



# No association between surface shifts and time-loss overuse injury risk in male professional football



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## ABSTRACT

**Objectives:** To investigate frequent surface shifts and match play on an unaccustomed surface as potential risk factors for injury in Scandinavian male professional football.

**Design:** Prospective cohort study.

**Methods:** Thirty two top-division clubs (16 Swedish, 16 Norwegian) were followed during seasons 2010 and 2011. The influence from (1) number of surface shifts (between artificial turf and grass) during five-match sequences, and (2) match play on an unaccustomed surface (other surface than on the home venue) on subsequent overuse injury risk was evaluated with generalized estimating equations (GEE). GEE results are presented with risk ratios and 95% confidence interval (CI). Injury rate was expressed as time loss injuries/1000 h, and compared between groups with a rate ratio and 95% CI.

**Results:** No association was found between the number of surface shifts and subsequent overuse injury risk (risk ratio 1.01, 95% CI 0.91–1.12). Furthermore, no difference was seen in subsequent overuse injury risk after match play on unaccustomed compared with accustomed surface (risk ratio 1.04, 95% CI 0.78–1.38). Grass clubs (grass installed at home venue) had a lower match injury rate when playing away matches on artificial turf compared with away matches on grass (rate ratio 0.66, 95% CI 0.40–0.89).

**Conclusions:** This study showed no association between surface shifts or playing matches on an unaccustomed surface and time-loss injury risk in professional football, suggesting that clubs and players can cope with such surface transitions.

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## 1. Introduction

Third-generation artificial turf (AT) is increasingly used as a playing surface for football worldwide, and in the Scandinavian countries AT is used at all levels of play. Previous injury surveillance studies in male and female elite,<sup>1–3</sup> male and female intercollegiate,<sup>4,5</sup> and male and female youth level,<sup>6–8</sup> have found no overall differences in acute injury rates between natural grass (NG) and AT. However, one study found a decreased overall injury rate on AT in female intercollegiate football,<sup>9</sup> but this study used different injury and exposure definitions compared with previous studies which make comparisons difficult. Recently, data from Scandinavian male professional football showed that clubs with

AT installed at their home arenas had higher general injury rates compared with clubs having NG installed at their home arenas, especially regarding overuse injuries.<sup>3</sup> However, this increased injury rate for AT clubs was evident on both playing surfaces, and it was thus suggested that the higher injury rate could not be attributed to high AT exposure per se, but possibly due to more frequent surface shifts among the AT clubs. Owing to different surfaces at clubs' home venues, shifts between playing surfaces frequently occur in Swedish and Norwegian football. Frequent surface shifts have been proposed as a risk factor for football injury,<sup>3,10</sup> but this has not been directly evaluated.

The primary aim of this study in male professional football was to investigate the influence of frequent surface shifts, and from playing matches on an unaccustomed surface, on overuse injury risk. The secondary aim was to evaluate if match play on unaccustomed surface influence injury rates during that particular match. Our hypotheses were that frequent surface shifts are associated

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with an increased overuse injury risk, and that match play on unaccustomed surface is associated with an increased injury rate in that particular match as well as increased overuse injury risk in the three-day period after the match.

## 2. Methods

In total, 32 clubs in the male professional leagues in Sweden (16 clubs) and Norway (16 clubs) were followed prospectively for two consecutive seasons, 2010 and 2011 (Appendix 1). The study protocol harmonizes with the Declaration of Helsinki and was approved by the Local Ethics Committees in Linköping, Sweden (Dnr: M240-09) and Region Øst-Norge and the Norwegian Social Science Data, Norway (S-06188), respectively.

The development of the study design has been presented previously.<sup>11</sup> Briefly, all players with a first-team contract were invited to participate. Players who were injured at the start of the study were included, but their present injuries were excluded. A player who left a club during the study period was included for as long as he participated. General cohort characteristics have been published previously.<sup>3</sup>

A representative from each club's medical team was responsible for reporting injury and exposure data to the research group. An injury form was filled in for all injuries with questions regarding injury date, activity (type of match or training), injury type, injury location, injury mechanism and, for acute injuries, whether the injury occurred on AT, NG or any other playing surface (Appendix 2). An exposure form included individual participation in club training and match exposures in minutes and the playing surface (Appendix 3a–c). Injury and exposure forms were sent to the study group on a monthly basis. To ensure correct data, the study group controllers checked all data sent from the participating clubs within a few days after its arrival. Prompt feedback was sent regularly to all clubs in order to ensure correct data.

