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A Prospective Analysis of the Injury Incidence of Young Male Professional Football Players on Artificial Turf

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Abstract

Background: The effects of synthetic surfaces on the risk of injuries is still debated in literature and the majority of published data seems to be contradictory. For such reasons the understanding of injury incidence on such surfaces, especially in youth sport, is fundamental for injury prevention.

Objectives: The aim of this study was to prospectively report the epidemiology of injuries in young football players, playing on artificial turfs, during a one sports season.

Patients and Methods: 80 young male football players (age 16.1 ± 3.7 years; height 174 ± 6.6 cm; weight 64.2 ± 6.3 kg) were enrolled in a prospective cohort study. The participants were then divided in two groups; the first included players age ranging from 17 to 19 (OP) whereas the second included players age ranging from 13 to 16 (YP). Injury incidence was recorded prospectively, according to the consensus statement for soccer.

Results: A total of 107 injuries (35 from the OP and 72 from the YP) were recorded during an exposure time of 83.760 hours (incidence 1.28/1000 per player hours); 22 during matches (incidence 2.84/1000 per player hours, 20.5%) and 85 during training (incidence 1.15/1000 per player hours, 79.5%). Thigh and groin were the most common injury locations (33.6% and 21.5%, respectively) while muscle injuries such as contractures and strains were the most common injury typologies (68.23%). No statistical differences between groups were displayed, except for the rate of severe injuries during matches, with the OP displaying slightly higher rates compared to the YP. Severe injuries accounted for 10.28% of the total injuries reported. The average time lost due to injuries was 14 days. Re-injuries accounted for 4.67% of all injuries sustained during the season.

Conclusions: In professional youth soccer injury rates are reasonably low. Muscle injuries are the most common type of injuries while groin and thigh the most common locations. Artificial turf pitches don't seem to contribute to injury incidence in young football players.

Keywords: Football, Injuries, Incidence, Soccer, Young

1. Background

Environmental issues such as adverse climatic conditions (cold and hot climates) limit the growth of natural grass pitches. For such reason, artificial turfs have been introduced as a solution to overcome the main disadvantages of using natural grass pitches for football competitions. Natural grass has apart from weather dependency, high maintenance costs and its use must be restricted, due to the concerns over wear and tear. The latest generation of artificial turf pitches were introduced in the late 2000s and consist of a carpet of long (> 40 mm) and widely spread fibers of polypropylene, filled with sand and rubber grains (1). These materials have been used by the International Federation of Football Association (FIFA) since 2004/2005 (2) for competitions or matches, as a valid alternative to natural grass pitches. However, a major concern regarding artificial turf is its shock absorption capacity. As shown by Naunheim et al. (3) repeated pressures on the pitch can cause compacting of the rubber based surface making it harder than natural grass pitches. Interestingly, a comparison between different artificial turf surfaces (old generation foam surface and new generation shredded rubber based surfaces) and natural grass has shown that there are no significative differences in the shock absorption capacity, either between the old and new generation artificial turfs or the natural grass pitches (3). Such evidence however does not

clarify if artificial surfaces are safe or not in the matter of injury prevention. A review from Williams et al. (4) highlights contradictory findings between a variety of studies in this field. According to the above-mentioned evidence, the surface typology has to be seriously considered when training or competing, since it could be a factor potentially influencing the number of injuries (5, 6). Meyers et al. (7, 8) studying the difference between injury rates on artificial turf and natural grass indicates that in many cases artificial turf is safer than natural grass. In addition, several authors report that there are no differences in injury rates or differences in physiological parameters between artificial and natural turf (9-11).

Ekstrand et al. (12) have compared the injury rates on artificial turf compared to natural turf in male professional players and found that the risk of injury wasn't statistically different between the two groups. Fuller et al. (13, 14) found no major differences in the incidence, severity and nature of injuries when studying male and female amateur players that both competed either on natural and artificial turf in colleges and universities in the USA. However, a more in depth analysis of scientific literature has provided measures of injury patterns or their incidence on artificial turf pitches mainly in adult football players (13, 15, 16); while youth football has so far received less attention. Despite the lower rate of youth football studies, in general, those who provide differences on injury patterns between different typologies of surfaces point out no significative differences between artificial and natural turfs (17-19). Another noteworthy observation is that, in general, in studies performed on young individuals, lower injury rates are usually displayed (20) if compared to those performed in adults (13, 15, 16).

2. Objectives

For such reasons, the aim of our study was to prospectively report the epidemiology of the injury patterns of young professional football players that trained and competed on artificial turf pitches, during a one year competitive season.

