Journal of Science and Medicine in Sport 19 (2016) 766–770

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Hip adduction and abduction strength profiles in elite, sub-elite and amateur Australian footballers

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ARTICLE INFO

Article history:
Received 6 August 2015
Received in revised form
18 November 2015
Accepted 6 December 2015
Available online 18 December 2015

Keywords:
Adduction-to-abduction ratio
Australian Football League
Groin
Sprains and strains
Muscle strength dynamometer
Isometric contraction

ABSTRACT

Objectives: It has been reported that obtaining an adduction-to-abduction strength ratio of 90–100%, and an adduction strength equal to that of the uninjured side, are suitable clinical milestones for return to sport following groin injury. Little is known about hip adduction and abduction strength profiles in Australian footballers. This study aimed to compare isometric hip adduction and abduction strength profiles between preferred and non-preferred kicking legs in elite, sub-elite and amateur Australian footballers.
Design: Cross sectional study
Methods: 36 elite, 19 sub-elite and 18 amateur Australian footballers, with a mean age of 24, 19 and 23 years respectively, were included. Maximal hip isometric adduction and abduction strength were measured using a hand held dynamometer with external belt fixation.
Results: There were no significant differences in isometric hip adduction ($p = 0.262$) or abduction ($p = 0.934$) strength, or the adduction-to-abduction ratio ($p = 0.163$), between preferred and non-preferred kicking legs, regardless of playing level. Elite players had significantly greater isometric hip adduction and abduction strength than both sub-elite (mean difference; adduction = 46.01 N, $p < 0.001$, abduction = 30.79 N, $p = 0.003$) and amateur players (mean difference; adduction = 78.72 N, $p < 0.001$, abduction = 59.11 N, $p < 0.001$). There was no significant difference in the adduction-to-abduction ratio between the playing levels ($p = 0.165$).
Conclusions: No significant differences were found between preferred and non-preferred kicking legs across the playing levels for isometric hip adduction, abduction or the adduction-to-abduction ratio. This may have implications for developing groin injury prediction and return to sport criteria in Australian footballers.

1. Introduction

Groin strains are the second most common type of muscle strain experienced in Australian football (AF).[1] The association between hip adductor muscle weakness and subsequent groin injury has been consistently demonstrated in a number of sporting populations including; professional ice hockey players[2], amateur soccer players[3],professional rugby league players[4], and elite junior AF[5,6] and soccer players.[6] Tyler et al. demonstrated that an adductor-to-abductor muscle strength ratio of less than 80%, was an even stronger predicator of groin injury than adductor strength alone.[2] Such findings that reduced adductor strength may precede the onset of groin injuries, have led to a number of sporting codes implementing pre-season hip strength screening, to identify players at risk of developing groin strains. A number of clubs in the Australian Football League (AFL) have reported that they regularly screen hip adductor muscle strength for the prevention and management of osteitis pubis[7], however the adduction-to-abduction strength ratio has not been reported for Australian footballers.

Groin injuries are prevalent amongst all levels of AF. However, it has been reported that junior elite players (under 18's), have a higher incidence of groin injuries compared to senior elite players.[8] Differences in muscle strength may account for the differences in the reported injury rates amongst different playing levels, however there has been little research into the differences in muscle strength profiles across the different playing levels of AF.

Lower extremity strength screening not only plays an important role in identifying individuals at risk of muscle strains, but it is also used as a method to determine readiness to return to play following injury.[9] Tyler et al. reported that obtaining

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http://dx.doi.org/10.1016/j.jsams.2015.12.005
1440-2440/

an adduction-to-abduction strength ratio of 90–100%, and an adduction strength equal to that of the uninjured side, were suitable clinical milestones for return to sport following a groin strain.[10] Similarly, it has been suggested that following hamstring injuries, an individual should wait until the injured hamstring strength is 90–95% of the uninjured side.[11–13] These recommendations are only suitable if hip strength is symmetrical between the legs in un-injured players.

It has been demonstrated that hip adduction symmetry cannot be assumed in injury free elite soccer players.[14,15] Thorborg et al. has demonstrated that the preferred kicking leg is significantly stronger than the non-preferred leg in eccentric hip adduction[15] and isometric hip adduction and abduction.[14] However the hip adduction-to-abduction ratio was not different between the legs.[14] Establishing adduction-to-abduction strength ratios and determining whether there is symmetry in hip strength profiles in AF players may assist in the development of injury prediction criteria and return to sport indicators.

Therefore the aim of this study was to establish if there were any significant differences in hip adduction and abduction strength profiles between the preferred and non-preferred kicking legs in AF players. A secondary aim was to determine if there were any differences in hip strength profiles across different playing levels.

