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Determinants of sports injuries in amputee football: initial analysis

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Abstract

Introduction. Sports injuries in sport for the disabled and for the able-bodied have been the subject of research for a long time. To date, however, there have been no investigations on sports injuries in athletes who, due to their disability, are capable of moving on one leg only during a match. The aim of the study was to determine types, incidence and causes of sports injuries experienced by amputee football players. Material and Methods. Forty players from 4 amputee football clubs took part in the study, 18 of whom were members of the Polish National Amputee Football Team. The study included a record of sports injuries that were consulted as well as those that were not consulted with a doctor. Moreover, the Competitive Aggressiveness and Anger Scale and a personal survey were employed in the study. Results. In a 6-month observation period, 111 sports injuries were noted. Three of injuries required medical consultations. Abrasions constituted the largest group of injuries. Goalkeepers experienced injuries most often, whereas defensive players picked them up least frequently. The injury incidence rate was 0.045 per player per training day. Conclusions. Amputee football is a sport with a low risk of injury. Injuries not consulted with a doctor are the most common ones among amputee football players. The study was conducted during six months of Amp Football League. The next research should include entire Amp Football season i.e. preparatory period as well as competition period.

KEYWORDS: amputee football, sports injuries, amputations, sport for the disabled.

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Introduction

Injuries in sport for the disabled and for the able-bodied have been the subject of research for a long time [2, 4, 6, 8]. Studies on injuries in Paralympic sports mainly revealed the incidence of minor injuries that led to short discontinuations of training lasting up to 7 days [16]. Ferrara and Peterson [8] classified Paralympic sports in regard to the risk of experiencing injuries. It may be noted that a high risk of injury occurs primarily in team sports. Some studies confirm that wheelchair basketball is a sport with a high risk of injury [8, 15]. However, the findings concerning the risk of injury in wheelchair rugby are contradictory. Ferrara and Peterson [8] as well as Bauerfeind et al. [2] claim that this discipline belongs to a group of sports with a high risk of injury, which is not borne out by the research of Molik et al. [15]. Every tenth competitor incurred an injury during 2002 Winter Paralympic Games [29], while over 2000 medical interventions were noted during 2008 Beijing Summer Paralympic Games [28]. The review of the literature shows that the incidence of sports injuries in amputee football players has not been investigated as yet. However, similar studies were carried out on able-bodied footballers.

Football is one of the most common and popularised team sports in Poland [22]. It is in this sport that alternate quick starts and sudden stops as well as runs with changing directions can be observed. This activity requires high motor fitness levels on the part of the players [3]. During a football season, 86%-97% of competitors experience injuries [1, 23]. Studies show that 75-93% of injuries occurred in lower limbs. The

vast majority of them were traumatic injuries, while overload-related changes were found in 9-34% of the players [1]. Brukner [5] observed that lower limb injuries occurred most frequently in the ankle joint (17-26%) and knee joint (17-23%). Another investigation revealed that injuries in youth aged 15-19 mainly included abrasions (57%) and muscle strains (18%), while bone fractures and muscle ruptures constituted the smallest group of injuries (13%) [30]. The International Federation of Association Football FIFA (Fédération Internationale de Football Association) revealed that during 64 matches of 2002 World Cup there occurred 2.7% of body injuries per match, with 37% of them caused by fouls, 36% resulting from a direct contact with an opponent without breaking the rules and 27% picked up without any interaction with an opponent [26].

It may be assumed that amputee football players are prone to the same types of injuries as able-bodied competitors. Amputee football is a sport for individuals after limb amputation and those with limb defects. As a variation of football, it is based on general rules of FIFA. Yet, due to limitations and different physical capabilities of players, some regulations had to be individually developed with regard to tournaments for physically disabled players. Amputee football players are classified into two groups – outfield players, who had a unilateral lower limb amputation (A2/A4), and goalkeepers, who had a unilateral upper limb amputation (A6/A8) [24]. Amputee football can also be practised by individuals from the 'Les Autres' group, i.e. those with other locomotor disabilities (in this case – with underdeveloped limbs) [17]. There are no age limits for amputee football players. Compared to traditional football, the roles of the players on the pitch are exactly the same. There are forwards, midfielders, defenders as well as goalkeepers.

