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INJURIES IN OVERHEAD ATHLETES (J DINES AND C CAMP, SECTION EDITORS)

Common Injuries in Professional Football Quarterbacks

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Abstract

Purpose of Review Professional football quarterbacks are at particular risk for upper extremity injuries due to the physical demands of their position coupled with the inherent risks associated with professional football. This review sought to evaluate current clinical literature to better characterize the injury profile unique to this athletic population.

Recent Findings Shoulder injuries are the most prevented upper extremity injury among professional football quarterbacks. The quarterback position is disproportionately impacted by shoulder injuries when compared to professional athletes at other positions. Moreover, contrary to other professional throwing athletes, the majority of upper extremity injuries in the professional quarterback result from direct contact as opposed to the throwing motion.

Summary The injury profile among professional quarterbacks is unique compared to other positions and other overhead professional throwing athletes. Overall, a paucity of high quality clinical evidence exists to support the management of injuries in this elite population.

Keywords Professional football · NFL · Quarterback · Upper extremity · Shoulder · Injuries

Introduction

For contact athletes, the shoulder is one of the most commonly injured joints due to its exposed location. Additionally, for overhead throwing athletes, the shoulder is also prone to injuries due to the extreme forces placed on it during the throwing mechanism. For these reasons, the professional football quarterback in the National Football League (NFL) is especially at risk for shoulder and elbow injuries. Appropriate management of these injuries in the professional quarterback requires a detailed understanding of the physical demands of the position coupled with knowledge of the injury profile that is unique to this position.

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Epidemiology

Although the actual number of shoulder injuries vary among the different levels of play, shoulder injuries are quite common in football. In high school football in the USA, there are approximately 480,000 shoulder injuries per year [1]. In addition to the level of competition, the profile of football-related injuries is unique to the position [2••, 3, 4]. Data from the NFL Scouting Combine has been evaluated to determine the incidence of shoulder injuries in professional football prospects. Several authors using data from the NFL Combine have reported on the predominance of shoulder injuries, particularly among quarterbacks [2••, 3, 4]. Kaplan and colleagues [4] reported that nearly 50% of all athletes at the combine reported a history of shoulder injury, with 34% requiring operative intervention. Moreover, quarterbacks had the highest percentage of players at their position with a history of shoulder injury [4]. Brophy et al. [3] reported that injuries to the shoulder girdle comprised 3 of the top 15 most common injuries among all athletes at the NFL Combine. Other data from the NFL Injury Surveillance System (NFLISS) has also provided useful insight. Kelly et al. looked at quarterback injuries and determined that shoulder injuries were the second most common type, representing 15.2% (233/1543) of all injuries [5].

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Among these, AC joint injuries were the most common type of shoulder injury at 40% [5].

Throwing Mechanics

Knowledge of the throwing mechanics involved in the football passing motion is essential for understanding the impact of upper extremity injuries on the elite quarterback. Despite several similarities in the throwing motion between football and other overhead throwing sports, fundamental differences exist. Even when comparing the throwing motion of baseball and football players, key mechanical and kinematic differences result in unique injury profiles, which have important implications for subsequent management.

Limited research has been dedicated to understanding the mechanics associated with the football pass [6–9]. Kelly and colleagues defined the phases of the football throw in athletes based on shoulder girdle muscle activation patterns [7]. Several unique aspects of the throwing motion of a football have been attributed to the difference in size relative to that of a baseball [6, 7, 9]. A professional football is approximately three times as heavy as a baseball (0.42 vs. 0.14 kg) [5–7]. As a result, differences in arm velocities and the position of the arm and trunk during the throwing motion exist.

Unique characteristics of the football throwing motion are highlighted by its comparison to the baseball throwing motion. Baseball pitchers generate higher rotational and angular velocities in the shoulder, elbow and trunk when compared to football players [6, 9]. Additionally, during the deceleration phase of throwing, baseball pitchers generate higher compressive forces and torques at the shoulder and elbow comparatively [6]. Moreover, the position of the body and arm differs between the two throwing motions. Quarterbacks tend to stand more upright, have shorter strides, and "lead with the elbow" during arm cocking and ball release [6]. Differences in the trunk position and stride length may be intrinsic to the nature of the sport, as quarterbacks often have to release the ball quickly and protect themselves from oncoming defenders. The relative position of the arm at the time of late cocking and ball release in quarterbacks represents an attempt to lessen the mechanical loads across the arm by assuming a position with greater horizontal adduction and elbow flexion, therefore, decreasing the lever arm associated with throwing a heavier object.

