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Retrospective Study

Epidemiology of open fractures in sport: One centre's 15-year retrospective study

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Abstract

AIM

To describe the epidemiology of sport-related open fractures from one centre's adult patient population over a 15-year period.

METHODS

A retrospective review of a prospectively-collected database was performed: The database contained information all sport-related open fractures, sustained from 1995 to 2009 in the Edinburgh, Mid and East Lothian Populations.

RESULTS

Over the 15-year period, there were 85 fractures recorded in 84 patients. The annual incidence of open sport-related fractures was 0.01 per 1000 population. The mean age at injury was 29.2 years (range 15-67). There were 70 (83%) males and 14 females (17%).

The 6 most common sports were soccer ($n = 19$, 22%), rugby ($n = 9$, 11%), cycling ($n = 8$, 9%), hockey ($n = 8$, 9%); horse riding ($n = 6$, 7%) and skiing ($n = 6$, 7%). The five most common anatomical locations were finger phalanges ($n = 30$, 35%); tibial diaphysis ($n = 19$, 23%); forearm ($n = 12$, 14%); ankle ($n = 7$, 8%) and metacarpals ($n = 5$, 6%). The mean injury severity score was 7.02. According to the Gustilo-Anderson classification system, 45 (53%) fractures were grade 1; 28 (33%) fractures were grade 2; 8 (9%) fractures were grade 3a; and 4 (5%) fractures were grade 3b. Out of the total number of fractures, 7 (8%) required plastic surgical intervention as part of management. The types of flaps used were split skin graft ($n = 4$), fasciocutaneous flaps ($n = 2$); and adipofascial flap ($n = 1$).

CONCLUSION

We analysed the epidemiology of open fractures secondary to sport in one centre over a 15-year period. Soccer and rugby were the most common causative sports while fractures of the finger phalanx and of the tibial diaphysis were the most common sites. Open fractures are uncommon in sport; however, when they are sustained they usually occur on muddy sport fields or forest tracks and therefore must be treated appropriately. It is important that clinicians and sports therapists have knowledge of these injuries, in order to ensure they are managed optimally.

Key words: Open; Fracture; Sport; Epidemiology; Injury; Trauma

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Core tip: We reviewed all open sport-related fractures presenting to our trauma centre over a 15-year period to provide comprehensive epidemiological data on this injury type. Open sport-related fractures occurred at an annual incidence of 0.01/1000 population. The mean age at injury was 29.2 years; the gender ratio was 7.4:1 (male:female). The most common causative sports were soccer and rugby. The most common fracture locations were finger phalanx and tibial diaphysis. Fourteen percent of the fractures were Gustilo-Grade 3; 8% required plastic surgical intervention. Open fractures in sport are a rare, but significant, injury; awareness and education is necessary among clinicians to optimize outcome.

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INTRODUCTION

Open fractures are uncommon in the United Kingdom

sporting population, however they have a high morbidity, which makes the patient group significant. This institution has previously published work looking at the epidemiology of open fractures and found an incidence of 30.7 per 100000 per year^[1].

Sports and exercise is ever increasing in popularity, particularly team sports and multi-sport endurance^[2]. This is due to the impact of social and cultural influences, such as easier access to sporting facilities and social media. The epidemiology of acute sporting fractures has been described by Court-Brown *et al*^[3] 2008. The authors describe sports-related fractures as having a Type C distribution with unimodal peaks in both young males and females^[3]. They also noted a clear preponderance towards upper limb fractures in sports, the majority of which involve the finger phalanges, metacarpus or distal radius^[3]. Lastly they recorded an open fracture rate of 1.7% among sport-related fractures, with an annual incidence for open sport-related fractures of 0.02 per 1000 population. Court-Brown *et al*^[1] 2012 also described the epidemiology of open fractures, they conclude that 3.6% of all open fractures are a result of sport.

In order to obtain accurate epidemiological data, when the incidence of open fractures is this low, it is necessary to perform a long-term study of these fractures within a large population group^[3]. Thus, while there has been an increasing cohort of literature of the epidemiology of sport-related fractures, the literature describing the epidemiology of open fractures in sport remains minimal^[1,3].

