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Star excursion balance test performance and application in elite junior rugby union players

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ABSTRACT

Objectives: To evaluate performance on selected reach directions of the Start Excursion Balance Test (SEBT) in an elite underage rugby union population, and determine if differences exist between the forward and back position units. This information may have implications for the application of this test in player injury prevention and management.
Design: Descriptive study.
Setting: Gymnasium at an elite junior rugby union screening camp.
Participants: 102 healthy male elite rugby union players (age = 17.9 ± 1.1 years, height = 1.83 ± 0.07 m, body mass = 90.5 ± 11.3 kg).
Main outcome measures: Participants were assessed on the Anterior (A), Posterior-medial (PM), and Posterior-lateral (PL) reach directions of the SEBT.
Results: Normative data for SEBT performance in the A, PM and PL reach directions were established for an elite junior rugby union population. No significant differences in dynamic postural stability were observed between the forward and back position units.
Conclusions: This study provides normative SEBT data on an elite junior rugby union population, which enables clinicians to compare player dynamic postural stability and has implications for use in the prevention and management of player injuries.

1. Introduction

Rugby union is a field based sport consisting of two teams of fifteen players. It is a complex, contact sport, comprising of bouts of walking, jogging and running, interspersed with sprinting and static exertions (Cahill, Lamb, Worsfold, & Headey, 2013). Changes in direction and center of gravity, incorporating rapid reaction to other players' movements and events are required during play (Green, Blake, & Caulfield, 2011), and must be performed accurately with high velocity to execute game demands at a high level. The maturation of elite junior players to successful senior players is dependent upon the effective development of numerous physical, technical, tactical and psychological attributes required to complete game-related tasks. Physical attributes such as fundamental movement, mobility, agility, hypertrophy, strength, power and endurance, as well as sport specific skills have all been proposed as part of the Youth Physical Development Model (YPDM) (Lloyd & Oliver, 2012). This model provides a multistage overview of athletic development from early childhood (2 years of age) up to adulthood (21+ years of age). Dynamic postural stability is fundamental to the utilization of many of these attributes, with their effective execution being dependent upon the ability to maintain single leg control with concomitant multi-planar movement demands. Neuromuscular training is typically used by sports medicine and conditioning staff to enhance team preparation, performance and recovery and this form of training can be incorporated into team activities to improve dynamic postural stability (Filipa, Byrnes, Paterno, Myer, & Hewett, 2010; Plisky, Rauh, Kaminski, & Underwood, 2006), which is an integral component of lower limb neuromuscular control.

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The lower limb is the most commonly injured anatomical region in rugby union, with anterior cruciate ligament (ACL) injuries in forwards and hamstring injuries in backs responsible for the majority of missed days attributable to sustained lower limb injuries (Kaplan, Goodwille, Strauss, & Rosen, 2008). Previous research has demonstrated the potential for increased knee joint ligament loading during sidestepping and crossover cutting manoeuvres compared to straight line running; which has been attributed to the increased frontal and transverse plane moments generated during these high velocity multi-planar game tasks (Besier, Llyod, Cochrane, & Ackland, 2001). This may result in increased risk of injury to the ACL and knee collateral ligaments during cutting tasks, particularly at knee flexion angles of 0–40 degrees, if appropriate muscle activation strategies are not used to counter these increased moments. A recent systematic review identified the Star Excursion Balance Test (SEBT) as a highly representative dynamic postural stability test for physically active individuals (Gribble, Hertel, & Plisky, 2012). The SEBT requires the individual to move from a double to single-legged stance position while maximally reaching along set multidirectional lines with the opposite leg and touching down lightly on a tape measure with the distal end of the reach foot, without compromising equilibrium (Coughlan, Fullam, Delahunt, Gissane, & Caulfield, 2012). Application of the test in its original form of eight reach directions is time consuming in a clinical environment and there is sufficient evidence to support the reduction from eight directions to three [i.e. the Anterior (A), Posterior-medial (PM) and Posterior-lateral (PL)] (Hertel, Braham, Hale, & Olmsted-Kramer, 2006; Robinson & Gribble, 2008). These directions have been shown to assess unique elements of postural stability (Earl & Hertel, 2001) and may be useful in predicting future athletic injury (Plisky et al., 2006).