Common Injuries

Shoulder

Shoulder injuries are exceedingly common among professional football players, particularly those at the quarterback position. Quarterbacks have higher rates of shoulder injuries than other position players [2••, 4]. Shoulder injuries are the second most common overall injury in NFL quarterbacks, after head injuries [5]. Kaplan and colleagues reported a history of shoulder injury in approximately 50% of athletes at the NFL Combine [4]. Similarly, recent data evaluating over 2200 athletes at the NFL Combine demonstrated that shoulder injuries were the second most common injury overall with over 50% of athletes reporting a history of shoulder injury [2••]. Specifically, quarterbacks are the position most at risk for shoulder injury with 71% of quarterbacks reporting a history of injury. Interestingly, when compared to a matched cohort of quarterbacks without a history of shoulder injury, the presence of a shoulder injury in quarterbacks did not affect the number of games started, overall QB rating, yards per attempt, or touchdowns [2••].

Injuries to the shoulder girdle in quarterbacks either can be traumatic or can result from the throwing motion (Table 1). The most common mechanism of shoulder injury in professional quarterbacks results from direct contact (82.3%), while approximately 14% of shoulder injuries occur secondary to the throwing motion [5]. Shoulder injuries in the professional quarterback therefore represent a unique injury profile compared to other overhead athletes given the high percentage of traumatic contact injuries. Understanding the spectrum of this specific injury profile coupled with knowledge of the biomechanical demands of the football throwing motion is essential for appropriate care of the elite football quarterback.

Acromioclavicular Joint Injuries

Acromioclavicular (AC) joint injuries are consistently among the most commonly reported shoulder injuries in professional football players [2••, 3–5]. Injuries to the AC joint commonly occur following direct impact to the superior or lateral aspect of the shoulder. Football players are particularly susceptible to this while being taken down during a tackle or when colliding with another player. While not specific to the quarterback position, Beaulieu-Jones and colleagues recently reported that AC joint injuries were the most common injury to the shoulder girdle in over 2200 athletes at the NFL Combine, accounting for 46% of all shoulder injuries [2••].

Table 1 Common shoulder girdle injuries

Traumatic	Throwing related
AC joint sprain/dislocation	Rotator cuff tendonitis
Shoulder dislocation/instability	Biceps tendonitis
SLAP/labral tear	
Contusions (deltoid, rotator cuff, and scapular stabilizers)	
Fractures	

Injuries to the AC joint tend to be more common in quarterbacks compared to other position players [3, 4, 10]. Among professional quarterbacks, injuries to the AC joint represent 40–56% of all shoulder injuries [2••, 4, 5]. In a study utilizing the NFL Injury Surveillance System (NFLISS), Lynch et al. reported exclusively on AC joint injuries in the NFL [10]. While defensive backs had the highest total number of AC joint injuries (29.2% of all AC joint injuries), quarterbacks were found to be the most susceptible position player to AC joint injuries in terms of overall incidence (20.9 AC joint injuries per 100 players). Furthermore, quarterbacks had the second highest positional exposure risk of AC joint injury and the highest mean number of days lost (17.3 days) secondary to AC joint injury [10]. Similar data was reported by Kelly et al., who reported a mean of 22.1 days lost secondary to AC joint injuries in NFL quarterbacks [5]. Brophy and colleagues reported that AC joint injuries were the most prevalent diagnosis (30 injuries/100 exposures) among quarterbacks at the NFL Combine [3]. For comparison, no other upper extremity injury was in the top 5 of the most commonly reported injuries [3].

The management of AC joint injuries in the professional quarterback largely consists of non-operative treatment with progressive rehabilitation. This is largely due to the high incidence of low grade AC joint injuries among these athletes. Kelly and colleagues [5] reported that 88% of AC joint injuries in NFL quarterbacks were type I–III injuries (44% of which were type I) for which nonsurgical management is routinely recommended. Lynch et al. reported that among 57 AC joint injuries in NFL quarterbacks, only 2 required operative intervention [10]. Other authors have also reported successful non-operative management of low grade AC joint injuries in professional quarterbacks [5].

In our experience, type I–III AC joint injuries can be effectively treated non-operatively by initial protection in a sling followed by a progressive rehabilitation and strengthening program, with an expected return to play at 5–6 weeks post injury for more severe injuries. Operative treatment is typically recommended for type IV–VI injuries.

