Upper Extremity Angular Kinematics of an American Football Long Snap

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INTRODUCTION

- A long snap with a fast release velocity (v_r) allows the punter to avoid contact from opponents and kick the football such that favorable field position is acquired [1]
- Three distinct phases constitute the long snap: stance phase (SP), force production phase (FPP), and release phase (RP) (**Fig. 1**) [2]

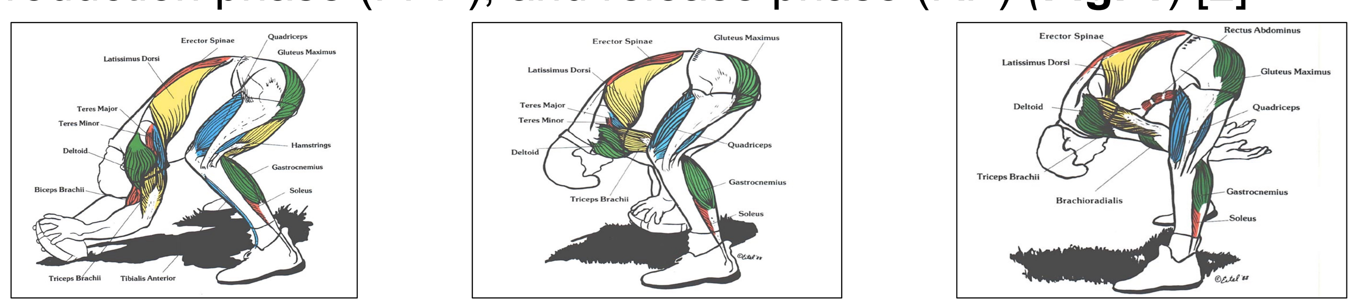
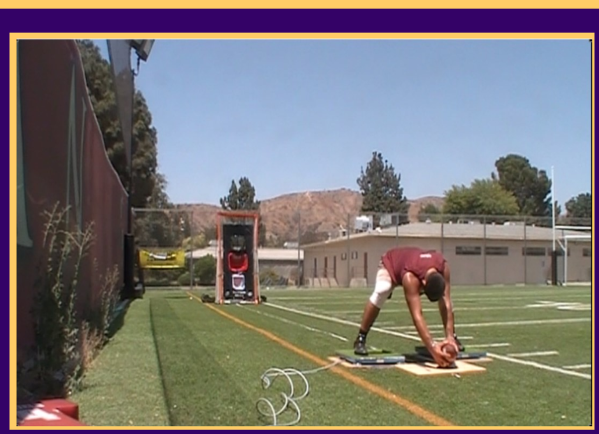


Figure 1. Phases of the long snap (from left to right): stance phase, force production phase, and release phase

- Limited, prior research has determined correlations between upper extremity kinematic variables, such as peak elbow flexion in FPP and shoulder angle in SP, and faster v_r [1,3,4]
- We aimed to determine further associations between upper extremity kinematic variables and long snap v_r in order to provide evidence-based principles for high school and college football players to produce faster snaps
- It was expected that greater elbow flexion in FPP and greater shoulder extension in SP would produce a faster long snap

METHODS

- Ten experienced football long snappers (five high school; five collegiate) participated in the study
- The average age (18.9 ± 1.3 years), years of long snapping experience (5.1 ± 1.65 years), long snapping camps/lessons attended (15.9 ± 9.5 camps/lessons), and body mass (99.6 ± 7.5 kg) were measured
- Subjects performed six long snaps directed at the target placed 13.3 meters (15 yards) behind the anterior tip of the football (**Fig. 2**)
- Trials were video recorded at 30 Hz from a sagittal view placed on the left side of the subject
- Kinovea v0.8.27 was used for tracking video recorded trials (**Fig. 3**)
- Shoulder and elbow joint angle (ϴ), angular velocity (ϴ/s), and timing (represented as a % of FPP) were tracked and calculated throughout all three phases of the long snap
- RV was tracked immediately after RP
- Correlational analyses were conducted between upper extremity kinematic variables and v_r for each trial (α=0.05)