We aim to provide the first long-term study describing the epidemiology of sport-related open fractures from one centre's adult patient population. This information will be useful for medical professionals treating patients participating in sport and sport governing bodies.

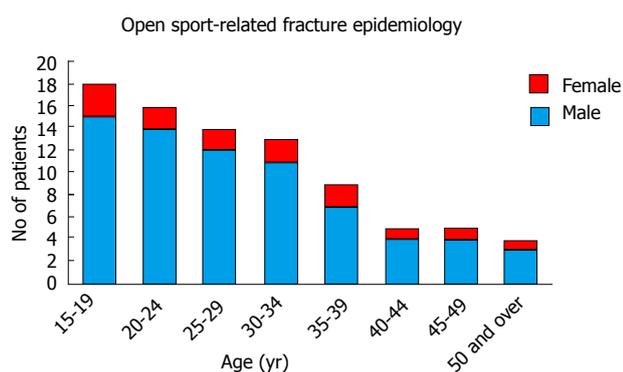
MATERIALS AND METHODS

All acute fractures presenting to the Royal Infirmary of Edinburgh, Orthopaedic Trauma Unit from the residents of Edinburgh, Mid and East Lothian, over the period of 1995 to 2009, were prospectively recorded on a database. This included all patients from the region, who were injured elsewhere, but were followed up under the Edinburgh Orthopaedic Trauma Unit: This was to provide accurate epidemiological data. Conversely, all non-resident patients who were injured within the region were excluded from the database. The mean population count for the region over the study period was 539858 (Population Count in 2000, $n = 534715$ ^[3]; Population Count in 2007, $n = 545000$ ^[4]).

The database was retrospectively reviewed in 2016, and all open fractures, sustained over the 15-year period (1995 to 2009), were identified. Subsequently, a subgroup, in which the injury was secondary to a sporting activity, was identified. Sporting activity was defined as participation in an athletic game or activity

Table 1 Total number of sport-related open fractures, divided by causative sport and the 5 most common fracture locations

Sport	Number	Percentage of the whole cohort (%)	Finger phalanx	Tibial diaphysis	Forearm	Ankle	Metacarpal
Soccer	19	22	3	9	1	1	0
Rugby	9	11	2	1	0	3	1
Cycling	8	9	3	1	2	0	0
Hockey	8	9	8	0	0	0	0
Horse riding	6	7	1	1	2	1	0
Skiing	6	7	3	1	2	0	0
Mountain bike	4	5	0	0	2	0	0
Quad bike	4	5	0	2	1	1	0
Basketball	3	4	2	0	1	0	0
Shinty	3	4	3	0	0	0	0
Sledging	3	4	0	2	0	1	0
Motorcross	2	2	0	0	0	0	2
Badminton	1	1	1	0	0	0	0
Bowling	1	1	1	0	0	0	0
Cricket	1	1	1	0	0	0	0
Golf	1	1	0	0	0	0	1
Snowboarding	1	1	0	1	0	0	0
Squash	1	1	1	0	0	0	0
Surfboard	1	1	1	0	0	0	0
Trampolining	1	1	0	0	1	0	0
White water rafting	1	1	0	1	0	0	0
Unknown	1	1	0	0	0	0	1
Totals	85	100	30	19	12	7	5

**Figure 1** Open sport-related fracture epidemiology.

at time of injury. The Gustilo-Anderson classification^[5] was used to describe the extent of soft tissue injury associated with the fracture: For all the fractures, the grading of this classification was based on the intra-operative findings after surgical debridement.

The database contained information on patient age and gender, site of the fracture, mode of injury, sport participated at time of injury, Gustilo grading for each fracture, and required treatment, including both Orthopaedic and Plastic Surgical procedures. Review of each presenting radiograph, as well as confirmation of the designated Gustilo grading^[4], was performed by the senior author, a Professor of Orthopaedic Trauma Surgery.

