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Can glenohumeral joint isokinetic strength and range of movement predict injury in professional rugby league

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ABSTRACT

Objective: To isokinetically record shoulder strength scores and range of motion in a professional rugby league squad. To prospectively monitor injuries over a season looking for associations between measured variables and injury.
Design: A cohort study design involving prospective screening of risk factors with subsequent injury surveillance.
Setting: University Sports Science Laboratory and Professional Rugby League Club.
Participants: All players participating in the clubs reserve team squad for the 2011 season ($n = 20$).
Main outcome measures: Concentric (Con) and eccentric (Ecc) peak torque values; ratio of Ecc internal rotation IR to Con external rotation ER, also known as the dynamic control ratio (DCR), shoulder range of IR and ER.
Results: Eight players (36%) received a total of eleven injuries over the season. There were no statistically significant differences between injured and non-injured shoulders. IR range of movement was significantly lower in injured versus non-injured groups with left ($p = 0.022$) and right ($p = 0.024$). Left IR range of movement was predictive of injury using binary logistic regression ($p = 0.046$). No isokinetic strength parameters reached statistical significance ($p > 0.05$) for prediction of injury; however size effects were apparent for reduced con IR of the left shoulder and Ecc IR of both shoulders.
Conclusion: Reduced shoulder IR range appears predictive of future shoulder injury although caution is drawn due to small participant numbers. Injury prevention strategies for rugby league players should include exercises to improve shoulder IR and possibly Ecc IR strength.

1. Introduction

Rugby League is an international collision sport with similar rules to rugby union. During the course of a match players are exposed to multiple physical contacts and tackles, with the game requiring high aerobic and anaerobic fitness levels as well as a large skill component for each player (Gabbett, 2005).

Shoulder injuries are the most common in rugby league leading to significant time loss from playing and training. The classic mechanism for shoulder dislocations is reported as forced external rotation in abduction (Hudson, 2010) and is a commonly hypothesised position for shoulder injury in rugby (Herrington, Horsley, Whitaker & Rolf, 2008. The implementation and evaluation of effective injury prevention strategies relies on the successful identification of injury risk factors (van Mechelen, Hlobil & Kemper, 1992). However, there are currently few, if any, reliable predictors of injury in rugby league (Gabbett et al., 2004).

Edouard, Frize, Calmels, Samozino, Garet and Degache (2009) found rugby union players to have significantly higher shoulder isokinetic strength scores than the general public. The authors hypothesise strength deficits within individuals of the rugby playing group may predispose those subjects to possible injury. However, there is no supporting evidence provided and the authors have not as yet conducted such a prospective study. In a recent study shoulder strength has been linked to injury in baseball pitchers (Byram, Bushnell, Dugger, Charron, Harrell, & Noonan, 2010). This study found a link between reduced pre-season isometric ER strength and supraspinatus strength and subsequent injury. However the authors themselves state that isometric testing is not indicative of muscle function in sport and that eccentric testing would possibly be more valuable.

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Isokinetic strength scores have been obtained in other sports including volleyball (van Cingel et al. 2007), badminton (van Cingel, Kleinrensink, Mulder, de Bie & Kuipers, 2007) and tennis (Julienne, Gauthier, Moussay & Davenne, 2007). However none of the aforementioned articles look at a link with injury. Isokinetic shoulder measurements have been shown to differentiate between healthy and unhealthy shoulders and can be seen as a reliable and valid measure of shoulder disability (van Meeteren, Roebroeck, Sellesa, Stijnen & Stam 2004).

van Cingel et al (2007) looked at dynamic control ratios (DCR) in badminton players as possibly indicative of shoulder injury. A DCR is hypothesised as a more functional score for the restraining effect of the lateral rotators in the end stage of the badminton swing. The authors found significant differences between sexes and suggest a DCR of less than one may be predictive of injury but state further research is required. Furthermore the traditional DCR of Ecc ER/con IR has been shown to be predictive of shoulder injuries in elite volleyball players (Wang & Cochrane, 2001b). Utilising the principle of dynamic control ratio's in other sports and applying them to rugby a ratio of eccentric IR/concentric ER is proposed to screen for forced external rotation and shoulder injury.

Reduced shoulder range of movement may be a factor predisposing to shoulder injuries including subacromial impingement (Borich, Bright, Lorello, Cieminski, Buisman & Ludewig, 2006), internal impingement (Myers, Laudner, Pasquale, Bradley & Lephart, 2006) and superior labrum anterior to posterior lesions (SLAP) (Grossman, Tibone, McGarry, Schneider, Veneziani & Lee, 2005). Grossman et al. (2005) used a cadaveric study to show how posterior cuff tightness and associated reduced range of internal rotation caused mal-positioning of the humeral head in extremes of glenohumeral lateral rotation. This is hypothesised as a possible causal mechanism of type II SLAP lesions as commonly seen in rugby players (Funk & Snow, 2007).

This study aimed to associate shoulder isokinetic strength and range of motion variables with subsequent injuries over a rugby league season. Shoulder concentric and eccentric peak torques were recorded as well as a DCR of Ecc IR/Con ER. It was hypothesised that a reduced range of shoulder motion and strength would be predictive of shoulder injury.

2. Method

2.1. Subjects

Twenty-two professional or semi-professional rugby league players voluntarily participated in this study. Exclusion criteria were current shoulder pathology or pain. Previous injury to the shoulder did not cause withdrawal. Two participants left the club immediately after initial testing and therefore were lost to follow up meaning a final cohort of twenty subjects.

2.2. Procedure

Subject's performed isokinetic shoulder strength and range of motion testing two months in to a nine month season. All warm-ups, familiarisations, testing and recording was performed by the first author. A familiarisation session was incorporated with all isokinetic testing to limit experimental error four days prior to testing. A standardised warm up incorporating elastic resistance bands and stretching was performed pre-testing to limit injury risk.

Isokinetic and range of motion scores were recorded on the same day in a random order. Isokinetic assessment was carried out on a Biodex-System III Dynamometer (Biodex Medical, Shirley, New York). Subjects were seated with the testing arm at 90° shoulder abduction in the frontal plane. When defining test range of movement the limit was set at the maximum pain-free position without trunk movement for both IR and ER, as used in a study by Hill, Pramanik and McGregor (2005). Average testing ROM was 125.3° and 122.3° for left and right shoulder accordingly. Con and Ecc scores were taken on each arm at 180°/s for five repetitions per test, Con/Con and Ecc/Ecc regimes. Gravitational correction was included on all tests to prevent overestimation of peak torque. A torque limit of 140 Nm was set for eccentric trials following feedback and difficulties from the familiarisation sessions. Reactive eccentric mode was selected for measurement of eccentric scores as it is deemed safer. Passive eccentric mode could subject the participant to torque limits greater than they can produce and therefore potentially injure the shoulder (Zanca, Oliveira, Saccol & Mattiello, 2011).

Fig. 1. Bubble goniometry ER.

Range of motion was measured using a bubble goniometer (model 12-1056, Fabrication Enterprises, White Plains, NY) in supine for ER (Fig. 1) and prone for IR (Fig. 2) as described by Kolber, Saltzman, Beekhuizen and Cheng, (2009). The authors technique showed excellent intersession reliability for IR = 0.987 and ER = 0.970.

Fig. 2. Bubble goniometry IR.