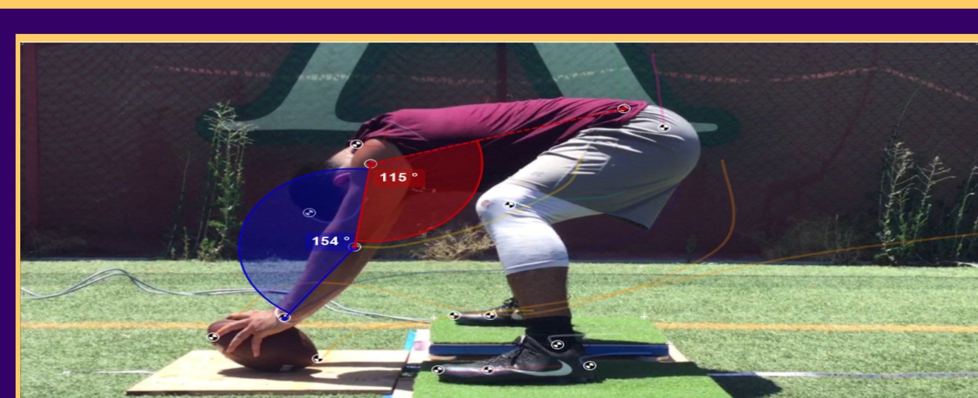


Figure 2 (left). Image of long snapper subject and experimental set-up
Figure 3 (right). Interface of Kinovea v0.8.27 software with tracking markers and displayed shoulder joint and elbow joint angles

RESULTS

Figure 4. Image of left elbow joint extended at SP (0 ms or 0% of FPP)

Figure 5. Image of left elbow joint at minimum elbow joint angle (peak flexion) in FPP (300 ms or 81.7% of FPP)

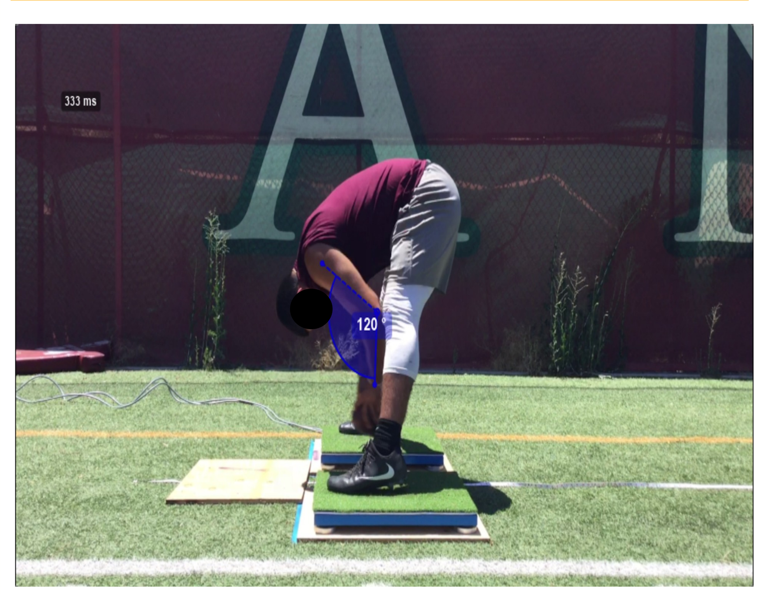


Figure 6. Image of left elbow joint at max elbow joint angular velocity in FPP (333 ms or 90.7% of FPP)

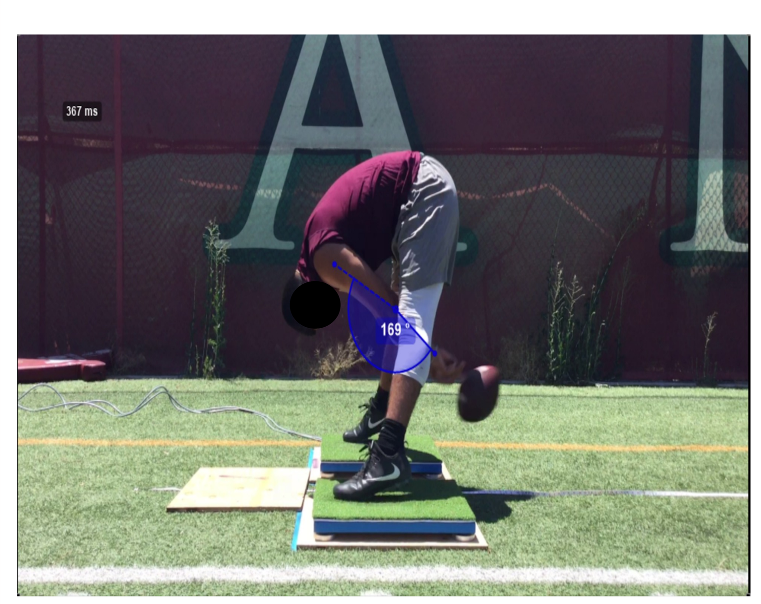


Figure 7. Image of left elbow joint angle at release (367 ms or 100% of FPP)