Shoulder Dislocation/Instability

Shoulder dislocations and shoulder instability are relatively uncommon injuries among professional quarterbacks. Conversely, anterior instability is fairly common among all elite football players, particularly linebackers and defensive backs, with an overall prevalence of approximately 20% [4]. Brophy and colleagues [11] evaluated athletes from the NFL Combine and noted that only 27/322 quarterbacks reported a history of shoulder instability, 13 of which went on to play in the NFL. Of all quarterbacks with instability, 16 athletes required surgical stabilization with 8 of those eventually playing in the NFL. Albeit a small sample size, the authors concluded that there was no significant relationship between shoulder instability and/or surgical stabilization on career length [11]. Kaplan and colleagues also reported on a similar population [4]. Only 2/21 quarterbacks had a history of anterior instability, with 1 athlete requiring surgical stabilization [4]. Shoulder dislocations can result in a significant amount of missed playing and require prolonged rehabilitation [5].

SLAP Tears/Labral Tears

Acute labral pathology is uncommon in the professional quarterback [4, 5, 12•]. Chambers and colleagues evaluated SLAP tears in the NFL from 2000 to 2014, utilizing the NFLISS and determined that SLAP tears comprised only 3.1% of all shoulder injuries in NFL athletes and were isolated injuries without concomitant shoulder injury in 85% of athletes. Interestingly, 75% of injuries occurred as the result of direct contact with another players [12•], which differs from the traditionally described peel-back mechanism in baseball pitchers [13]. Kelly and colleagues also reported a low incidence (0.4%) of labral pathology resulting from the throwing motion in professional quarterbacks [5]. Chambers et al. reported that only 3/65 SLAP tears occurred in quarterbacks; however, two of these underwent surgical fixation. Conversely, 60% of SLAP tears in other professional football athletes were treated non-operatively [12•]. Kaplan et al. also reported a low overall incidence of SLAP tears (2.1%), none of which occurred in quarterbacks. Therefore, while SLAP tears and labral pathology are infrequent injuries in the professional quarterback, there may be a lower threshold to treat these operatively given the high incidence of traumatic injury as opposed to the typical injury pattern seen in other overhead athletes.

Rotator Cuff Injury

The spectrum of rotator cuff disease in professional quarterbacks is atypical compared to what is usually encountered in the overhead athlete. NFL quarterbacks have slower arm speeds with decreased rotational and angular forces across the shoulder compared to baseball players [6]. Additionally, the overall number of throws per game is significantly lower in football compared to that in baseball. Therefore, while rotator cuff tendonitis represents the most common shoulder injury in professional quarterbacks resulting from the throwing motion (6.1%), it is not surprising that rotator cuff injury secondary to contusion is the most common pathology of the rotator cuff in this population (8.4%) [5]. Rotator cuff pathology represents the third most common shoulder injury among athletes at the NFL Combine [4], and disproportionately affects linemen, representing 20–25% of shoulder injuries at this position [4, 14•]. While injury to the rotator cuff is fairly common, actual rotator cuff tears are very infrequent representing only 1.8% of total injuries [4]. Kaplan and colleagues reported that only 2/21 quarterbacks at the NFL

Combine had a history of rotator cuff tendonitis, and only 1/21 had a history of rotator cuff tear [4]. Similarly, a more recent study by Gibbs et al. reported that only 3/49 athletes at the NFL Combine with a history of rotator cuff tear were quarterbacks [14•]. Athletes with a history of rotator cuff tear were less likely to be drafted and played fewer games in the NFL compared to matched controls; however, this is difficult to extrapolate to the professional quarterback given the low overall prevalence [14•].

Biceps Tendonitis

Pathology of the long head of the biceps tendon is a common pain generator in the overhead athlete. In professional football quarterbacks, biceps tendonitis represents the second most common shoulder injury related to the throwing motion following rotator cuff tendonitis [5]. Interestingly, biceps tendonitis only accounted for 4.3% (3.9% of which were attributed to the throwing motion) of all shoulder girdle injuries among professional quarterbacks in a study utilizing the NFLISS [5]. Conversely, other authors have reported that up to 80% of professional baseball pitchers have abnormal pathology of the long head of the biceps tendon [15]. Kelly and colleagues reported that time lost due to biceps pathology had a median of 9.5 days [5]. In our experience, biceps tendonitis is most effectively treated with a combination of rest, anti-inflammatory medications, and progressive rehabilitation.