Amputee football as a 'new' form of football has become the subject of scientific research. Scientists from Turkey are leading researchers in this field [14, 19, 20], which is an indication of the degree that amputee football is developed in this country. In their research, Özkan et al. [20] showed that offensive amputee football players had lower body mass and lower percentage of fat tissue than other players. Moreover, amputee footballers demonstrated increased maximal oxygen uptake (VO_2max) and high parameters of anaerobic performance obtained during 10 m, 20 m and 30 m sprints. In another study [19], they found a significant correlation of body composition and somatotype with anaerobic performance and sprint ability of amputee football players. Simim et al. [24] noted a significant difference in the percentage of body fat between midfielders and defenders of the Brazilian team, which would imply differences in the players' somatotypes depending on their positions on the pitch. Physical adaptation to the requirements imposed by the specificity of different playing positions in amputee football has also been examined by other authors [9]. They revealed significant correlations of technical skills, body mass, body height and age with a particular position on the pitch. On the other hand, when analysing motor activities of the players during an amputee football match, the authors noted that each outfield player covered a similar distance on the pitch [9]. Thus, no significant differences were observed between players' positions on the field and physical tests they performed [9].

The review of the literature shows there are no previous studies regarding the incidence of sports injuries in amputee football players. In the case of footballers who had a lower limb amputation, injuries may bring about not only a discontinuation of training but also lead to limitations in everyday life or even to dependence on other individuals. Therefore, the aim of the study was to determine types, incidence and causes of sports injuries experienced by amputee football players.

Material and Methods

Participants

The study included 40 male amputee football players from 4 clubs competing in 2015 Polish Amputee Football League matches. At the time of the research, 18 of the players were members of the Polish National Team. All players were informed about the aim of the study as well as possibility of withdrawal at any moment. All of them signed consent form to participate in this study. Mean age of the study participants was 29.7 years (SD = 10.73). The oldest player was 55, while the youngest one was 14 years old. On average, their training experience was 26.1 months (SD = 16.51). Mean number of training and tournament days during a 6-month study period was 56 (SD = 26.49). The study group consisted of 14 forwards (including 6 midfielders), 20 defenders and 6 goalkeepers. 70% of the subjects had an acquired disability, whereas the other had a congenital disability. 85% of the participants had a lower limb disability, while 15% had an upper limb disability.

Measures

Four research tools were used in the study:

1. A register of sports injuries that were not consulted with a doctor. The subjects provided information about the injuries (type, anatomical region, duration

of training absence) and circumstances thereof (place, situation on the pitch, phase of a game or training as well as type of activity that resulted in the injury). Information about injuries were conveyed by club physiotherapist on the day of trauma.

2. A register of sports injuries that were consulted with a doctor. The register included information about the date and circumstances of the injury, date of medical intervention, diagnosis, conducted diagnostic tests, treatment and its duration, time of training absence and duration of ailments.
3. The Competitive Aggressiveness and Anger Scale (CAAS) developed to identify athletes being prone to manifesting acts of aggression and anger [13]. The scale consists of 12 questions, six evaluating the level of aggressiveness and another six referring to the level of anger. The questions concerning aggressiveness refer to the willingness to demonstrate physical and verbal abuse, while those assessing anger determine the level of irritation resulting from a loss as well as the level of negative emotions against opponents. Responses are given on a 5-item Likert-type scale, where 1 corresponds to 'almost never' and 5 to 'almost always'. The higher the score, the higher the levels of aggressiveness and anger presented by the athletes. The measure was in the beginning of the study.
4. A personal survey that related to demographic data of the participants: age, sex, education, occupation, date of injury or its diagnosis, type of disability.

Kruskal-Wallis analysis of variance was applied to assess differences in the injury incidence rate in amputee football with regard to playing positions, while U Mann-Whitney test was used to evaluate differences concerning disability types. Correlations between the incidence of sports injuries and continuous variables (level of competitive anger and aggressiveness, number of months in training, time devoted to training per week) were determined on the basis of Spearman's rank correlation coefficient (r_s) values. The injury incidence rate was calculated as the number of injuries divided by the number of players and the mean number of training and tournament days [12].

Results

During a 6-month observation period, amputee football players experienced a total of 111 injuries (per player $\bar{x}$ = 2.71; SD = 1.62). The types of injuries are shown in Table 1. There were 108 injuries not consulted with a doctor. These included abrasions (n = 76), bruising (n = 12), muscle strains (n = 10) and sprains (n = 10). Three injuries required medical consultations, i.e. eyebrow cut, unilateral mandibular dislocation and ankle luxation. Two out of 10 ankle sprains (not consulted with a doctor) led to a 2-week training absence, while the remaining ones (n = 8) resulted in a 5-day training absence. Ankle luxation required a 3-week training absence. The injury incidence rate was 0.045 per player per training day.

During the study period, the injury incidence rate in 6 goalkeepers ($\bar{x}$ = 3.7) was higher than in 14 forwards ($\bar{x}$ = 3.4) and 20 defenders ($\bar{x}$ = 2.1).

