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Predictive factors for ankle syndesmosis injury in football players: A prospective study

Amy D. Sman[a,*], Claire E. Hiller[a], Katherine Rae[b], James Linklater[c], John Morellato[d], Nathan Trist[e], Leslie L. Nicholson[a], Deborah A. Black[a], Kathryn M. Refshauge[a]

[a] Faculty of Health Sciences, University of Sydney, Australia
[b] Sports Clinic, University of Sydney, Australia
[c] Castlereagh Imaging, Australia
[d] Department of Orthopaedic Surgery, University of Ottawa, Canada
[e] Department of Physiotherapy, North Shore Private Hospital, Australia

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ABSTRACT

Objectives: Up to 25% of all ankle injuries involve the ankle syndesmosis and factors that increase risk have yet to be investigated prospectively. This study aimed to identify predictors of ankle syndesmosis injury in football players.
Design: A prospective study.
Methods: Rugby Union and Australian Football League players were recruited during 2010. Rugby League and different Rugby Union players were recruited during 2011. Baseline data collection included: age, body size, flexibility, strength and balance. Bivariate correlations were performed between all predictors. Variables with $r \geq 0.7$ had only one variable entered in further analysis. Remaining predictor variables were analysed for association with the presence/absence of ankle syndesmosis injury. Variables with non-significant association with injury ($p > 0.2$) were included in a backward step-wise Cox regression model.
Results: 202 male participants aged 21 ± 3.3 years (mean $\pm$ SD) were recruited of whom 12 (5.9%) sustained an ankle syndesmosis injury. The overall incidence rate was 0.59/1000 h sport participation for Rugby Union and Rugby League. Australian Football League training data was not available. No significant predictors were identified; however, participants who sustained an injury during the season performed a higher vertical jump (63.6 ± 8.2 cm) and greater Star Excursion Balance Test reach (80.5 ± 5.3 cm), than participants who did not sustain an injury: 59.1 ± 7.8 cm for Vertical Jump and 77.9 ± 6.1 cm for Star Excursion Balance Test. This was normalised for height.
Conclusions: Variables such as age, body size, foot posture, flexibility and muscle strength did not increase risk of ankle syndesmosis injury. Jump height and balance performance may play a role in predicting ankle syndesmosis sprains.

1. Introduction

Acute ankle injuries are the most common injury incurred by athletic and sporting populations.[1,2] The prevalence of injuries to the distal tibiofibular joint or ankle syndesmosis has been reported to be between 1% and 25%[3,4] of all acute ankle joint injuries with recent incidence rates of 0.38/1000 athlete exposures being reported.[2] In addition, Kaplan et al. reported that 15% of 320 inter-collegiate football players attending the NFL Combine had sustained a previous ankle syndesmosis injury. Athletic activities such as football and rugby, with the inherent intensity of play and twisting and cutting demands are particularly susceptible to ankle syndesmosis injuries[5] with athletes often sidelined for the remainder of the season. However, the true incidence is likely to be underestimated due to missed diagnosis.[6]

Although the distal tibiofibular joint is technically a syndesmotic joint, the literature uses the term syndesmosis injury to describe damage to the ligaments of the distal tibiofibular joint (the anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL) and transverse ligament), the interosseous ligament and the interosseous membrane.[7] To avoid confusion, we have adopted the same strategy.

Ankle syndesmosis injury is a more serious injury than lateral ankle sprain. A study of professional NFL football over 6 years[8] found that players with injuries involving the ankle syndesmosis missed significantly more games and practice sessions, received

* Corresponding author.
E-mail address: amy.sman@sydney.edu.au (A.D. Sman).

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Table 1
Subject demographic data.

Variables	Uninjured ($n = 190$)	Injured ($n = 12$)	p-Value
Age (y)	21 (3.3SD)	20 (2.7SD)	0.51
Height (cm)	184.6 (5.9SD)	182.1 (6.2SD)	0.16
Weight (kg)	95.2 (13SD)	92.5 (10SD)	0.48
BMI (kg/m^2)	27.9 (3.1SD)	27.9 (2.2SD)	0.98
Sport (n)[a]			
Rugby Union	85	5	
AFL	23	1	
Rugby League	82	6	0.87

[a] Comparison between all three sports with the presence/absence of ankle syndesmosis injury.

more treatments, and experienced delayed recovery compared to those with typical ankle sprain. Persistent pain, prolonged recovery and heterotopic ossification are reported to be common complications following an ankle syndesmosis injury.[6]

Theoretical models of injury prevention dictate that both intrinsic and extrinsic risk factor identification is a necessary step required in the prevention of sports injuries.[9] Research investigating risk factors for ankle injuries has been primarily focussed on lateral ankle sprain,[8] with only one study[10] investigating ankle syndesmosis injury. The following risk factors were investigated in military cadets[10]: gender, type of sport, level of competition and body mass index (BMI). Factors identified to increase risk included: being male, level of competition, and exposure to certain sports. Additionally, a systematic review of lower limb injuries in athletes[9] identified studies which reported the following risk factors, particularly in football; level of competition, shoe type, age, gender, previous injury, aerobic fitness, body size, flexibility and muscle strength. Many of these tests have been incorporated as screening tests by trainers and coaches; however, no prospective study has identified risk factors for ankle syndesmosis injury. Therefore, the aim of this study was to identify predictors of ankle syndesmosis injury in players from several football codes.

