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Angular Kinematical Analysis of Rotational Technique during Discus Release Phase in National-Level Discus Throwers

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ABSTRACT

Purpose: The purpose of the study was to determine the relationship of various joint angles with the performance of the rotational technique during discus release phase in Indian national-level male discus throwers. **Methodology:** For the present study, the sample consisted of eight Indian male national-level discus throwers. The age ranged of the subjects ranged between 27 to 32 years. Subjects were selected from the national interstate senior athletics championship-2023, Bhubaneswar (India). The angle of the various body joints measured by Kinovea 0.9.5 motion analysis software in degree and performance evaluated through officials. For analysis of data correlation (Pearson Correlation) test was used. The level of significance was set at 0.05 levels. **Result:** by the help of study it is conclude that there is significant difference was found in left knee angle obtained value of (-.765*) is greater than tabulated value of (.707), right shoulder angle obtained value of (.715*) is greater than tabulated value of (.707) and left elbow angle obtained value of (-.827*) is grater then tabulated value of (.707) therefore it shows significant relationship of this independent variable with the performance of rotational technique during discus release in discus throw.

Keywords: Angular kinematic, discus release, rotational technique

Introduction

During discus release, angular kinematics involves the athlete spinning to build angular momentum, characterized by angular velocity and moment of inertia. The athlete generates torque through their muscles to increase angular velocity, and by manipulating their body position, they optimize the moment of inertia for effective spin control. At the point of release, the angular velocity is converted into the discus's linear velocity, with the goal of achieving the optimal release angle and speed for maximum distance. Throughout the motion, the conservation of angular momentum is key, allowing the athlete to adjust their spin rate by changing their body posture. Before releasing the discus, the athlete spins around one or more times to build angular momentum. This spinning motion is characterized by angular velocity, which is the rate at which the athlete and the discus rotate. The final part of the motion is the release of the discus. The athlete must release the discus at an optimal angle and speed to maximize the distance it travels. The angular velocity at the moment of release is converted into the linear velocity of the discus, contributing to its flight distance.

Objective of the study

The purpose of the study was to determine the relationship of various joints angles with the rotational technique performance of discus throw during the discus release phase.

Methodology

Selection of the Subject

The present study's sample consisted of eight Indian male national-level discus throwers. The age range of the subjects ranged Between 27 to 32 years. Subjects were selected from the 62nd national interstate senior athletics championship-2023, Bhubaneswar (India). The study was

confined to right-handed discus throwers only, with rotational technique during the discus release phase in the discus throw.

Procedure of Data Collection

The video graphic technique was used for collecting data. The video graphs would taken by a professional photographer under the supervision of an expert. According to the availability of two Panasonic Lumix S5 high-speed cameras were used, which have frequencies from 60 to 300 frames per second (f/s). The data were recorded from the sagittal plane and frontal plane.

Statistical Technique

The statistical analyses of data pertaining to the study were collected on top eight (8) male Indian national-level discus throwers. For the analysis of data the correlation (Pearson correlation) test was used. The level of significance to check the relationship obtained by correlation (Pearson correlation) was set .05 level. All statistical functions were performed with the SPSS (version 24) software.

Finding and Results

The result was made on the basis of the findings of the present study. The researcher reached the result of this empirical investigation which is presented by the respective Table-1, Table-2, Graph-1 and Graph-2