Numerous research studies have utilized the SEBT for screening and injury prevention in an athletic population, namely soccer (Daneshjoo, Mokhtar, Rahnama, Yosuf, &, 2012; Filipa et al., 2010; Thorpe & Ebersole, 2008), and basketball (Bicici, Karatas, & Baltaci, 2012; McLeod, Armstrong, Miller, & Sauers, 2009; Sabin, Ebersole, Martindale, Price, & Broglio, 2010) cohorts, however there are no previously published studies evaluating dynamic postural stability as quantified by performance on selected directions of the SEBT in rugby union. Owing to the importance of postural stability in the physical development of players and game related tasks, the purpose of this investigation was to evaluate SEBT performance in the A, PM and PL reach directions in a group of healthy elite junior rugby union players and investigate performance differences between position units in these directions. We expected that differences would exist between position units owing to the physical and tactical requirements of these players. This information may have implications for the use of this test in the prevention and management of player injuries.

2. Methods

2.1. Participants

One hundred and two male players from the national under-19 and under-18 rugby union squads who were participating in a musculoskeletal and fitness screening camp participated in the study (Table 1). Prior to testing, the participants signed an informed consent form and players under the age of eighteen co-signed this form with their parents/guardians. Inclusion criteria were selection for the national age-grade panel, no neurological or balance disorders, no history of lower extremity surgery or fracture, no lower extremity injury in the previous three months and no pain reported during the testing procedure. Players were categorized into position units (i.e. forward or back) based on their selection by coaching staff. The study was approved by the University College Dublin Human Research Ethics Committee.

2.2. Protocol

Leg length was measured with the participant lying supine on a plinth; the participant bridged to lift the hips off the table and then returned to the starting position. The investigator then passively straightened the legs to equalize the pelvis. Limb length was then measured in centimeters from the anterior superior iliac spine to the most prominent bony point of the ipsilateral medial malleolus with a standard tape measure. The reach directions were evaluated by affixing three tape measures to the gymnasium floor, one orientated anterior to the apex (A) and two aligned at 135° to this in the PM and PL directions (Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010). Intra-tester reliability (ICC) in these directions has been reported to range from 0.84 to 0.87 and test–retest reliability from 0.89 to 0.93 (Plisky et al., 2006). The order of the test leg and reach direction were randomized for each participant. Participants were provided with standardized instructions and a demonstration by a member of the research team in a familiarization session. Each participant undertook 4 practice trials in each direction to minimize learning effect (Munro & Herrington, 2010; Robinson & Gribble, 2008) immediately prior to the test session. The player's feet were measured and marked midway along the medial border of the foot. A line was drawn from this point laterally on the dorsal aspect of the foot in line crossecting with a line drawn up from the second toe. This was the point to be placed on the convergence of the tape measures. All trials were conducted barefoot to eliminate additional balance and stability gained from shoes (Gribble & Hertel, 2004a). Trials were deemed invalid if the participant removed his hands from the hips, movement or raising of the stance leg from the convergence point, failure to return to start position, placement of the reach foot at either side of the tape measure or application of sufficient weight

Table 1
Demographic information.

	Position	Mean	Standard deviation	95% CI	*P*-value	Effect size (partial eta squared)
Age (years)	Forward ($n = 59$)	17.64	0.79	17.48–17.79	0.59	0.00
	Back ($n = 43$)	17.57	0.88	17.40–17.75		
Height (m)	Forward	1.85	0.08	1.83–1.87	0.00	0.15
	Back	1.80	0.09	1.78–1.82		
Body mass (kg)	Forward	96.17	12.19	93.78–98.57	0.00	0.35
	Back	82.85	13.73	80.16–85.55		
Body mass index (kg/m^2)	Forward	28.08	3.46	27.40–28.76	0.00	0.19
	Back	25.62	3.90	24.86–26.39		
Left leg length (m)	Forward	0.98	0.06	0.97–0.99	0.00	0.12
	Back	0.94	0.07	0.93–0.96		
Right leg length (m)	Forward	0.98	0.06	0.97–0.99	0.00	0.12
	Back	0.94	0.07	0.93–0.96		