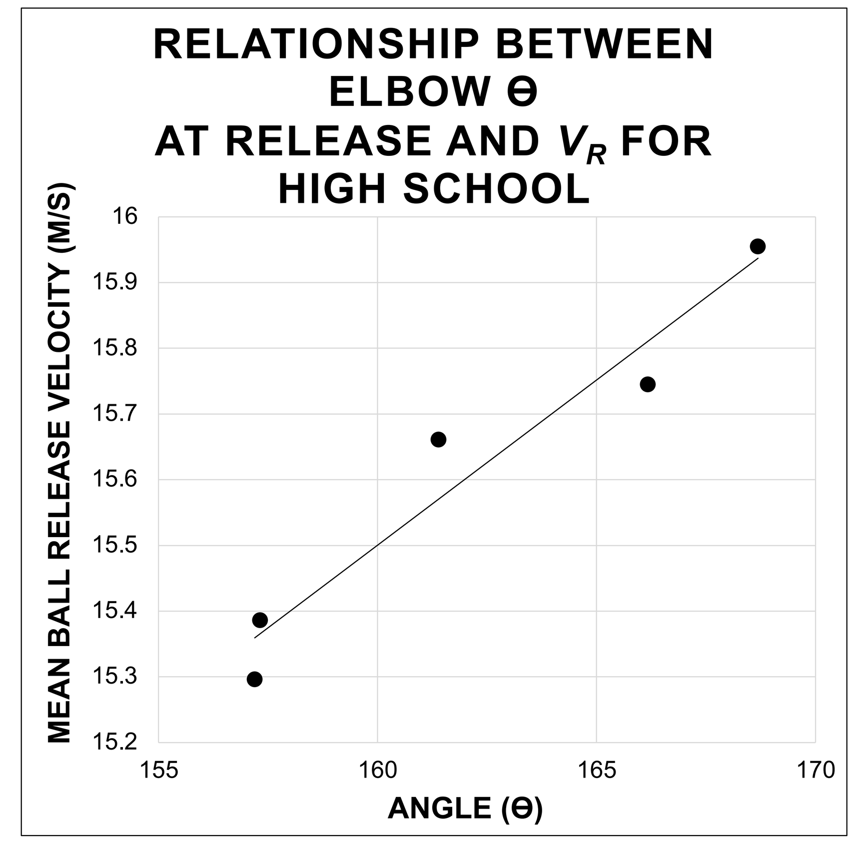


Figure 8. High school players' ball release velocity increased as elbow joint angle at release increased (r=0.970, p=0.002)

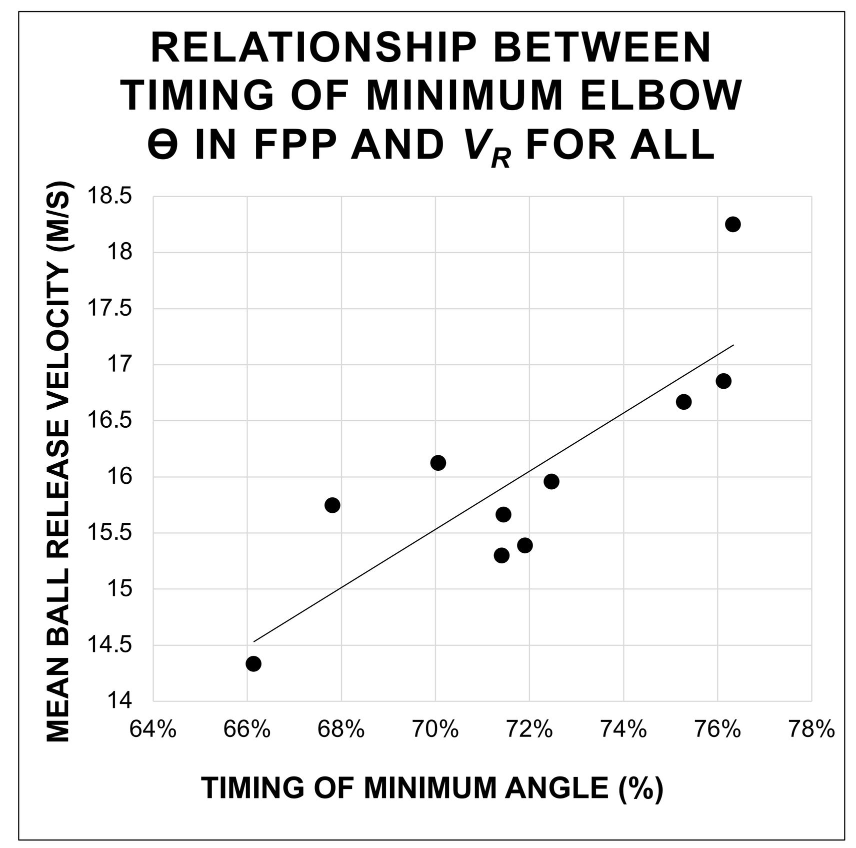


Figure 9. All players' ball release velocity increased as minimum elbow joint angle occurred later in the snap (r=0.829, p=0.002)