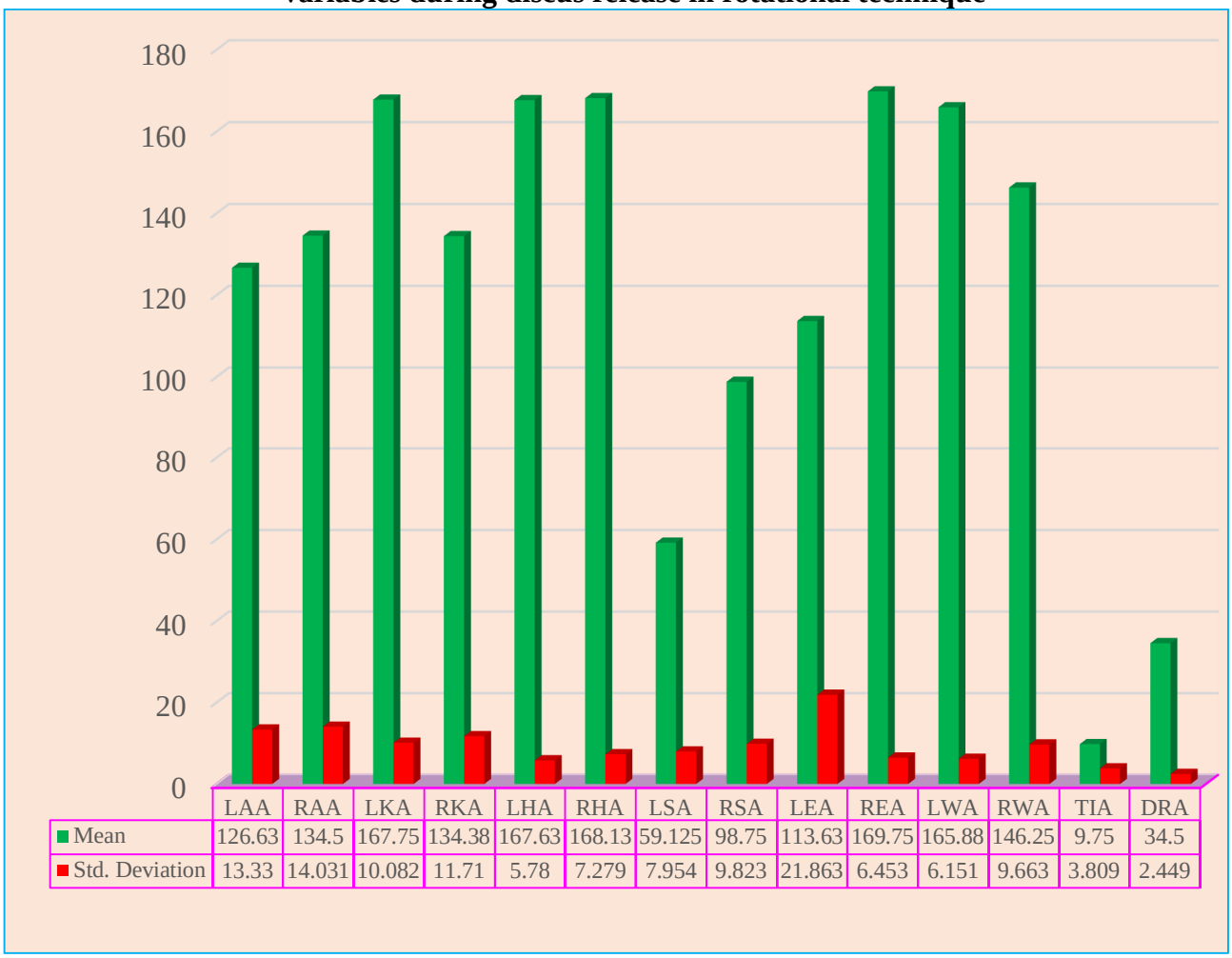
Table 1: Descriptive statistics of discus throwers in relation to angular kinematical variables during discus release in rotational technique

Variable	Mean	Std. Error	Std. Deviation	Variance	Skewness	Kurtosis	Min.	Max.
LAA	126.625	4.71297	13.330	177.696	.284	-1.131	111.00	148.00
RAA	134.500	4.96056	14.031	196.857	-1.068	1.108	107.00	151.00
LKA	167.750	3.56446	10.082	101.643	-1.006	-.587	151.00	177.00
RKA	134.375	4.14012	11.710	137.125	1.215	1.445	123.00	158.00
LHA	167.625	2.04361	5.780	33.411	.186	1.383	158.00	178.00
RHA	168.125	2.57347	7.279	52.982	-.673	-.877	156.00	176.00
LSA	59.125	2.81220	7.954	63.268	-1.016	-.370	45.00	67.00
RSA	98.750	3.47311	9.823	96.500	-.171	-.874	85.00	112.00
LEA	113.625	7.72967	21.863	477.982	.611	-1.521	92.00	146.00
REA	169.750	2.28153	6.453	41.643	-.306	-.764	160.00	179.00
LWA	165.875	2.17484	6.151	37.839	-.877	-.198	155.00	173.00
RWA	146.250	3.40562	9.633	92.786	.106	-.757	132.00	161.00
TIA	9.750	1.34629	3.809	14.500	-.365	-.820	4.00	15.00
DRA	34.500	.86603	2.450	6.000	.000	-1.200	31.00	38.00

Where, LAA- Left Ankle Angle, RAA- Right Ankle Angle, LKA- Left Knee Angle, RKA- Right Knee Angle, LHA- Left Hip Angle, RHA- Right Hip Angle, LSA- Left Shoulder Angle, RSA- Right Shoulder Angle, LEA- Left Elbow Angle, REA- Right Elbow Angle, LWA- Left Wrist Angle, RWA- Right Wrist Angle, LWA- Left Wrist Angle, TIA- Trunk Inclination Angle, DRA- Discus Release Angle.

