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In-season monitoring of hip and groin strength, health and function in elite youth soccer: Implementing an early detection and management strategy over two consecutive seasons

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ABSTRACT

Objectives: The primary purpose of this study was to describe an early detection and management strategy when monitoring in-season hip and groin strength, health and function in soccer. Secondly to compare pre-season to in-season test results.
Design: Longitudinal cohort study.
Methods: Twenty-seven elite male youth soccer players (age: 15.07 ± 0.73 years) volunteered to participate in the study. Monitoring tests included: adductor strength, adductor/abductor strength ratio and hip and groin outcome scores (HAGOS). Data were recorded at pre-season and at 22 monthly intervals in-season. Thresholds for alerts to initiate further investigations were defined as any of the following: adductor strength reductions >15%, adductor/abductor strength ratio <0.90, and HAGOS subscale scores <75 out of 100 in any of the six subscales.
Results: Overall, 105 alerts were detected involving 70% of players. Strength related alerts comprised 40% and remaining 60% of alerts were related to HAGOS. Hip adductor strength and adductor/abductor strength ratio were lowest at pre-season testing and had increased significantly by month two ($p < 0.01$, mean difference 0.26, CI95%: 0.12, 0.41 N/kg and $p < 0.01$, mean difference 0.09, CI95%: 0.04, 0.13 respectively). HAGOS subscale scores were lowest at baseline with all, except Physical Activity, showing significant improvements at time-point one ($p < 0.01$). Most (87%) time-loss were classified minimal or mild.
Conclusions: In-season monitoring aimed at early detection and management of hip and groin strength, health and function appears promising. Hip and groin strength, health and function improved quickly from pre-season to in-season in a high-risk population for ongoing hip and groin problems.

1. Introduction

Groin injuries affect both youth and senior soccer players at various levels of the sport.[1–3] On average, professional men's teams sustain seven time-loss injuries per season with most resulting in moderate to severe time-loss[3] and when non-time-loss injuries are included the injury rates may be even higher.[1] Most groin problems in soccer appear to be of gradual onset[1] and they seem to deteriorate over time.[4] This has prompted close monitoring of players in-season to facilitate early detection and management of groin problems.[4]

The demands of soccer impacts on hip adductor strength in elite male youth players.[5] Kicking and change of direction loads in soccer require substantial hip adductor activity and strength.[6–8] It is therefore not surprising that playing soccer with hip adductor strength deficits increases the risk of groin injury[2] and that lower hip adduction/abduction strength ratios and eccentric adduction strength are present in players with groin problems.[9,10] Additionally, adductor strength reductions have been shown to precede the onset of groin pain.[11] This demonstrates a latent period, a subclinical state, from

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onset of adductor strength reductions to development of clinical symptoms. Further, players with current groin problems and those with a groin injury in the previous season demonstrate significantly lower scores on all six subscales of the hip and groin outcome score (HAGOS).[4,12] The HAGOS is a patient reported outcome measure that has been validated in soccer players and can differentiate between those with and without hip and groin problems.[13,14] Its use has been supported to capture minor and/or overuse injuries.[15]

To date, primary groin injury prevention protocols have failed to demonstrate a significant effect, possibly due to challenges around implementation and compliance.[16,17] Secondary prevention strategies may provide an alternative and/or complement primary prevention approaches in reducing the groin injury burden by limiting time-loss. Secondary prevention aims to identify signs of hip and groin health problems early, to allow for timely management in the subclinical phase to prevent deterioration of the problem by implementing indicated preventative measures.[18] Indicated preventative measures are applied to individual players and includes load management and regular re-testing.[18] This approach may enable clinicians to detect groin problems prior to players recognising or reporting them as an injury. Secondary prevention strategies require valid and reliable clinical screening tests that can detect players with or at risk of developing injury. Available evidence suggests that hip adductor strength, adductor/abductor strength ratio and HAGOS are appropriate to include in a secondary groin injury prevention strategy.[2,10,19]

The primary purpose of this study was to describe an early detection and management strategy when monitoring in-season hip adductor strength, adductor/abductor (add/abd) strength ratio and HAGOS, against thresholds related to groin problems in soccer. Secondly to compare pre-season (baseline) data with in-season results.

2. Methods

Twenty-seven male U17 Australian soccer players and their parents or legal guardian provided written informed consent to participate in the study. The players were selected from part-time training centres to commence full-time training at the football association's centre of excellence program. All players volunteered to participate in this study, which was approved by the Australian Institute of Sport and La Trobe University Human Ethics Committees.

