



Original research

Cervical range of motion, cervical and shoulder strength in senior versus age-grade Rugby Union International front-row forwards

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ABSTRACT

Objectives: To provide normative values for cervical range of motion (CROM), isometric cervical and shoulder strength for; International Senior professional, and International Age-grade Rugby Union front-row forwards.

Design: Cross-sectional population study.

Setting: All international level front-row players within a Rugby Union Tier 1 Nation.

Participants: Nineteen Senior and 21 Age-grade front-row forwards underwent CROM, cervical and shoulder strength testing.

Main outcome measures: CROM was measured using the CROM device and the Gatherer System was used to measure multi-directional isometric cervical and shoulder strength.

Results: The Age-grade players had significantly lower; cervical strength (26–57% deficits), cervical flexion to extension strength ratios (0.5 vs. 0.6), and shoulder strength (2–36% deficits) than the Senior players. However, there were no differences between front-row positions within each age group. Additionally, there were no differences between age groups or front-row positions in the CROM measurements.

Conclusions: Senior Rugby Union front-row forwards have greater cervical and shoulder strength than Age-grade players, with the biggest differences being in cervical strength, highlighting the need for age specific normative values. Importantly, Age-grade players should be evaluated to ensure they have developed sufficient cervical strength prior to entering professional level Rugby Union.

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1. Introduction

Cervical (neck) injury rates are high in both Senior (Fuller, Sheerin, & Targett, 2013) and Age-grade (under 18 or under 20) (Bleakley, Tully, & O'Connor, 2011; Palmer-Green, Stokes, Fuller, England, Kemp, & Trewartha, 2013) Rugby Union players. These injuries often involve long absences from the game and can affect long-term health (Fuller et al., 2013). Cervical injuries typically occur during contact events, such as scrums, rucks and mauls, competing for the ball at a ruck, and tackles. Consequently, Front-row forwards, who have relatively high exposure to contact with the opposition (Brown et al., 2014; Duthie, Pyne, & Hooper, 2003),

are particularly vulnerable (Brooks & Kemp, 2011; Usman & McIntosh, 2012).

The scrum is an important component of Rugby Union and has a high injury propensity (Fuller, Brooks, Cancea, Hall, & Kemp, 2007). It involves a pack of eight players, termed 'forwards'. Three play in the front-row (Loose-head Prop, Hooker and Tight-head Prop), two 'locks' in the second-row, and three 'back row' players. They scrummage aggressively against an opposing forward pack to secure the ball when restarting play following an infringement or stoppage (World Rugby, 2014). Effective scrummaging requires coordinated pushing by the eight players (Trewartha, Preatoni, England, & Stokes, 2014), which produces forces greater than the sum of each forward's individual scrummaging force (Quarrie & Wilson, 2000). Unsurprisingly, scrum engagement forces are positively related to the total body mass of the opposing pack (Du Toit, Olivier, & Buys, 2005; Milburn, 1990). Rugby players' size has increased markedly over the last 25 years (Sedeaud, Marc, Schipman, Tafflet, Hager, & Toussaint, 2012) and therefore,

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engagement forces have doubled since 1990 (8000 N vs. 16,500 N) (Milburn, 1990; Preatoni, Stokes, England, & Trewartha, 2013). Front-row players bare the brunt of this engagement force, absorbing a greater proportion of the load than the other forwards (Milburn, 1990; Quarrie & Wilson, 2000).

Increased Rugby Union player cervical muscle strength following specific neck muscle training has been demonstrated (Geary, Green, & Delahunt, 2014), and it is proposed that greater cervical strength could protect against injury (Brooks, Fuller, Kemp, & Reddin, 2005; Brooks & Kemp, 2011; Peek & Gatherer, 2005), as a stronger neck should have higher capability to withstand extreme forces applied during Rugby contact events, such as the scrum and tackle. This is supported by a recent study that associated strength improvements following a short-term exercise intervention, with lower rates of Rugby Union related neck injuries (Naish, Burnett, Burrows, Andrews, & Appleby, 2013). Whilst some isometric cervical strength data for generic groups of professional Rugby Union players is available, specific normative cervical strength values for the very best players, in the most high risk positions, are required to provide player rehabilitation, conditioning and selection benchmarks.

Some normative cervical strength values have been reported for adult amateur and school-aged players (Hamilton et al., 2012, 2014) although not all cervical movements were assessed. Further, establishing normative upper limb strength values (as myotomal shoulder strength deficit is a common sequelae to cervical injury) for players at high-risk of cervical injury would be useful in informing injury prevention and return to play programmes. Normative values would not only inform preparation of elite young front-row players for professional Senior rugby, but could also help distinguish between injured and uninjured individuals (Cagnie, Cools, De Loose, Cambier, & Danneels, 2007), thus informing rehabilitation programmes and return to play criteria.

