points will contribute to better drag flick performance, and balance control in an upright position will have a direct impact on the shooting performance of various competitive activities (Dinu et al., 2016). The highest stick velocity helps generate greater momentum and velocity forces and both are directly related to the speed of the flick drag ball (Bartlett, 2007). This is seen in the significant left knee angle results between professionals and amateurs, thus contributing to the player's ability to maximize the final speed of the ball with a lower knee angle close to the surface.

CONCLUSION

This study highlights the importance of adjusting drag flick performance factors based on biomechanical variables to improve overall performance. It found a significant influence on the final speed of the ball when drag flick. Based on the analysis of data between professional and amateur groups in the approach to contact phase in the total approach distance (TDA) variable that affects the coefficient of final drag results, there is a significant difference of 54.04 (cm) by the professional group higher than the amateur group which is only 38.88 (cm). Then in the pull phase and follow-up movement (drag – follow through a phase) some significant differences in influence result in higher ball speed, The drag length (DL) of the professional group has an average of 307.60 (cm) while the amateur group is only at an average score of 130.81 (cm) so that it affects the drag speed of the professional group which produces a score of 3.60 m / s, While amateurs only at a score of 2.14 m/s. Furthermore, what makes a significant difference between the professional and amateur groups is the angle of friction of the left knee during drag (LKA) because the position of the body and concentration of the low mass point affect the speed of the stick (stick velocity). After all, the professional group has the ability with a lower knee angle close to the surface. Finally, the results of the analysis showed a significant difference, namely the width between two feet (SW) when dragging the professional group had an average of 135.77 (cm) while the

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amateur group at an average of 86.78 (cm) which affected the final ball release time of the professional group 0.36 (sec) which was faster than the amateur group 0.67 (Sec).

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