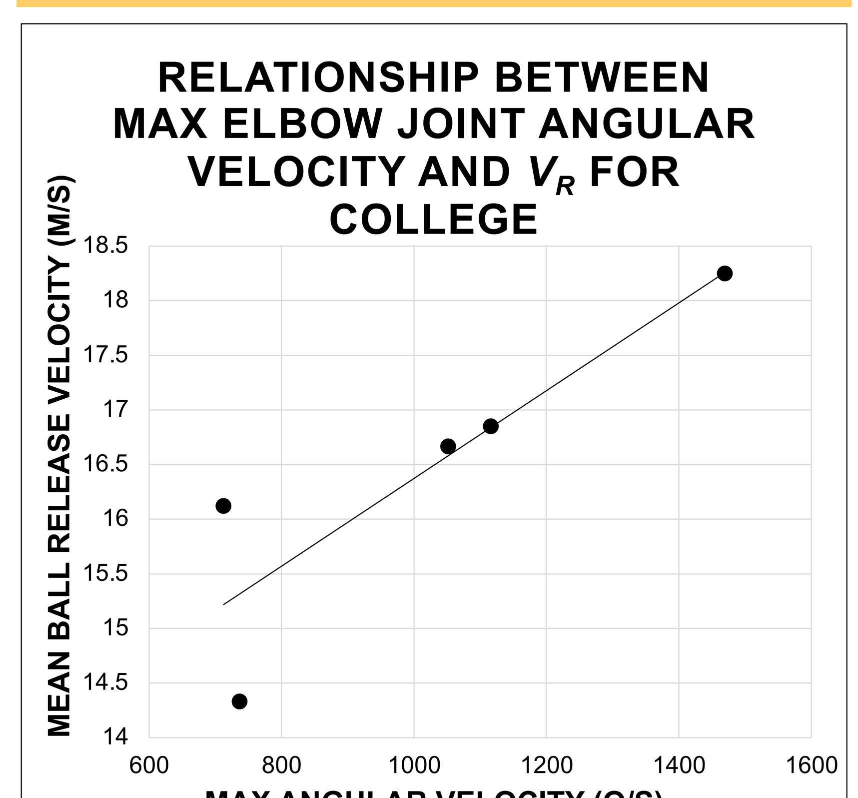


Figure 10. College athletes' ball release velocity increased as elbow joint angular velocity increased (r=0.881, p=0.032)

RESULTS (cont'd)

- High school long snappers attained larger v_r values when left elbow extension at RP was greater (r=0.970, p=0.002) (**Fig. 8**)
- Faster long snaps occurred when the left elbow joint angle was extended from the most flexed position later in the snap for both the whole group (r=0.829, p=0.002) and the collegiate long snappers (r=0.907, p=0.020) (**Fig. 9**)
- Additionally, when collegiate long snappers extended their left elbow faster (i.e. larger maximum angular velocities), there was a tendency for a larger v_r to be produced (r=0.881, p=0.032) (**Fig. 10**)
- Shoulder joint angle in SP was not significantly correlated with v_r for all subjects (r=0.079, p=0.897)
- Peak elbow flexion in FPP yielded a statistically insignificant association with v_r for all subjects (r=-0.465, p=0.172)

DISCUSSION & CONCLUSION

- The importance of elbow angular kinematics in long snapping from prior research was ultimately supported by this study, yet shoulder angular kinematics did not seem as influential to v_r
- Conservation of Angular Momentum may explain the importance of maintaining maximally flexed elbow angle longer through the snap
  - Maintaining a flexed elbow decreases overall arm moment of inertia, making the arm easier to swing backward.
  - The elbow then must extend over a larger range in a shorter duration as the ball is released, creating larger v_r values
- High school long snappers may not display many significant relationships between elbow kinematic variables and v_r due to their lesser accumulated instruction, musculature development, and overall physical maturation, per prior research [3]
- This study would have benefitted from a 3-dimensional analysis of the snap where improved accuracy of joint angular kinematics and implication of right side – left side kinematics could be determined
- In general, American football long snappers should emphasize extending their left elbow faster and closer to RP in order to obtain a larger v_r

REFERENCES AND ACKNOWLEDGMENTS

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