Kinematic Analysis of Overhead Throwing in Male Elite and Varsity Cup Cricketers

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Summary

Throwing is an aggressive, high-intensity upper extremity action requiring precise coordination and muscle activation. In a study, 20 elite cricketers performed 26 throws under different conditions: static and dynamic approaches, with maximal, >75%, and self-paced intensities. The results showed no significant differences in humeral angular velocities or shoulder rotational kinematics between static throws and those following a dynamic run-up. These findings suggest that lower body involvement including force generation, neuromuscular engagement, and momentum from the run-up, could play a critical role in overhead throwing, as upper limb kinematics remain similar across conditions.

Introduction

Throwing in sport is one of the most aggressive and vigorous actions performed by the upper extremity, requiring significant segmental coordination and muscle activation to execute. A timing inaccuracy, weakness, imbalance or discontinuation of the kinetic chain will elicit a poorly executed throw, while potentially elevating injury susceptibility [1] and affecting game outcome. The aim of this study is to investigate overhead throwing shoulder kinematics between two different throwing approaches in cricket.

Methods

The three-dimensional (3D) kinematic metrics were analysed using a six camera Vicon motion analysis system, capturing at 240 Hz. A custom 78-piece marker set was applied to participants (N=20). Each participant threw 26 throwing trials, 13 static and 13 dynamic (with a run-up) with the following objective breakdown: three maximal efforts (Max) to establish maximal throwing speed (MTS), five >75% MTS and five Self-Paced (SP). From the distinction of throwing phases, three critical points in the throwing cycle were identified; Maximal External Rotation (MER), point of Ball Release (BR) and Maximal Internal Rotation (MIR).

Results and Discussion

The humeral angular velocities of the throwing arm reached maximum approximately at the point of BR. There are no significant differences in humeral angular velocities between static versus dynamic approaches (Table 1). Interestingly, the same cohort demonstrated that the dynamic approach to throwing produced greater ball velocity.

Shoulder rotational kinematics were maintained across approaches, which concurred with a similar study conducted in 2022 [2]. Notably, up to 55% of the energy required for pitching in baseball is attributed to lower body force contributions [3]. Therefore, throwing should be examined as a full-body movement, highlighting not only shoulder kinematics but also the critical role of lower limb involvement in generating force and facilitating efficient energy transfer. Future research should also examine the contribution of neuromuscular activation.

Conclusions

Throwing subjects the shoulder to high angular velocities, though kinematics remained consistent across approaches. Greater ball velocities during dynamic throws suggest increased lower body and run-up contributions, reducing reliance on upper limb force.

Acknowledgments

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References

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Table 1: Shoulder angular velocities at BR between static and dynamic approaches (Expressed in deg/s).

	Static		Dynamic		
Objective	BR	SD	BR	SD	*p-value*
Maximal	5586,59	1107,53	5650.79	1387.17	$p = 0.654$
75% MTS	5065,90	1009,04	4899,61	1253,744	$p = 0.201$
Self-Paced	4384,49	853,00	4589,70	993,66	$p = 0.203$

*Significant difference is set at $p \leq 0.05$.