THE CONTROL OF ROTATION DURING RUGBY UNION GOAL KICKING

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INTRODUCTION: While the basic kicking technique in ball sports is well understood, there has been limited research conducted on the biomechanics of rugby union goal kicking. Specifically, the movement characteristics which contribute to kicking accuracy have not been well defined. It is probable that the control of body rotation plays an important role in determining kicking accuracy. The quantity of rotation is characterised by the extent of angular momentum but surprisingly this quantity has seldom been used in analysis of kicking technique. This study aims to investigate how rugby players control rotation during execution of the kicking action and to determine the relationship between segmental angular momentum contributions and kicking accuracy.

METHOD: Five regular rugby union goal kickers (age = 18.6 ± 1.1 years, mass = 82.6 ± 3.5 kg) of at least regional age-group level participated in this study. Each subject performed a minimum of five goal kicking trials under two experimental conditions: 'accuracy' and 'distance'. Each trial involved the subject using their normal approach to kick a stationary rugby ball from a tee towards a vertical line attached to a net 8 m away. Whole-body 3-D kinematics were recovered by an eight camera Vicon 612 motion analysis system sampling at 120 Hz. The accuracy of each kick was calculated as the horizontal displacement from the intended vertical line as measured by a 50 Hz digital video camera (Sony DCR-TRV900E) positioned directly behind and above the direction of ball travel. From the original motion capture, joint centres were reconstructed to permit a 10-segment kinematic model to be developed (shank+foot (2), thigh (2), trunk, head+neck, upper arm (2), forearm (2)). Using the inertia data set of De Leva (1996) and the methods of Bahamonde (2000) the segmental angular momentum contributions to the 3-D whole-body angular momentum about the XYZ global axes were determined for each time instant prior to and post ball contact.
Differences in measures between conditions were tested using dependent t-tests.

RESULTS: The magnitude and timing of segmental angular momenta peaks during the kicking action did not show substantial differences between the 'accuracy' and 'distance' condition. As anticipated, the kicking leg contributed a large proportion of the overall angular momentum about the lateral horizontal and the vertical axes throughout the action. There was evidence of considerable counter-rotation movements about the vertical axis during the ball contact phase, particularly by the non-kicking arm, which served to limit the whole-body longitudinal rotation. The extent of intra-individual differences in technique between successful and unsuccessful trials (based on accuracy score) requires further investigation.

DISCUSSION: The minimal differences in technique found between 'accuracy' and 'distance' conditions is in line with contemporary coaching advice which states that goal kickers should develop a single "grooved" technique, irrespective of the situational demands. Most techniques lead to the kicking leg generating angular momentum about a global vertical axis. There is evidence from this study that successful goal kickers use effective motions in the non-kicking arm to counteract this angular momentum from the kicking leg, minimising whole-body rotation about a longitudinal rotation and aiding the execution of a "J-style" kick.

REFERENCES:

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