It is evident from Table: 1 that the mean and standard deviation scores of angular kinematics variable in degree during Discus Release Of Rotational Technique In Discus Throw have been found as follows: Left Ankle Angle Mean 126.625 (Std. 13.330), Right Ankle Angle Mean 134.500 (Std. 14.030), Left Knee Angle Mean 167.750 (Std. 10.082), Right Knee Angle Mean 134.375 (Std. 11.710), Left Hip Angle Mean 167.625 (Std. 5.780), Right Hip Angle Mean 168.125 (Std 7.279), Left Shoulder Angle Mean 59.125 (Std. 7.954), Right Shoulder Angle Mean 98.750 (Std. 9.823), Left Elbow Angle Mean 113.625 (Std. 21.863), Right Elbow Angle Mean 169.750 (Std. 6.453), Left Wrist Angle Mean 165.875 (Std. 6.151), Right Wrist Angle Mean 146.250 (Std. 9.633), Trunk Inclination Angle Mean 9.75 (Std. 3.809), Discus Release Angle Mean 34.500 (Std. 2.450) respectively.

Graph: 1 Graphical representation of discus throwers in relation to angular kinematical variables during discus release in rotational technique



	LAA	RAA	LKA	RKA	LHA	RHA	LSA	RSA	LEA	REA	LWA	RWA	TIA	DRA
Mean	126.63	134.5	167.75	134.38	167.63	168.13	59.125	98.75	113.63	169.75	165.88	146.25	9.75	34.5
Std. Deviation	13.33	14.031	10.082	11.71	5.78	7.279	7.954	9.823	21.863	6.453	6.151	9.663	3.809	2.449

Table: 2 Relationship of angular kinematical variables with the performance during discus release of rotational technique in discus throw

VARIABLE	PEARON CORRELATION														
	PERFORMANCE	LAA	RAA	LKA	RKA	LHA	RHA	LSA	RSA	LEA	REA	LWA	RWA	TIA	DRA
PERFORMANCE	1														
LAA	.123	1													
RAA	-.410	-.080	1												
LKA	**-.765***	-.317	.582	1											
RKA	-.587	-.552	-.027	.372	1										
LHA	.396	-.221	-.466	.040	.004	1									
RHA	.19E7	.031	-.475	.024	-.170	.578	1								
LSA	-.510	-.789*	.111	.533	.657	-.055	-.153	1							
RSA	**.715***	-.050	-.108	-.508	-.558	.277	.126	-.513	1						
LEA	**-.827***	-.111	.216	.413	.718*	-.383	-.478	.359	-.520	1					
REA	.503	.484	-.267	-.445	-.717*	-.079	.487	-.420	.161	-.761*	1				
LWA	.141	-.173	.257	.361	.046	.673	.259	-.184	.271	-.174	-.325	1			
RWA	.233	-.885**	-.043	.126	.394	.533	.026	.535	.245	-.152	-.424	.451	1		
TIA	.536	.820*	-.267	-.400	-.699	.268	.352	-.810*	.197	-.580	.648	.157	-.508	1	
DRA	-.081	.195	.058	-.052	-.137	-.459	.349	.018	-.315	-.268	.696	-.422	-.387	.123	1

**** Correlation is significant at the 0.01 level (2-tailed).**

*** Correlation is significant at the 0.05 level (2-tailed).**

Where, LAA- Left Ankle Angle, RAA- Right Ankle Angle, LKA- Left Knee Angle, RKA- Right Knee Angle, LHA- Left Hip Angle, RHA- Right Hip Angle, LSA- Left Shoulder Angle, RSA- Right Shoulder Angle, LEA- Left Elbow Angle, REA- Right Elbow Angle, LWA- Left Wrist Angle, RWA- Right Wrist Angle, LWA- Left Wrist Angle, TIA- Trunk Inclination Angle, DRA- Discus Release Angle.

Table-2 reveals that in case of left knee angle obtained value of (-.765*) is greater than tabulated value of (.707), right shoulder angle obtained value of (.715*) is greater than tabulated value of (.707) and left elbow angle obtained value of (-.827*) is grater then tabulated value of (.707) therefore it shows significant relationship of this independent variable with the performance of during discus release in rotational technique in discus throw.

Whereas, in case of left ankle angle, right ankle angle, right knee angle, left hip angle, right hip angle, left shoulder angle, right elbow angle, left wrist angle, right wrist angle, trunk inclination angle and discus release angle obtained values (.123), (-.410), (-.587), (.396), (.197), (-.510), (.503), (.141), (.233), (.536) and (-.081) are lower than tabulated value of (.707) therefore it

shows insignificant relationship of these independent variables with performance of rotational technique in Discus Throw.

Since the significant relationship was found between angle of left ankle and angle of left shoulder among independent variables as calculated "r" (-789*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

Since the highly significant relationship was found between angle of left ankle and angle of right wrist among independent variables as calculated "r" (-.885**) is found greater than the required tabulated value of (.834) at 0.01 level of significance.