For analysis purposes, niche sporting activities, of a very similar nature, were grouped to allow for more meaningful interpretation of the data: Grouping however was only performed if the sports were considered to be suitably similar. For instance road cycling and track cycling were combined as cycling;

however, mountain biking, was considered a separate sport.

RESULTS

Epidemiology

There were 85 fractures sustained by 84 people over the 15-year period. The annual incidence of open sport-related fractures was 0.01 per 1000 population. Of the 84 patients, 70 (83%) were male and 14 (17%) were female (Figure 1). The mean age of the total cohort was 29.2 (range 15-67; SD 11.75; 95%CI: 2.5). The mean age of the female population was 31.93 years and the mean age of the male population was 28.62 years. Forty fractures occurred during competitive sport, nine during training for competitive sport and thirty-six during recreational sport. Two fractures were sustained by professional athletes and eighty-three fractures were sustained by recreational athletes.

Causative sports

The 6 most common sports were soccer ($n = 19$, 22%), rugby ($n = 9$, 11%), cycling ($n = 8$, 9%), hockey ($n = 8$, 9%); horse riding ($n = 6$, 7%) and skiing ($n = 6$, 7%) (Figure 2). Other common sports were mountain biking ($n = 4$, 5%), quad biking ($n = 4$, 5%), basketball ($n = 3$, 4%), shinty ($n = 3$, 4%) and sledging ($n = 3$, 4%). Table 1 shows the total number of fractures, divided by sport, and by fracture location.

Fracture location

The top 5 fracture locations were finger phalanges, 35% ($n = 30$); tibial diaphysis 22% ($n = 19$); forearm 14% ($n = 12$); ankle 8% ($n = 7$) and metacarpals 6%

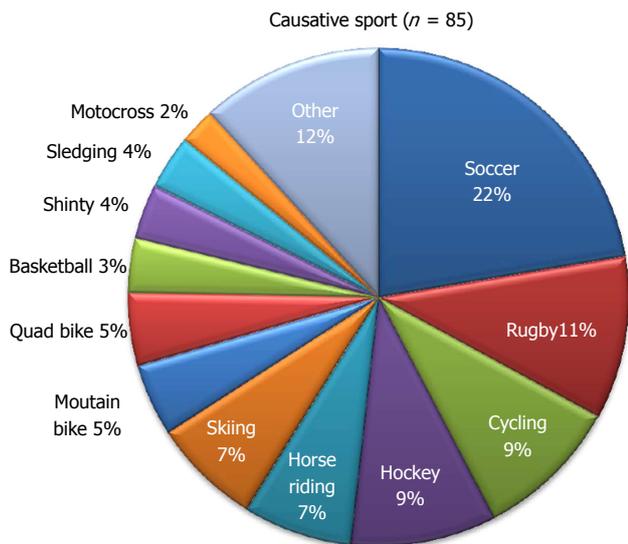


Figure 2 Causative sports for open sport-related fractures.

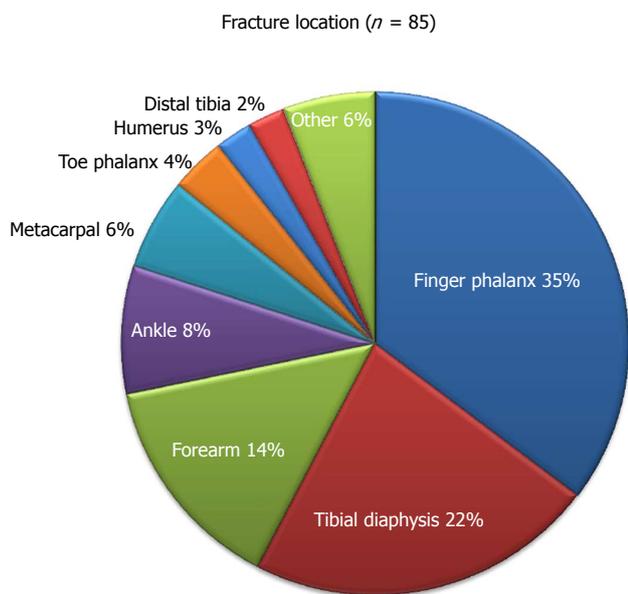


Figure 3 Fracture location for open sport-related fractures.