Kruskal-Wallis analysis of variance revealed significant differences in the injury incidence rate in amputee football with regard to playing positions ($H_{(2,40)}$ = 10.15; $p < 0.001$). These differences were noted between

Table 1. Types of injuries noted in the examined amputee football players

Injured muscle groups/anatomical regions (n; %)					
abrasion	bruising	muscle strain	sprain	luxation	cut
upper limb stump (9; 8.1%)	quadriceps femoris muscle (2; 1.8%)	hamstring muscles (4; 3.6%)	ankle joint (10; 9.0%)	ankle joint (1; 0.9%)	eyebrow (1; 0.9 %)
upper limb (18; 16.2%)	shoulder joint (2; 1.8%)	quadriceps femoris muscle (2; 1.8%)		mandibular joint (1; 0.9%)	
lower limb stump or underdeveloped limbs (10; 9.0%)	lower limb stump (8; 7.21%)	back muscles (4; 3.6%)			
lower limb (32; 28.8%)					
arm (7; 63%)					
(76; 68.5%)	(12; 10.8%)	(10; 9.0%)	(10; 9.0%)	(2; 1.8%)	(1; 0.9%)

defenders and forwards (p = 0.042) as well as goalkeepers (p = 0.033). The differences in the injury incidence rate between forwards and goalkeepers were not significant (p = 1.000). The observed correlations are illustrated in Figure 1.

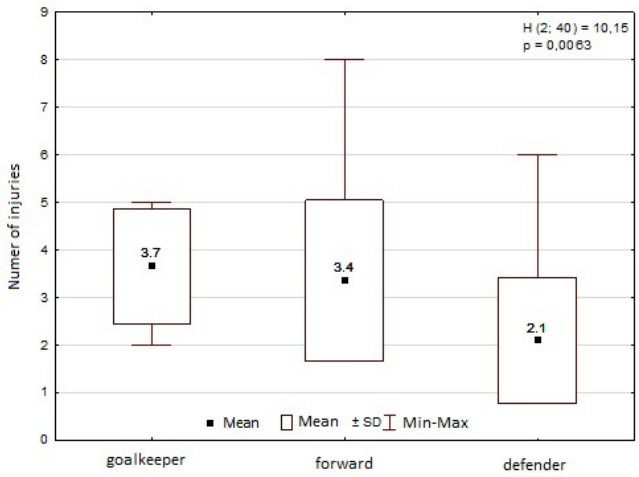

Figure 1. Differences in the injury incidence rate in amputee football with regard to playing positions

The findings indicate that the injury incidence rate in individuals with congenital disabilities ($\bar{x}$ = 3.8) was higher than in players with acquired disabilities ($\bar{x}$ = 2.4). U Mann-Whitney test revealed significant differences in the injury incidence rate in amputee football with regard to disability types (Z = –2.553; p = 0.008). The differences are shown in Figure 2.

The majority of injuries took place on a synthetic surface (n = 59). Forty three of all the injuries occurred

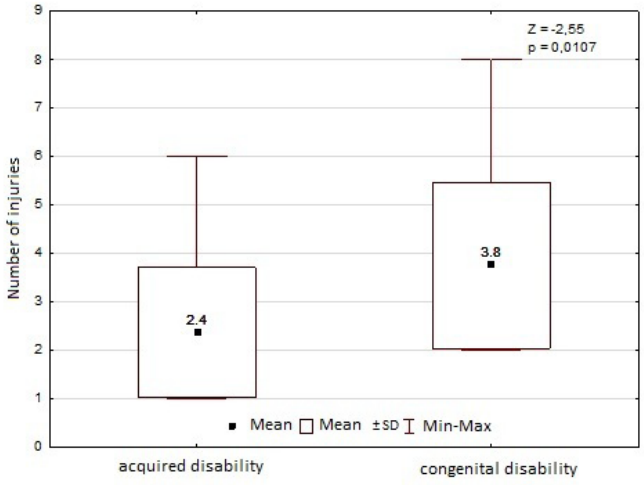

Figure 2. Differences in the injury incidence rate in amputee football with regard to disability types

on a natural grass surface. Furthermore, it was revealed that most injuries occurred mid-game (n = 71) and were caused by crutches (n = 76). Problems with crutches resulted in 13 of the injuries. The majority of injuries (n = 61) occurred during an interaction with an opponent. A negative correlation was found between the number of training months and the injury incidence rate (r_s = –0.409; p = 0.008). This means that the longer the training experience of amputee football players, the less frequently they experienced sports injuries. Mean CAAS score obtained by amputee football players was 34.5 pts (SD = 8.2). Defenders exhibited higher levels of aggressiveness and anger ($\bar{x}$ = 35.6 pkt.) than forwards ($\bar{x}$ = 34.0 pts). No significant correlations of the injury incidence rate with competitive aggressiveness (r_s = –0.041; p = 0.798) and anger (r_s = –0.081; p = 0.617) as well as time devoted to training per week (r_s = 0.028; p = 0.863) were revealed.