3. Patients and Methods

A total of 80 young male elite football players (age 16.1 ± 3.7 years; height 174 ± 6.6 cm; weight 64.2 ± 6.3 kg), belonging to the same team (U.S. Lecce Football Club, Serie A; based in Villa Contento, Novoli, Italy) were enrolled for this study. The participants were then divided in two groups; the first included the older players (OP) of the team (age range 17 to 19 years old) whereas the second included the younger players (YP) of the team (age range 13 to 16 years old). The OP groups included 23 players whereas the YP group included 54 players. The sample was divided in two groups, since the players had different times of exposure, due to their different age ranges. Injury typology and injury location were recorded for each player during one sports season (From July 2012 to May 2013). The players trained and competed on artificial turf pitches. The athletes were enrolled in the study according to the inclusion criteria approved by the local ethics committee. The principles of the Italian data protection act were observed. The over-age participants (18 years old or above) provided a written informed consent, whereas the under-age participants (17 years old or younger) provided an assent form and an informed consent signed by their parents. The study was performed in compliance with the Helsinki declaration.

The study followed the design of consensus on definitions and data collection procedures in studies of football injuries outlined by the FIFA (21, 22) and the Union of European Football Association (UEFA) (23). The "strengthening the reporting of observational studies in epidemiology" (STROBE) research checklist was adopted (24-26). The STROBE is a 22 item checklist that includes recommendations on what should be included in an accurate and complete report of an observational study.

Baseline data were collected at the start of the season. Individual players' exposure to training sessions and competitions was registered. The Sensor Medica Research Unit was responsible of the recording of each injury immediately after each pathological event on a standard form for injury recordings. These were sent to the research group at the end of each month (The Sensor Medica medical staff were the only ones responsible for recording the injuries). The injury form provided, was the consensus statement on injuries in football (21). This form contains information on the date of the injury, the scheduled activity, the typology and location of every injury and any re-injury, if occurred.

Injury severity was classified according to a time loss definition. Minor injuries were those causing absence from 1 - 6 days from training and competitions; moderate injuries were those causing absence from 7 - 30 days from training and competitions; severe injuries were those causing absence > 30 days from training and competitions. Re-injuries were classified as injuries of the same typology and at the same location as an injury occurring within 2 months after a player's return to full participation from an injury.

Incidence of injury was defined as the number of injuries per 1,000 player hours [(Σ injuries/Σ exposure hours) ×1,000 player hours].

In total, over the whole season the participants underwent 460 training sessions (The OP group was exposed to 160 training sessions of 120 minutes each, whereas the YP group was exposed to 300 training sessions of 120 minutes each) and 33 matches (The OP group was exposed to 18 matches of 90 minutes each whereas the YP group was exposed to 60 matches of 90 minutes each). The incidence rates were calculated according to these times of exposure. The primary outcome measure was the injury incidence (injuries/1000 per player hours of exposure) in training and match play. Secondary outcomes included injury location and typology as well as injury severity.

Injury incidences were calculated manually according to the number of injuries/1000 hours per player of exposure for each injury location and injury typology. Statistical analyses were performed through the "Statistica" software 8.0 for Windows (StatSoft Inc., Tulsa, OK, USA). A chi-squared test was used to detect significative differences when appropriate. Significance was set at $P < 0.05$.

4. Results

In total, 83.360 hours of exposure were displayed for the whole sample (75.600 hours during training and 7.760 during matches. These were 24.302 from the OP and 59.058 from the YP; 21.984 and 2.318 vs. 53.616 and 5.442 from training and matches of the OP and the YP, respectively). On average each player participated in 26 matches and underwent 153 training sessions (median values being 30 and 150, respectively). The injury incidence of the sample was 1.28 injuries per season. A total amount of 107 injuries were registered, with 22 (20.56% with an incidence of 2.84) occurring during matches and 85 (79.43% with an incidence of 1.15) during training. Such injuries were also divided by group with 35 from the OP (25 from training and 10 from matches) and 72 from the YP (60 from training and 12 from matches). The location and typology of injuries are shown in Tables 1 and 2. Muscle injuries (including strains and contractures), were the most common injury typologies. While the thigh and the groin were the most common injury locations. Other common injury typologies were tendon injuries (13% of injuries). Severe injuries (causing absence for > 30 days) accounted for 10.28% of all injuries (Table 3). The most common subtypes of severe injuries (According to the time lost from training and matches) were strains (n = 3, 27.27%) and contractures (n = 3, 27.27%). Also tendon injuries (n = 2, 18.18%), were common in these populations. None of the severe injuries required surgery. No significant differences were found between groups neither for the incidence of injuries location or typology both for training sessions and matches. The only significant difference (P 0.04) was found between the rate of severe injuries of matches, being the OP more subject to injuries. On average, each player missed 14 days due to injuries during the season. This means that approximately from 5 to 6 % of the season is lost due to injuries if we assume that a season lasts 300 days. Re-injuries constituted 4.67% of all injuries and caused a non-significantly longer absences than non re-injuries in the sampled population (17 vs. 14 days, $P > 0.05$).