2. Methods

A prospective study of predictive factors for ankle syndesmosis injury was conducted over two seasons, between 2010 and 2012. Ethics approval was obtained from the Human Ethics Research Committee at the University of Sydney, Australia (ID: 13099). Written informed consent was obtained from all participants. Where participants were aged 16–18 years, parental/legal guardian consent was obtained.

A total of 202 males aged 21 ± 3.3 years (mean $\pm$ SD) participated (Table 1). The majority of participants were right leg dominant (82.6%), 143 (70.6%) reported a history of ankle sprain and 47 (23.3%) a previous ankle syndesmosis sprain. One hundred and seven (53%) participants played a forward field position and 95 (47%) a back field position. Participants were recruited from both professional Rugby League (3 clubs) and amateur level Rugby Union (1 club) and Australian Football League (AFL) (1 club) clubs in Sydney and Canberra, and screened during their pre-season (November–February). Ninety-seven participants (Rugby Union, AFL) were studied from November 2010 to September 2011 and 105 different participants (Rugby Union, Rugby League) were studied from November 2011 to September 2012. Participants were included if over 16 years because the distal tibial epiphysis closes between 12 and 15 years.[11] The exclusion criterion was presence of symptoms at baseline testing that could affect performance.

Data were collected on-site at each participating club. The number of practice and game hours was collected weekly from the professional level clubs using their weekly team game lists and training schedules. Strength and conditioning trainers provided practice and game participation times for participant in amateur level clubs. Prior to baseline testing, participants completed a questionnaire including: age, height, weight (from which BMI was derived), type of sport played, playing position, competition level, previous ankle or syndesmosis sprain(s) and previous lower body injuries. Lower limb dominance was determined according to three basic activities; (1) kick an imaginary ball, (2) stamp on the ground, (3) hop on one leg. All predictor variables were measured by trained assessors at the commencement of the pre-season training period using standardised tests. All assessors underwent at least one training session to ensure standardised performance of the tests and consistent interpretation of findings. The order of test performance, the order of the directions to be tested and test leg for each of the measured predictor variables were randomised using a web-based randomisation program; www.randomizer.org. Participants performed three trials for each test on each leg, unless otherwise stated. The best trial was used for analysis.

Restricted dorsiflexion range of motion measured by the weight bearing lunge test contributes to lower extremity injuries.[12] The weight bearing lunge test has been well documented,[12] and has excellent intra-rater (ICC; range 0.97–0.99) and inter-rater (ICC; 0.99) reliability.[12,13] We measured the distance from wall to heel (nearest 0.1 cm).

Isokinetic ankle strength increases risk of ankle injury in college athletes.[14] Reliability for inversion and eversion strength is excellent for both intra-rater (ICC range 0.78–0.98) and inter-rater reliability (ICC range 0.74–0.88).[15,16] We used a Lafayette push–pull hand-held dynamometer[17] with a 'make' test as it is more reliable and comfortable for the participant,[15,16] and minimised injury risk during testing.[15] Participants were seated with the knee flexed at 5–10 degrees and the ankle in neutral position. Participants performed one sub-maximal practice trial on each foot in each direction for familiarisation. Standard verbal encouragement was given.

The standing heel rise test is a common clinical test of calf muscle fatigue.[18] Recent studies have found that musculoskeletal injury incidence in football players increases as the game or season progresses.[4,19] This could be due to neuromuscular fatigue which may have a negative influence on postural control and thereby increase the risk of injury.[9,20] We developed a new clinical device (IP Australia innovation patent AU2012101251) that provided standardised measures of the test with excellent inter-rater reliability ($ICC_{2,1}$ 0.97, CI: 0.94–0.98). Participants performed maximum single-leg heel rises in rhythm with a metronome set at 23 heel rises/min until the test was either not completed correctly on two consecutive occasions, or the participant could no longer perform a heel rise.[21] One trial for each limb was recorded.

Evidence suggest that a decreased postural stability as quantified by specific reach directions of the SEBT increases the risk of ankle injury.[22] The SEBT is well-documented, and has high reliability documented across different studies ($ICC_{2,1} = 0.78–0.96$).[23] Anterior, postero-medial and postero-lateral directions were measured and normalised to the participants leg-length.[22,23] We used a composite reach distance score of the anterior, postero-medial and postero-lateral directions for analysis. Participants were allowed three practice trials for each of the three directions for each limb to familiarise themselves with the test and its protocol.

It has been suggested that a decreased vertical jump (VJ) increases risk of contact injury in Rugby.[24,25] Therefore, we used a 'Vertec^{TM} device' or a vertical jump testing mat to measure jump height. Reliability for both methods is high (both $ICC_{2,2} = 0.99$) and both methods are highly correlated ($r = 0.91$, $p \leq 0.001$).[26] The test required a counter-movement jump with arm swing without taking a step. Participants were allowed one practice trial for familiarisation. When the Vertec^{TM} was used, participants touched the highest possible slat during the jump and the jump height was normalised