(n = 5) (Figure 3). Of the forearm fractures, four were of the distal radius, four were of the proximal ulna, three were of the combined radial and ulna diaphysis and one was of the ulnar diaphysis. Other fracture sites included toe phalanges (n = 3); humerus (n = 2); distal tibia (n = 2); pelvis (n = 1); clavicle (n = 1); femur (n = 1); patella (n = 1) and talus (n = 1). The fractures involving finger phalanges, included 5 of the little finger; 6 of the ring finger; 3 of the middle finger; 4 of the index finger; 10 of the thumb and in 2 cases the finger involved was unknown. Of all the fractures, 59% (50/85) were of the upper limb. Table 2 shows the fracture locations for the top 6 sports.

Injury severity

According to the Gustilo-Anderson classification

Table 2 The six most common causative sports and their anatomical distribution

Anatomical location	Soccer	Rugby	Cycling	Hockey	Horse riding	Skiing
Ankle	1	3	0	0	1	0
Clavicle	0	0	1	0	0	0
Distal radius	0	0	0	0	2	0
Distal humerus	1	0	0	0	0	0
Femur	0	0	1	0	0	0
Finger phalanx	3	2	3	8	1	3
Metacarpal	0	1	0	0	0	0
Patella	0	1	0	0	0	0
Distal tibia	1	1	0	0	0	0
Proximal ulna	0	0	2	0	0	1
Radius and ulna	1	0	0	0	0	1
Talus	0	0	0	0	1	0
Tibial diaphysis	9	1	1	0	1	1
Toe phalanx	3	0	0	0	0	0
Ulna	0	0	0	0	0	0
Total	19	9	8	8	6	6

system^[5], 45 (53%) fractures were Grade 1; 28 (33%) fractures were Grade 2; 8 (9%) fractures were Grade 3a; and 4 (5%) fractures were Grade 3b (Figure 4).

The mean Injury Severity Score was 7.02 (SD 4.33; 95%CI: 0.92). There were 2 deaths during the 15-year period; 1 road-cyclist who had an open proximal ulna fracture; and 1 soccer player, who sustained a grade 3a open tibia fracture.

Primary orthopaedic management

Regarding the primary index procedures: Twenty-two fractures were treated with wound management and cast/splint application; twenty-six fractures with wound management and open reduction internal fixation; eighteen fractures with wound management and intra-medullary nailing; eleven fractures with wound management and kirschner-wire fixation; five fractures with wound management and external fixator application; and three fractures with wound management and tension band wire fixation (Table 3).

Plastic surgical intervention

There were 7 fractures (8%) that required plastic surgical intervention as part of their management. The types of flaps used were split skin graft (n = 4), fasciocutaneous flaps (n = 2); and adipofascial flap (n = 1) (Table 4).

DISCUSSION

The aim of this study was to describe the epidemiology of sport-related open fractures. The main findings were that sport-related open fractures demonstrated a uni-modal incidence of injury, with an annual incidence of 0.01 per 1000 population, a mean age at injury of 29.2 years and a male to female ratio of 7.4:1. Ninety-eight percent of these injuries were sustained by non-professional athletes. Over half of all fractures were

Table 3 Orthopaedic management of the open fractures

Fracture location	Wound management + splint/cast	Wound management + ORIF	Wound management + intra-medullary nail	Wound management + K-wire fixation	Wound management + external fixator	Wound management + tension band wire
Finger phalanx	20	3	-	6	1	-
Tibial diaphysis	-	2	17	-	-	-
Ankle	-	7	-	-	-	-
Metacarpal	-	2	-	3	-	-
Distal radius	-	2	-	-	2	-
Proximal ulna	-	1	-	-	-	3
Radius and ulna	-	3	-	-	-	-
Toe phalanx	1	-	-	2	-	-
Distal humerus	-	2	-	-	-	-
Distal tibia	-	1	-	-	1	-
Ulna diaphysis	-	1	-	-	-	-
Clavicle	1	-	-	-	-	-
Pelvis	-	1	-	-	-	-
Patella	-	1	-	-	-	-
Femur	-	-	1	-	-	-
Talus	-	-	-	-	1	-
Total	22	26	18	11	5	3

ORIF: Open reduction internal fixation; K-wire: Kirschner wire.