Contusions/Fractures

Muscle contusions and fractures are inherent to any collision sport and are associated with varying degrees of disability. Muscle contusions represent the second most common injury to the shoulder girdle in professional quarterbacks [5]. The most commonly contused muscles in order of decreasing frequency are the deltoid (11.3%), rotator cuff (8.4%), and scapular stabilizers (1.7%) [5]. Upper extremity fractures are infrequent, however, potentially devastating injuries. Clavicle fractures represent the fourth most common shoulder injury (4%); however, only 1/21 quarterbacks had a history of clavicle fracture [4]. Similar results were reported using the NFLISS, whereby fractures of the proximal humerus, scapula, and clavicle represented 3.7% of shoulder injuries [5]. Upper extremity fractures can potentially impact the ability of the quarterback to play at the professional level. Brophy and colleagues [11] reported on 11 quarterbacks at the NFL Combine with a history of forearm fractures. Of the quarterbacks included, only one went on to play in the NFL [11].

In our experience, we recommend open reduction and internal fixation for midshaft clavicle fractures which are significantly displaced and/or shortened, given the high rates of nonunion and symptomatic malunion with these fractures [16–18]. Nondisplaced fractures can be treated non-operatively. Athletes are made non-weight bearing and allowed to range the arm as they can tolerate. Gradual return to throwing can start around 6 weeks with return to play between 8 and 10 weeks. Distal clavicle fractures represent a distinct entity and treatment is usually dictated by the stability of the fracture. Fractures lateral to the coracoclavicular ligaments are stable and are typically treated non-operatively. Fractures involving the coracoclavicular ligaments or medial to these ligaments are unstable and require open reduction and internal fixation [19, 20].

Elbow

Elbow injuries are commonly encountered in the overhead throwing athlete. Management of these injures is often customized to the demands of the sport and position. In the late cocking and early acceleration phase of the throwing motion in baseball and football, a substantial valgus force is produced at the elbow [6]. Various biomechanical studies have demonstrated that the anterior bundle of the ulnar collateral ligament (UCL) functions as the primary restraint against the valgus stress that occurs between 20° and 120° of elbow flexion [21–24]. Morrey et al. demonstrated that the UCL provides 54% of the resistance to the valgus torque with the elbow flexed at 90° [25]. The maximum valgus torque generated by the pitching motion has been determined to be as high as 64 Nm, which often approaches or exceeds the maximum tensile strength that the UCL can withstand prior to failing [26]. Over time, this can result in attritional changes until the ligament ultimately fails. Conversely, the valgus force about the elbow is not as great during the football throwing motion [6]. The decreased valgus force coupled with other key biomechanical differences between pitching motion and the football throwing motion are likely the reason why very few UCL injuries in NFL quarterbacks result from the throwing motion [27–29].

Published data on UCL injuries in the professional quarterback is limited. This is most likely due to the relative infrequency of UCL injuries in football compared to other overhead throwing sports such as baseball [30]. The largest series to date on UCL injuries in professional quarterbacks was published by Dodson and colleagues [28]. These authors used the NFLISS from 1994 to 2008 and documented ten UCL injuries in quarterbacks. Despite the small sample size, several key trends were evident from this data. Most injuries occurred as the result of being tackled with only two resulting from the throwing motion [28]. The high prevalence of trauma-related UCL injury is also supported by a small series from Kenter and colleagues [27]. Nine of the ten UCL injuries in Dodson's series [28] were managed non-operatively, including three athletes who had complete tears. Not surprisingly, athletes with a higher grade injury required a longer time to return to competition. Quarterbacks with a grade I–II injury returned around 7 days, whereas grade III injuries has a mean of 67 days to return to play [28]. There is a tremendous paucity of data on UCL reconstruction in the professional quarterback, with most case series consisting of only one–two athletes [28, 31, 32].

In our personal experience, the vast majority of UCL injuries in professional quarterbacks, including complete tears, can be managed non-operatively. Early treatment consists of rest, various treatment modalities, and ice and anti-inflammatory medications. Progressive rehabilitation and strengthening of the flexor-pronator musculature is essential for strengthening the muscles that counterbalance the valgus force about the elbow during the throwing motion, especially in a UCL deficient quarterback. The athlete is then started on a throwing program and advanced gradually.

Conclusion

Upper extremity injuries in the professional quarterback are relatively common. Knowledge of the unique injury profile and physical demands of the quarterback position are essential for determining optimal management. Overall, there is a paucity of high quality clinical evidence supporting the management of injuries in this elite population. Data from the NFL Combine and NFLISS has offered some insight into this population, however, has several inherent limitations curtail the generalizability of the available evidence. In our experience, the vast majority of injuries can be managed non-operatively with progressive rehabilitation. Better evidence is needed to help determine optimal management of injuries in the professional quarterback.

Compliance with Ethical Standards

Conflict of Interest All authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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