The Jump Throw Proximal to Distal Sequence - Contribution of the Proximal Segments to the Shoulder Kinematics

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Summary

The proximal to distal sequence in a jump throw among male handball players was examined with respect to contribution of the proximal segments to the angular velocity of the throwing shoulder. Kinematic differences between playing positions (central/backfield vs wing/pivot players) were revealed.

Introduction

Throwing is a fundamental skill in handball, with optimal force transmission from the lower extremities, through the pelvis & trunk to the upper extremity, being a vital part of efficient throwing performance. Despite the jump throw being the most common way of throwing in handball [1], unique due to the lack of floor contact for the acceleration phase, kinematic descriptions of the jump throw are scarce.

When throwing, kinematic patterns involving low proximal force production due to sub-optimal proximal mechanics in a standing throw are linked to increased shoulder stress [2]. However, the extent to which proximal segment kinematics influence shoulder motion in a jump throw remains unclear. Defining optimal proximal segment contribution during jump throws is essential for identifying sub-optimal movement patterns as a potential source of overload injuries in handball.

Methods

This cross-sectional study included 42 elite male handball players. All outfield players, over the age of 18, available for full training and competition at the time of data collection, were eligible for participation. Data collection took place at the Research Center of Rehabilitation and Movement Science, University of Iceland.

A kinematic analysis of a jump throw was performed using a 12-camera motion capture system (Qualisys, Gothenburg, Sweden). Forty reflective markers were used to define and track both thighs, pelvis, thorax, and the upper arm and forearm segments of the throwing arm.

The following variables were analyzed: 1) Relative timing of peak angular velocity for each segment with respect to the reference segment within the defined throwing motion, 2) Proportion of variance in shoulder internal rotation (IR) angular velocity explained by the proximal segment kinematics, 3) The mean magnitude of the angular velocity (°/s) and ROM of relevant segments/joints for central/backfield players vs wing/pivot players. Statistical analysis was conducted in Microsoft Excel and Jamovi.

Results and Discussion

On average, the participants followed the proximal to distal sequence during a jump throw, with one exception; the peak hip flexion (leading leg) angular velocity occurred after the peak pelvis rotation (Figure 1). Central/backfield players demonstrated greater peak angular velocity and ROM across all measured segments except for thorax rotation ROM. Peak pelvis rotation angular velocity and peak hip flexion (leading leg) ROM were found to explain 41% of the variance for peak shoulder IR angular velocity.

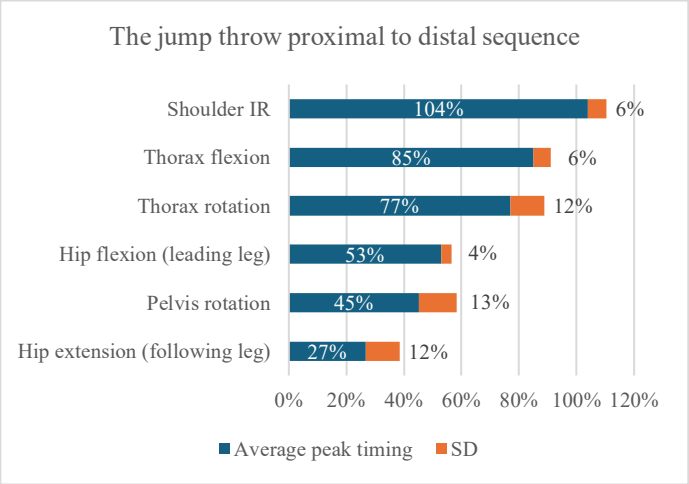

Figure 1: *The average proximal to distal sequence during a jump throw for all participants (Y-axis). The relative timing (as a percentage of the throwing motion duration) of peak angular velocity (X-axis). IR = internal rotation, SD = standard deviation.*

This is the first study to evaluate the contribution of proximal segments to the shoulder motion in a jump throw and to show the extent of the proximal segments´ contribution. The findings also indicate the throwing segmental sequence to be task specific and not always strictly proximal to distal. Different on-field demands likely cause central/backfield players to display higher angular velocity and ROM during the jump throw, compared to wing/pivot players.

Conclusions

The study highlights the importance of pelvis rotation and hip flexion motion for energy transfer to the throwing shoulder during a jump throw.

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References

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