Discussion

During a 6-month study period, the players experienced a total of 111 injuries (consulted and not consulted with a doctor). The injury incidence rate was 0.045 per player per training day. This result is far lower than the results revealed by Magno e Silva et al. [12], who conducted research on visually impaired swimmers, or the findings of Bauerfeind et al [2] concerning wheelchair rugby players. Both Magno e Silva et al. [12] and Bauerfeind et al. [2] found the injury incidence rate to be 0.3 per athlete per training day. The differences may stem from disability types of the analysed competitors. Blind/visually impaired individuals are likely to be more prone to injuries due to the lack of visual control of possible risks during performance.

Different specificity of sports may be another cause of the discrepancies. According to wheelchair rugby rules and regulations, intentional contact between wheelchairs is permitted. This means that players are exposed to injuries to a larger extent. In amputee football, though, it is forbidden to perform actions (tackles) that may cause any of the players to experience an injury. Furthermore, differences in the findings might have resulted from study periods. In our research, during a 6-month observation period all the players participated in both club training sessions and all League matches. Also, 18 competitors took part in the Polish National Team camps. As a result, mean number of training and tournament days per player was 56. As far as the study conducted by Bauerfeind et al. is concerned [2], only 14 National Team members were examined, and mean number of training and tournament days was 25. Sample

sizes as well as observation periods could have led to the differences in the findings of the above-mentioned studies.

The number of training sessions as well as matches played by able-bodied professional footballers is much higher. It is reflected in the findings of UEFA 2014/2015 season report. The mean number of injuries was 2.7 per 1000 training hours and 20.5 per 1000 match hours [26]. Ferrara and Peterson [8] classified football as a high injury risk sport, which is not confirmed in the present study. It could result from the fact that research include only competition period which lasted six months (April–September). In this period players trained as well as participated in competitions. However, the results are in line with the findings of the previous investigations, which revealed that the majority of injuries experienced by disabled competitors were the so-called minor injuries [8, 14]. We observed similar injuries distribution in each month during the study. We did not notice increased number of injuries at the end of the playing season. In the case of amputee football players, minor injuries (not consulted with a doctor) accounted for as many as 97.3% of all injuries, while only 2.7% of injuries required medical consultations. Eleven injuries led to training breaks.

In their research, Ferrara and Peterson [8] showed correlations between anatomical regions affected by injuries and disability types as well as sports disciplines that athletes practised. Nyland et al. [18] emphasised that the number of lower limb injuries was greater in blind athletes and in individuals with other dysfunctions who moved in a standing position. In turn, Klenck and Gabke [10] found that the stump was most likely to be injured in athletes after limb amputations. In our research, lower limb stump injuries constituted 9% of the injuries, which is not consistent with the results obtained by Klenck and Gabke [10]. It was most probably caused by the fact that 38.5% of the competitors had undergone hip disarticulation, while the remaining players applied elastic bandage or stump straps under football socks in order to reduce the risk of an injury. Nearly half of the injuries (46%) involved lower limbs, which confirms the observations of Nyland et al. [18].

Our study revealed significant differences in the number of injuries between defenders and forwards as well as goalkeepers. Goalkeepers experienced injuries most frequently. It may stem from the specificity of injuries they pick up and from the fact that the number of athletes playing in this position is low. The main injuries noted in goalkeepers are abrasions and bruises which occur when performing dives. Injuries were also more prevalent in forwards than defenders. Forwards are exposed to a large number of attacks directed at them, which results in higher injury incidence. Being neither tall nor heavy, they manifest high levels of speed and agility. This enables them to use crutches much faster during movement. Defenders, however, are taller and heavier, which may also affect the number of injuries they experience. What is interesting is that our findings show significant heterogeneity of injuries with regard to disability types. Footballers with congenital disabilities experienced injuries more often. It may depend on their position on the pitch since it is those athletes who play as forwards most frequently.