Table 1. Incidence of Injuries as a Function of Location

Typology of Injury	Training [a]			P Value [b]	Match [a]			P Value [b]	Total [a]			P Value [b]
	OP	YP	Total		OP	YP	Total		OP	YP	Total	
Trunk, lower back/pelvis/ sacrum				0.787				0.406				0.944
Lower limb	5 (0.22)	9 (0.17)	14 (0.19)		0 (0)	3 (0.55)	3 (0.55)		5 (0.20)	12 (0.20)	17 (0.20)	
Hip/groin	5 (0.22)	16 (0.31)	21 (0.29)		0 (0)	2 (0.37)	2 (0.37)		5 (0.20)	18 (0.31)	23 (0.27)	
Thigh	6 (0.28)	17 (0.33)	23 (0.31)		7 (3.01)	6 (1.10)	13 (1.10)		13 (0.52)	23 (0.39)	36 (0.43)	
Knee	5 (0.22)	12 (0.23)	17 (0.22)		2 (0.86)	0 (0)	2 (0)		7 (0.28)	9 (0.15)	19 (0.23)	
Lower leg/achilles tendon	4 (0.19)	6 (0.12)	10 (0.14)		1 (0.43)	1 (0.18)	2 (0.18)		5 (0.20)	10 (0.17)	12 (0.15)	
Total	25 (1.13)	60 (1.16)	85 (1.15)		10 (4.30)	12 (2.20)	22 (2.84)		35 (1.40)	72 (1.22)	107 (1.28)	

[a] Values are presented as subject number (injuries/1.000 per player hours).
[b] P Values are between the incidences of OP and the YP; Significance was set at $P < 0.05$.

Table 2. Incidence of Injuries as a Function of the Type of Injury

	Training [a]			P Value [b]	Match [a]			P Value [b]	Total [a]			P Value [b]
	OP	YP	Total		OP	YP	Total		OP	YP	Total	
Typology of injury				0.978				0.092				0.972
Muscle rupture/tear/strain/ cramps	20 (0.91)	52 (1.01)	72 (0.98)		10 (4.30)	11 (2.02)	21 (2.71)		30 (1.19)	63 (1.07)	93 (1.11)	
Tendon injury/rupture/tendinosis/bursitis	5 (0.22)	8 (0.15)	13 (0.18)		0 (0)	1 (0.18)	1 (0.13)		5 (0.20)	9 (0.15)	14 (0.17)	
Total	25 (1.13)	60 (1.16)	85 (1.15)		10 (4.30)	12 (2.20)	22 (2.84)		35 (1.40)	72 (1.22)	107 (1.28)	

[a] Values are presented as subject number (injuries/1.000 per player hours).
[b] P Values are between the incidences of OP and the YP; Significance was set at $P < 0.05$.

Table 3. Incidence and Severity of Injuries

	Training [a]			P Value [b]	Match [a]			P Value [b]	Total [a]			P Value [b]
	OP	YP	Total		OP	YP	Total		OP	YP	Total	
Typology of injury				0.876				0.044				0.955
Minor	7 (0.31)	29 (0.56)	36 (0.48)		5 (2.15)	3 (0.55)	8 (1.03)		12 (0.48)	32 (0.54)	44 (0.53)	
Moderate	14 (0.64)	27 (0.52)	41 (0.56)		5 (2.15)	6 (1.10)	11 (1.42)		19 (0.76)	33 (0.56)	52 (0.62)	
Severe	4 (0.18)	4 (0.08)	8 (0.11)		0 (0)	3 (0.55)	3 (0.39)		4 (0.16)	7 (0.12)	11 (0.13)	
Total	25 (1.13)	60 (1.16)	85 (1.15)		10 (4.30)	12 (2.20)	22 (2.84)		35 (1.40)	72 (1.22)	107 (1.28)	

[a] Values are presented as subject number (injuries/1.000 per player hours).
[b] P Values are between the incidences of OP and the YP; Significance was set at $P < 0.05$.

