Pinning Down Head Impact Kinematics Across Wrestling Maneuvers

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Summary

This study examined head impact kinematics in wrestling across four specific maneuvers during offense and defense. Four wrestlers provided 149 observations while wearing inertial measurement sensors. Wrestlers on defense had higher peak linear velocities, peak linear accelerations, and peak rotational velocities than their counterparts on offense. The Fireman Throw produced the highest peak linear and rotational acceleration compared to the High Gut Wrench. In our controlled setting, wrestling head kinematic outcomes were lower than those previously measured in American football and rugby. Further work is needed to examine head kinematics in live matches, accounting for offensive and defensive tactics, to better understand takedown mechanics and inform concussion prevention.

Introduction

Wrestling has one of the highest concussion rates in collegiate sports [1]. Measuring high head accelerations is key to understanding concussion risk, yet few studies have examined head impact kinematics in wrestlers [2]. This pilot study aims to assess head kinematics in controlled offensive and defensive positions across various wrestling maneuvers in varsity wrestlers to identify factors contributing to wrestling head injury risk.

Methods

Data were collected over three sessions with six varsity wrestlers (four males, two females, age range:18-23), paired by weight class. In two sessions, only one wrestler per pair wore inertial measurement units (IMUs, XSens Awinda; fs = 60 Hz), while in one session, both wore IMUs. IMUs were placed on 17 anatomical landmarks to track kinematics. This analysis focuses on four maneuvers performed by all participating wrestlers, with each wrestler completing five trials on offense and defense. Linear mixed-effects models were used to compare head kinematic variables (peak resultant linear velocity, PLV; peak resultant linear acceleration, PLA; peak resultant rotational velocity, PRV, and peak resultant rotational acceleration, PRA) across position and maneuver. Maneuver type and position were fixed effects with athlete as a random effect. Estimated marginal means and 95% confidence intervals were calculated to summarize head kinematics for each maneuver by position.

Results and Discussion

This analysis included 149 observations from four varsity wrestlers, consisting of 40 High Gut Wrench, 40 Single Trip, 38 Double to Trip, and 31 Fireman Throw maneuvers. Wrestlers on defense experienced 12-31% higher PLV, PLA, and PRV than their offensive counterparts. The Double to Trip and Fireman Throw maneuvers resulted in higher head kinematics than the High Gut Wrench (Figure 1). However, the overall magnitudes were lower than those reported in American football [3] and rugby [4]. These findings highlight the role of takedown mechanics in head impact exposure and suggest potential position-based differences that warrant further investigation for injury prevention.

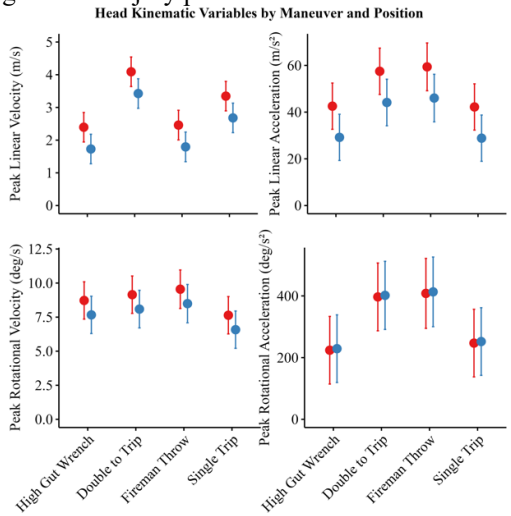

Figure 1: Wrestling head kinematic variables by maneuver and position. Offense in blue, defense in red. Error bars represent 95%CI.

Conclusions

These findings suggest head impact severity varies by maneuver and whether the wrestler executes or experiences a move. Wrestlers on defense generally endured higher head kinematics than their offensive counterparts, with takedowns like the Fireman Throw producing greater head kinematics than ground maneuvers like the High Gut Wrench. The lower head impact magnitude observed in this wresting pilot compared to American football and rugby may stem from the controlled trial setting, low IMU sampling rate, or inherent sport differences. Regardless, variations in head kinematics highlight the need to consider both takedown mechanics and wrestler position in understanding injury risk. Further research is needed to examine the biomechanical mechanisms behind these differences to better target concussion prevention strategies in wrestling.

References

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