2. Methods

AF players were recruited from three different clubs, representing different playing levels. Elite players were recruited from a club in the AFL, sub-elite from the West Australian Football League (WAFL) and amateur from the West Australian Amateur Football League (WAAFL). Players were included if they were males aged 18–35 years, played AF for at least five years and currently be playing AF at a minimum of one training session and one game per week. Players were excluded if they had sustained a lower limb injury which caused them to miss one or more games within the six months prior to testing, experienced pain during testing or were unable to provide a maximal voluntary contraction. Ethical approval was obtained from the universities Human Research Ethics Committee (PT256/2013), and all participants provided written informed consent prior to participation.

All assessments were completed during the 2014 pre-season training period. Pre-season timeframes varied for the different playing levels, so testing was completed between December 2013 and April 2014. All testing was completed prior to training, to allow for consistent testing conditions across the clubs, which all had different training volumes and intensities. Each player was required to complete a questionnaire prior to testing to determine their; age, height, body mass, preferred kicking leg, injury history and playing history. Maximal voluntary isometric hip adduction and abduction strength were measured for both the preferred and non-preferred kicking legs, using the protocol detailed below. The adduction-to-abduction ratio was calculated based on these measures, by dividing the maximal adduction score by the maximal abduction score. The order of testing (adduction or abduction) and kicking leg (preferred or non-preferred) were randomised for each player by the toss of a coin.

Hip adduction and abduction isometric strength were measured using a hand-held dynamometer (HHD) with external belt-fixation.[16] The HHD utilised was a Power Track II commander JTECH HHD (JTECH Medical, Salt Lake City, Utah), which was calibrated prior to data collection on each testing day. The testing setup also included a portable massage table, fixation-belt and a glass suction cup. Using HHD with external belt-fixation has been demonstrated to have excellent inter-tester reliability when assessing hip strength in strong individuals.[16] The use of belt-fixation removes the bias of tester strength, which is particularly important when assessing strong athletes, where the strength of the athlete may exceed the strength of the tester.[16]

Two physiotherapists performed the strength assessments. While the inter-rater reliability of the testers was not performed, the assessors completed a familiarisation session together, to ensure they were both following the standardised protocol. Tester 1 measured the elite players and tester 2 assessed both the sub-elite and amateur players. Both testers followed the protocol previously described by Thorborg et al.[16,17] Sub-maximal familiarisation trials were provided for both adduction and abduction tests to ensure the players were performing the correct action of pushing into the belt and HHD. Four efforts were completed for each strength measurement, two warm up efforts at 50% and 75% of maximal voluntary contraction, then a further two efforts at 100% of maximal voluntary contraction, all of which were held for 5 s. The strongest of the 100% maximal voluntary contractions was used for statistical analysis. A 30 s rest between trials was given to avoid fatigue.[16] The tester made use of a standardised command, to standardise the amount of encouragement given to each player of "go ahead, push, push, push, push and relax".[14]

Data were analysed using IMB SPSS Statistics for Windows version 22 (IMB Corp., 2013, Armonk, NY). All data were assessed for normality using the Shapiro–Wilk Test, and found to be normally distributed. Demographic information was calculated and are presented as means and standard deviations. A series of one-way analysis of variance were used to assess if there were any significant differences in demographics (age, body mass and height) between the playing levels. Post hoc tests using the Bonferroni adjustments were performed for any significant main effects.

A series of two-way analysis of covariance (ANCOVAs) were conducted to determine the effects of playing level (elite, sub-elite and amateur) and kicking leg (preferred and non-preferred) on; peak hip adduction isometric strength, peak hip abduction isometric strength and hip adduction-to-abduction isometric strength ratio; after controlling for age, body mass and height. Data are presented as adjusted and un-adjusted means and standard deviations. Post hoc analyses were performed with a Bonferroni adjustment. All post hoc tests are presented using mean differences with 95% confidence intervals (CI). For all analyses, an alpha level was set at $p < 0.05$.

3. Results

A total of 79 players were recruited for this study. Four players were excluded due to injury and a further two for a lack of football experience as they were new recruits to the elite playing group at the time of testing. The final sample size included 36 elite, 19 sub-elite and 18 amateur players. There were significant differences in age, height and body mass between the different playing levels (Table 1). Post hoc tests demonstrated that sub-elite players were significantly younger than the elite (mean

Table 1
Descriptive information for the elite, sub-elite and amateur Australian football players (mean ± standard deviation).

Descriptive	Elite ($n = 36$)	Sub-elite ($n = 19$)	Amateur ($n = 18$)	p value
Age (years)	24.11 (±3.44)	19.37 (±1.46)	22.89 (±4.23)	<0.001[a]
Height (cm)	188.93 (±6.55)	182.11 (±5.70)	182.78 (±6.80)	<0.001[a]
Body mass (kg)	87.81 (±7.91)	79.16 (±5.83)	87.61 (±14.38)	0.005[a]
Preferred kicking leg (R/L)	29/7	15/4	15/3	

L, left leg; R, right leg.
[a] Significant difference between the playing levels, $p < 0.05$.