The general injury and exposure definitions were consistent with the consensus statement established for injury studies in football.<sup>12</sup> A recordable injury was a time-loss injury, i.e., a physical complaint sustained during football training or match play leading to a player being unable to fully participate in future training or match play. Players were regarded as injured until they were declared fit by the medical team to be able to fully participate in all types of football training and be available for match selection. Acute injuries were defined as injuries with a sudden onset and known cause, whereas overuse injuries had an insidious onset and no known trauma.<sup>12</sup> A re-injury was defined as an injury of the same type and at the same site as and index injury. Re-injuries and index injuries were handled as two separate injuries in these analyses. Injury severity was based on the number of days of lay-off from football caused by the injury, and were categorized into: slight (0 days), minimal (1–3 days), mild (4–7 days), moderate (8–28 days), and severe injuries (>28 days). Clubs were defined as AT clubs or NG clubs according to the surface installed at their home venues. Accustomed surface was defined as the surface (AT or NG) each club had installed at their home venue and, vice versa, the other surface was defined as unaccustomed surface for that club.

For analyses on the association between frequency of surface shifts, and match play on accustomed vs. unaccustomed surface, and overuse injury risk, a generalized estimating equation (GEE) with a binominal distribution and log link model was used. Each competition match at player individual level was used as an observation. The outcome was any overuse injury  $\leq$  three days after each match observation. First, analysis was made to study potential associations between frequent surface shifts during five-match sequences and subsequent overuse injury risk. For each match observation (starting with the fifth competition match each season), the number of surface shifts in the previous match

sequence (four previous matches + the match observation) was used as an independent variable. Players with exposure from  $\geq$  four matches in the previous match sequence and the match observation were included. Match frequency in the previous match sequence (days during sequence) and match location at match observation (home/away) were included as covariates. Second, analysis was made to compare the risk of overuse injury when playing matches on accustomed vs. unaccustomed surfaces. In this analysis, all competition matches and players with any exposure at each match observation were included. GEE results are presented with risk ratios and 95% confidence intervals (CI). The GEE approach allowed assessment of potential club clustering effects and within-player variations but none of these were found to significantly affect the outcome of the analyses.

Analyses were also made to compare crude injury rates on accustomed vs. unaccustomed surfaces, at different match locations. This was made by comparing injury rate at (a) home matches (AT or NG), (b) away matches on AT and (c) away matches on NG. These analyses were made for AT and NG clubs, separately. Pre-season football activities in Sweden and Norway (from the beginning of January to the middle or end of March) are largely carried out indoors or outdoors on AT.<sup>3</sup> Therefore, only the competitive part of each season was included (starting with the primary competition match for each team and season. Injury rate is expressed as the number of injuries/1000 h with 95% CI, using a rate ratio with corresponding 95% CI, and significance was tested with z-statistics.<sup>13</sup> Injury rate data were plotted in histograms and distributions of data were determined by visual inspection. Data were approximately normally distributed, and z-statistics is therefore applicable. All analyses were two-sided and the significance level was set at  $p < 0.05$ .

## 3. Results

In the analysis of association between the number of surface shifts during a match sequence and subsequent overuse injury risk, 1806 match observations were included. The mean  $\pm$  SD number of surface shifts in the previous match sequence was  $1.9 \pm 1.4$ . No association was found between the number of surface shifts in the previous match sequence and subsequent overuse injury risk (risk ratio 1.01, 95% CI 0.91–1.12).

Regarding overuse injury risk in the three-day period after matches on unaccustomed vs. accustomed surface, a total of 1915 match observations were included. No difference was seen in overuse injury risk after match play on unaccustomed vs. accustomed surface (risk ratio 1.04, 95% CI 0.78–1.38).

For analyses of injury rate when playing on unaccustomed vs. accustomed surface, 31,443 h total match exposure (14,992 h at home arenas, 10,513 h at away matches on NG and 5,938 h at away matches on AT), and 699 injuries (327 sustained at home arenas, 253 at away matches on NG and 119 at away matches on AT) were included. NG clubs had a lower total injury rate (rate ratio 0.66, 95% CI 0.49–0.89) when playing away matches on AT compared with away matches on NG (Fig. 1). No differences were found when comparing NG clubs injury rates at home matches vs. away matches on AT, or home matches vs. away matches on NG. AT clubs had no differences in injury rate when playing home matches, away matches on AT or away matches on NG (Fig. 1).

## 4. Discussion

This study showed no association between surface shifts or playing matches on an unaccustomed surface and time-loss injury risk in professional football, suggesting that clubs and players can cope with such surface transitions. Interestingly, clubs normally

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