Not all cervical injuries in Rugby Union stem from one-off traumatic incidents. Some injuries, such as gradual onset disc and facet joint degeneration may result from the cumulative demands of rugby contact events. It has been hypothesised that the cumulative effect of Rugby's physical demands may be the cause of reduced cervical range of motion (CROM) identified in rugby players (Lark & McCarthy, 2007). Indeed, Rugby Union players have been reported to have similar CROM profiles to whiplash sufferers (Dall'Alba, Sterling, Treleaven, Edwards, & Jull, 2001; Lark & McCarthy, 2007) and greater rugby experience is associated with reduced CROM (Lark & McCarthy, 2007). Previous studies have measured CROM for semi-professional Rugby Union players (Lark & McCarthy, 2007, 2009, 2010b), but not professional players and have not compared top-level Senior and Age-grade players. Therefore, it is not known whether Age-grade players, with less playing experience, exhibit greater CROM than Senior players.

Therefore, the aim of this project is to establish and compare normative values for CROM, cervical strength and shoulder strength for Senior International Rugby Union front-row forwards, and International Age-grade Rugby Union front-row forwards.

2. Methods

2.1. Participants

The participants were split into two groups based on their age. The 'Age-grade' group consisted of 21 front-row players who had represented their country at under 18 or under 20 level, and the 'Senior' group that consisted of 19 front-row players who were all current or former Internationals currently playing professional rugby. All participants were deemed neck injury free and fit for Rugby selection by their team medical staff. These cohorts

effectively consisted of the entire population of international level front-row forwards within a single Tier 1 Rugby Union Nation. Each player's front-row position (Loose-head, Hooker or Tight-head), body mass and height were recorded and descriptive data for each position, within each age group, are shown in Table 1. Ethical approval was granted by the Cardiff Metropolitan University, Cardiff School of Sport Ethics Committee and written informed consent was obtained from all participants.

2.2. Procedures

Each participant's CROM, cervical strength and shoulder strength were tested on the same day with one tester collecting all Senior participant data whilst another collected all the Age-grade participant data. CROM was assessed prior to strength testing.

The testing procedure followed the methods described by Lark and McCarthy (Lark & McCarthy, 2007). Prior to the CROM device (Orthopedic Physical Therapy Products, Minneapolis, USA) being fitted, the player was seated in an upright position and practised each of the cervical movements to be tested. This pre-stretched the muscles and familiarised them with the testing protocol (Lark & McCarthy, 2007). The CROM device was then secured on the player's head. Additionally a magnetic collar was placed on the shoulders of the player to take into account any trunk rotation (Audette, Dumas, Cote, & De Serres, 2010). This device has previously been shown to be both valid and reliable at measuring CROM (Audette et al., 2010). Participants CROM was then measured when they attained the maximum active range of motion during a single repetition in each of the movement directions tested (flexion, extension, bilateral rotation and bilateral side flexion).

Prior to the cervical and shoulder strength testing participants undertook a standardised warm-up of self-resistance exercises, supervised by the tester. First, one isometric repetition at a self-perceived 50% maximum force was held for 4 s in each testing position. This was followed by a second repetition at self-perceived maximal (100%) force. Resistance was provided by either; the palm of the hand for cervical strength testing positions; or the opposite limb for shoulder strength testing positions. The sequence of positions used in the warm-up was identical to the sequence of positions used for the strength tests.

Cervical and shoulder strength was tested using the Gatherer System (Gatherer Systems Ltd, Aylesbury, UK), which has previously been used to test cervical and upper limb strength in Rugby Union players (Hamilton et al., 2014; Peek & Gatherer, 2005). This is

Table 1
Age group profiles [mean (SD)] for each front row position.

Age group	Players (n)	Age (y)	Height (cm)	Mass (kg)
Loose-head				
Age-grade	8	18 (1)	184 (3)	113 (6)
Senior	6	28 (5)	186 (5)	117 (5)
Total	14	23 (6)	185 (4)	115 (5)×
Hooker				
Age-grade	9	19 (1)	180 (4)	102 (4)
Senior	7	28 (4)	185 (3)	109 (3)
Total	16	23 (5)	182 (4)	105 (5)
Tight-head				
Age-grade	4	18 (1)	185 (8)	115 (4)
Senior	6	25 (4)	185 (5)	120 (4)
Total	10	22 (5)	185 (6)	118 (4)×
All front-row positions				
Age-grade	21	19 (1)	182 (5)	109 (7)
Senior	19	27 (5)**	185 (4)*	114 (6)*

× indicates significantly heavier than Hookers ($p \leq 0.05$). * indicates Senior significantly greater than Age-grade players ($p \leq 0.05$). ** indicates Senior significantly greater than Age-grade players ($p < 0.001$).

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