In their studies on wheelchair rugby, Bauerfeind et al. [2] and Molik et al. [15] found no significant differences in the number of injuries between offensive and defensive players. However, in wheelchair basketball the analysis of results revealed higher injury incidence in defensive players compared to their offensive counterparts [15]. Both disabled and able-bodied football players are prone to similar injuries resulting from game specificity [7, 11, 21]. Adamczyk and Luboiński [1] reported that lower limb injuries accounted for 75-93% of all injuries, which was consistent with the findings of our study, where 46% of lower limb injuries were noted. Percentage differences may stem from the fact that in amputee football players two types of lower limb injuries were distinguished, i.e. stump injuries as well as healthy limb injuries. The same authors stated that ankle joint sprains and muscle strains are the most common football-related injuries (27-35% and 10-47%, respectively). In the case of the analysed data, the injuries experienced in amputee football most often included abrasions (69%), bruising (11%), ankle joint sprains (9%) and muscle strains (9%). The obtained results were different from the findings presented by Adamczyk and Luboiński [1] as well as Żołnowski et al. [30], which was probably brought about by the fact that abrasions were not treated as sports injuries in the cited studies.

According to Simiński et al. [25], most injuries occurred mid-game (64%), which is in line with our findings, where 69% of injuries took place mid-game, while the remaining ones (31%) occurred mid-training. The results of our study regarding phases of training or matches when injuries occur are consistent with the observations of Żołnowski et al. [30]. It is interesting that the authors of the UEFA report on injuries claim that 92% of injuries are experienced mid-training without interaction with opponents, while such injuries experienced mid-game constitute 43% of all cases [27]. This is inconsistent with our data, according to which

injuries picked up when interacting with opponents accounted for 69% of the cases.

While analysing the heterogeneity of injury incidence in amputee football, the players' levels of aggressiveness and anger as well as their mean training experience and the number of minutes devoted to training per week were evaluated. Both offensive and defensive players exhibited similar levels of competitive aggressiveness and anger. It may stem from the lack of training typical of a given position on the pitch and from the fact that there are very few amputee football players, so they are often compelled to play in both positions. The analysis of our study results revealed a negative correlation between the number of training months and the injury incidence rate. It may indicate that training influences and improves general fitness and motor coordination of players, which, in turn, affects injury incidence.

It is noteworthy to mention that abrasions constituted the largest group of injuries (69%). Players may try to prevent abrasions by using proper equipment, i.e. gloves and stump straps. Due to the specificity of this sport, abrasions will always occur in lower limbs. In the case of goalkeepers, modern gear equipped with special safety pads may prevent abrasions and bruises. 14% of injuries were caused by using crutches. Even though players test more and more modern 'unbreakable' crutches, it is virtually impossible to eliminate injuries related to them completely.

The analysis of the injury incidence rate in regard to different elements of the game seems interesting. Our study showed that most injuries experienced by amputee football players occurred on the pitch with a synthetic surface, mid-game, when interacting with opponents and with no involvement of crutches. Such data may prove crucial for coaching teams in the process of reducing the risk of injuries and preparing players properly in terms of conditioning and coordination.

Nonetheless, several limitations were encountered in the course of the research. The sample size was quite small and heterogeneous in terms of amputation type, age, performance level and previous sports experience. Furthermore, there is a scarcity of data on the subject of amputee football and injury incidence in particular. This prevented us from comparing our findings with the results obtained by other researchers. The study was conducted during six months of Amp Football League. The next research should include entire Amp Football season i.e. preparatory period as well as competition period. Further research ought to focus solely on members of the Polish National Amputee Football Team, thus overcoming limitations linked to players' physical performance and age-related heterogeneity. However, there will still be a problem of a small sample size.

The present study is an initial analysis. In Poland, amputee football is at an early stage of development and players are subjected to scientific investigations more and more often. The findings seem to be vital from the perspective of both National Team coaches and club coaching teams. It seems to be immensely important not just from the cognitive point of view but also with reference to utility in training process. The collected data provide the basis for drawing conclusions concerning the underlying mechanisms of injuries among amputee football players and make it possible to broaden the knowledge in this area. What is certain is that every injury (even a minor one) leaves a permanent negative mark in bodies of both professional footballers and amputee football players. Therefore, it is absolutely necessary to learn the underlying mechanisms of injuries, minimise their effects and, should an injury occur, to introduce adequate rehabilitation procedures and to take a break from training.

Conclusions

1. Amputee football is a sport with a low risk of injury. Injuries not consulted with a doctor were the most common injuries among amputee football players.
2. Injuries prevalent in amputee football included abrasions and bruising. The majority of injuries occurred in lower limbs.
3. Most injuries experienced by amputee football players occurred on the pitch with a synthetic surface, mid-game and when interacting with opponents.
4. The goalkeepers and offensive players experienced injuries more often than the defensive players. Congenital disability correlated positively with the incidence of injuries.
5. The longer the training experience of amputee football players, the less frequently they experienced sports injuries.

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