Since the significant relationship was found between angle of left ankle and angle of trank inclination among independent variables as calculated "r" (.820*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

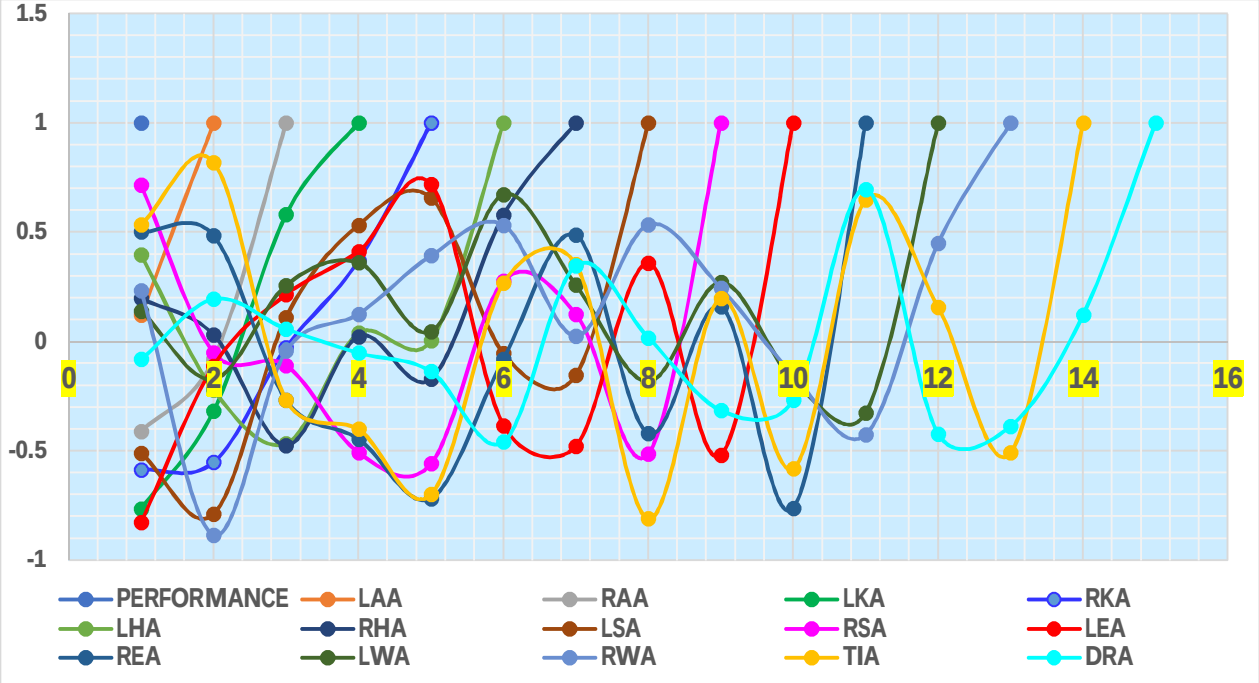
Since the significant relationship was found between angle of right knee and angle of left elbow among independent variables as calculated "r" (.718*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

Since the significant relationship was found between angle of right knee and angle of right elbow among independent variables as calculated "r" (-717*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

Similarly, the significant relationship was found between angle of left shoulder and angle of trunk inclination among independent variables as calculated "r" (-.810*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

Finally, the significant relationship was found between angle of left elbow and angle of right elbow among independent variables as calculated "r" (-.761*) is found greater than the required tabulated value of (.707) at 0.05 level of significance.

Graph:2 Graphical representation relationship of angular kinematical variables with the performance during discus release of rotational technique in discus throw



Discussion of the Study

As per the objective of the study was to determine the relationship of various joint angles with the performance of rotational technique during discus release phase in discus throw. Through this study, we found that there was significant difference found between left knee angle, right shoulder angle and left elbow angle during discus release phase of rotational technique performance in discus throwers. The angle of left knee during discus release significantly impacts throwing performance by stabilizing the body, facilitating force transfer, and controlling rotational speed. The right shoulder angle during disc release significantly impacts throwing performance by facilitating force transfer, extending the leverage arm, and influencing controlled disc release. The important role of left elbow extension in maximizing leverage, power, and accuracy in throws. During the release phase, extending the left elbow allows the thrower to maximize the leverage and power generated by the throwing arm.

Conclusion

In conclusion, the study highlights the importance of specific joint angles—left knee, right shoulder, and left elbow—during the release phase of the rotational technique in discus throwing. These joint angles significantly influence the thrower's ability to stabilize, generate, and transfer force, ultimately impacting the overall performance in the discus throw. Additionally, significant interrelationships were found among various joint angles, including between the left ankle and left shoulder, left ankle and right wrist, left ankle and trunk inclination, right knee and left elbow, right knee and right elbow, left shoulder and trunk inclination, and left elbow and right elbow. Specific joint angles in enhancing discus throwing performance and highlight the complex interplay of these variables in the mechanics of the sport.

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