Prior to commencing training, players completed standardised screening including pre-season testing of hip adductor strength, add/abd strength ratio and HAGOS. Furthermore, anthropometric data and a record of past injury and training history were collected. Monthly in-season testing occurred, across 22 time-points, on the morning of the first regular training day back after a rest day (generally 40 h post-match). Each time-point involved testing ten criteria: hip adductor and add/abd strength ratio on each leg and HAGOS (6 subscales), meaning that a maximum of ten alerts could be triggered per player. Unilateral adductor and abductor strength was tested in supine based on a previous report.[20] A 'break' test was used to introduce an eccentric component, since this can better identify players with current groin problems compared to isometric strength testing.[10] Warm-up consisted of two repetitions (five seconds) separated by ten second rest. A twenty second rest period prior to a single maximal test was applied to realistically allow testing of a squad in an acceptable time. Reliability of strength testing was investigated in ten players without a history of groin injury. The inter-rater intra-class coefficient two-way random model results were: adduction 0.86, abduction 0.87 and add/abd strength ratio 0.76. Minimal detectable change ($MDC = SEM \times 1.96 \times \sqrt{2}$)[21] results were: adduction 13.9%, abduction 14.6% and add/abd strength ratio 21%. Strength was recorded with a hand-held dynamometer (Micro FET2, Hoggan Health West Jordan UT, USA). Data were captured in Newtons and converted to N/Kg (peak force/body mass). Testing was performed by two male physiotherapists. A strength related alert included at least one of adductor strength reductions >15% and hip ratio <0.90. Mean (SD) hip ratio of 0.80 (±0.14) and 0.92 (±0.23) has been reported in soccer players with groin problems[9,10] and recent normative eccentric add/abd strength ratio data in professional players ranged from 0.9 to 1.4.[22]

Players completed an electronic version of the HAGOS including all subscales at each time point. All questionnaires were answered in full. The HAGOS has six subscales; Pain, Symptoms, Activities of daily living (ADL), Sport & recreational activities (Sport), Participation in physical activity (PA) and Quality of living (QOL).[13] Each subscale is scored 0–100 where higher scores indicate better hip and groin health.[13] In this study HAGOS alerts were defined by a score <75 out of 100 in any of the subscales since it best fits the 95% reference range, across all subscales, in differentiating soccer players with or without groin problems.[23] Clinical examination was conducted in accordance with the Doha consensus statement.[24] Unrestored strength reductions at re-testing and after multi-modal interventions were considered subclinical presentations requiring load management as an indicated preventative measure. Time-loss was calculated for detected injuries and subclinical presentations requiring load management. Time-loss was classified as: minimal (1–3 days), mild (4–7 days), moderate (8–28 days) and severe (>28 days).[3] The early detection and management process is outlined in Fig. 1.

Players declared themselves fit to commence training at pre-season testing. During the 22-month study period, the team played 87 matches involving two domestic competitions annually and international tournaments. The team completed 336 days of soccer training during the study period and there were no extended season breaks. Due to team logistics players were not available for strength testing in months 11, 12, 16 and 21.

Due to the study being performed in the applied soccer setting it required managing player findings and did not allow for a 'wait and see' approach. Consequently, players identified with alerts at pre-season and in-season testing proceeded per the outlined monitoring and clinical process (Fig. 1). Individual multi-modal management plans incorporated manual therapy, hip muscle activation and strength exercise programs to complete until strength reductions were restored. Exercise programs focused on simple, traditional weighted and elastic band resisted hip adduction and abduction that incorporated isometric, concentric and eccentric contraction modes known to activate the main hip muscle groups[25] and improve adductor strength in soccer players.[26] Injury rehabilitation comprised of contemporary groin management[27] and aforementioned exercises.[25,26] Additionally, the team performed 20 min of hip muscle activation, balance and pelvic stability exercises prior to training 1–2 times per week supervised by a physiotherapist. Exercises included lateral band walks, star excursion lunges with ball movement, banded hip bridging, isometric adduction, balance with football skills and jump/landing practices.

A linear mixed model was used to investigate if the outcome measures changed from baseline at any of the 22 time-points. Normality of the strength data was confirmed by visually assessing the Q–Q plots of the residuals. The HAGOS variables demonstrated some deviation of normality in the tails of the distribution, however fixed effects estimates are known to be robust under heavy-tailed conditions.[28] The dependent variables (HAGOS and strength) were treated as fixed variables and random intercept for subjects were included in the model to allow baseline values of the fixed variables to vary between subjects. The Welch's t-test was used to investigate if there were any differences in time-loss between groin problems detected at pre-season screening compared to those identified in-

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