

Electromyographic and Motion Capture Analysis of the Elbow and Forearm in the Overhead Football Throw

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Objectives: Muscle activation patterns and the kinetics of overhead throwing have been well described in the baseball athlete but not in the football athlete. Injury patterns vary between these two populations. The purpose of this controlled laboratory study was to describe the muscle activation patterns of the elbow and forearm during the overhead football throw. A better understanding of muscle activation patterns and kinetics will help clinicians understand the difference in injury between these two populations, with an objective of preventing injury in both groups. The hypothesis was that the unique grip and obligatory pronation upon ball release will cause the elbow and forearm muscles to have a unique activation pattern during the overhead football throw.

Methods: IRB approval was obtained. Electromyographic (EMG) and motion capture data was collected on eight male quarterbacks. An EMG direct transmission system measuring at 1200 Hz with 9 surface electrodes was used to collect EMG data, with signals normalized to maximal voluntary contraction values for each subject. EMG sensors were placed on the biceps, triceps, brachialis, brachioradialis, anconeus, extensor digitorum communis, flexor digitorum superficialis, pronator teres, and pronator quadratus. A 13 camera motion capture system measuring at 240 Hz with a full body marker set of 39 retro-reflective 9mm markers was used to capture motion data. The throwing motion was divided into four event segments: early cocking, late cocking, acceleration, and follow through.

Results: All athletes had NCAA experience and were aged 18-30 years old. The anconeus (26.9%, 36.3%, 57.6%, and 105.8% MVCs), extensor digitorum communis (22.7%, 28.0%, 31.0%, and 42.8% MVCs), and flexor digitorum superficialis (19.4%, 39.3%, 22.3%, and 104.7% MVCs) had high levels of activity throughout all phases of the football throw. The brachioradialis (56.8%MVC) and anconeus (57.6%MVC) were the most active muscles during the acceleration phase. The pronator teres (78.4%MVC), pronator quadratus (90.9%MVC), and flexor digitorum superficialis (104.7% MVCs) have very high levels of activation during the follow through phase.

Conclusion: High levels of activity of the anconeus suggest that it functions as a dynamic stabilizer during all phases of the throwing motion. High levels of activity of the extensor digitorum communis and flexor digitorum superficialis suggest that they are important for grip. The pronator teres and pronator quadratus are important at ball release to produce a spiral motion of the football. High activity of the medial sided musculature may impart dynamic stability to the elbow. These findings may explain why quarterbacks have a lower rate of UCL injury and a higher return to play without surgery.

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