5. Discussion

This one-season prospective study on young male professional football players revealed that the incidence of injuries on artificial turf is higher in matches rather than training sessions, even though the total amount of injuries, expressed in absolute values, follows an opposite trend. The main outcomes have shown that the thighs were the most common injury location, while muscle injuries (especially contractures and sprains) the most frequent injury typology. Our results support the findings both in location and typology found in other studies done in adult football players (12, 27-29). A recent study published by Verral et al. (30) analyzing the injury patterns in Australian football players describes the hamstrings as the most common location in the sampled population. Their findings also indicate that a hamstring injury significantly relates to future injuries in the hip/groin or the anterior cruciate ligament. Such evidence leads to consider appropriate that in professional soccer, coaches indeed need to elicit neuromuscular training or appropriate interventions such as balance or soccer specific drills, in order to prevent injuries of the lower limb (27).

The injury incidence here reported, of both training (1.15/1000 per player hours) and matches (2.84/1000 per player hours), are lower compared to those found in studies performed on adult football players (1.90 - 3.80 vs. 8.70 - 34.20 for training and matches, respectively) (4, 31-33). This may be related to the age of the players, that as known during youth, are overall less subject to injuries, even though our population is composed by professional athletes (20). However, the injury rates of the OP during matches are higher, even if not statistically significant, than those exhibited by the YP (4.30 vs. 2.20, respectively), except for the severe injuries, that occurred more frequently in the OP population. A possible explanation could be the lower pressure on the medical staff to keep a player on the pitch. At lower ages a preventive substitution due to early clinical signs is quite common. This is somewhat confirmed by the low rate of re-injuries (4.67% of total) that is considerably lower compared to those reported from other studies (12 - 30%) (31). Probably an inadequate rehabilitation reflects an insufficient return to functional stability, flexibility and strength when returning to competitions (34). What is already known about this topic, is that the possible causes of football injuries are multifactorial and that being said, there are many confounding risk factors to be considered (35-37).

Our study tried to report the epidemiology of injuries on artificial turf in young football players. Despite the impossibility of collecting data on a natural turf pitch, because of which a direct comparison cannot be made, similarities were found in the study from Aoki et al. (18), that investigated the injury incidence on different ground typologies (natural and artificial turf) in a homologous adolescent population. The conclusions of the aforementioned study clearly states no significant differences in injury rates between the different typologies of surfaces. However, an increased number of low back pain cases were reported from the players when playing on artificial turf. In our study low back pain was the main trunk injury reported, being 15.88% of the total reported injuries (17 out of 107). Despite such results, due to the limited populations, a generic conclusion cannot be made.

Our study design was based on the consensus definition of Fuller et al. (22), however, the data reported by the team's medical staff did not fulfill exactly each definition (31-33). In addition, defining injury severity by the number of days lost from soccer means that factors such as player motivation, time of the season, importance of a specific match, or other factors could contribute to an overestimation of absence time from practice rather than the severity of the insult itself (13). Despite this discrepancy of definitions, our results reflect the proportions found in studies with adult football players (Match vs. Training). Another interesting outcome is the overall time of absence, that we report as a mean value of 14 days. Such a result is also in line with those reported in male adult players with mean values ranging from 10 to 24 days (23, 38, 39).

A limitation of our study was the impossibility to understand the injury incidence of the sampled population on a grass field in order to make a direct comparison, or to distinguish such incidence according to each participant's characteristics (Playing position, duration of ex-

perience in playing football and the amount of training hours per day). However, being this a youth professional team, it would prove complicated due to team seasonal variations and that in some cases (i.e. other players injuries) the players had to modify their playing position. In addition, the medical staff should have reported if the injuries were caused by direct trauma or overuse. In order to overcome such issues we used a time-loss definition (31), so overuse injuries having a sudden onset or resulting from a long-term process (36) were generalized as "injuries".

Despite such limitations, comparing the two groups, lead us to interesting conclusions. Since no differences were found between the groups, in spite of the different exposure times, allowed us to understand that there might be other factors involved in the nature and incidence of injuries.

In conclusion, the present study showed that at this stage, neither age or exposure times seem to significantly contribute to the injury incidence rates and that injuries in young professional players are reasonably low (4, 12, 18, 40). The data here provided is in line with other studies from the scientific literature, and provides evidence that the most frequent typologies of injuries are strains and contractures, while the most frequent location was the thighs (4). Preventive measures should be performed to avoid the onset of such injuries. The main findings of our study contribute to the understanding of injuries in young professional football players and coaches and players should be informed that their fears regarding training or competing on artificial turf pitches are unjustified.

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Footnote

Authors' Contribution: The authors have equally contributed to the realization of this manuscript.

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