Table 4 Sport-related open fractures requiring plastic surgical intervention

Sport	Gustilo grade	Procedure	Injury
Soccer	2	SSG	Tibial diaphysis
Soccer	3a	Adipofascial flap	Tibial diaphysis
Soccer	3a	SSG	Tibial diaphysis
Soccer	3b	Fasciocutaneous flap	Distal tibia
Quad bike	3b	SSG	Ankle
Quad bike	2	Fasciocutaneous flap	Tibial diaphysis
Sledging	3b	SSG	Ankle

SSG: Split skin graft.

located in the upper limb, with finger phalanx fractures the most common fracture location. Soccer was the most common causative sport, accounting for over one fifth of all injuries. Regarding injury severity, 14% were Gustilo-Anderson Grade 3 classification, with only 8% of all fractures requiring plastic surgical intervention.

This is in keeping with existing literature on sport-related fractures^[3,6]. Court-Brown *et al.*^[3,6] previously reported that 12.8% of all fractures are sustained during sporting activities. These injuries were noted to present in a uni-modal distribution, with a mean age at injury of 25.6 years and a gender ratio of 7.5:1^[3]. Upper limb sport-related fractures were also noted to be more common than lower limb sport-related fractures, with 77% of all sport-related fractures occurring within the upper limb fractures^[3,6]. One point seven percent (1.7%) of these sport-related fractures were open, providing an annual incidence of open sport-related fractures of 0.02 per 1000 population^[3,6]. Robertson *et al.*^[7,8] also noted that between 96% to 98% of all sport-related fractures occur in non-professional athletes.

In comparison of both studies, regarding the in-

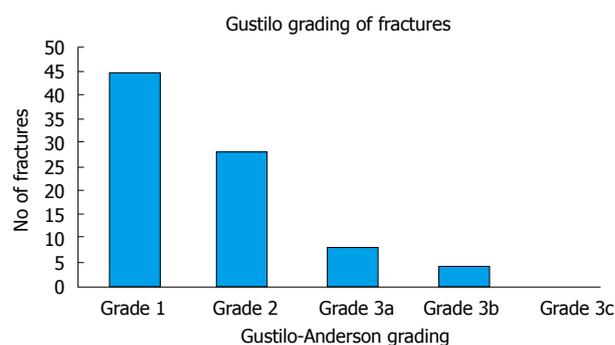


Figure 4 Gustilo-Anderson grading for open sport-related fractures.

creased mean age observed with our cohort, which specifically relates to open fractures, we feel this reflects a greater proportion of elderly athletes who sustain an open fracture during sport^[1]. Age has previously been identified as a risk factor for sustaining an open fracture: This is felt to be secondary both to the weakening effects of aging on the skin, as well as to the decreased levels of proprioception seen in the elderly, which predispose to more severe injury^[1,9]. Regarding the increased proportion of lower limb fractures in our cohort, we feel this is secondary to an increased proportion of tibial diaphyseal and ankle fractures, among the open fracture cohort. Both fractures have been noted to be at high risk of open injury with tibial diaphysis the second most common recorded open fracture and ankle fracture the fifth most common recorded open fracture^[1]. This provides a higher proportion of lower limb fractures among sport-related open fractures^[1].

Regarding the severity of injury within our study, the proportion of Gustilo-Anderson grade 3 fractures was slightly lower than that within previous studies^[9].

Court-Brown *et al.*^[1] reported a series of 2386 open fractures, within the general population, and 27% were Grade 3 grading. The difference between proportions is likely explained by the younger mean age of our "athletic" cohort at 29.2 years, with the mean age from Court-Brown *et al.*^[1] being 45.5 years. Age has been noted to be a risk factor to sustain a more serious grade of open fracture, due to the deleterious effects it has on the surrounding soft tissues and skin^[1,9]. This will also account for our marginally decreased requirement for plastic surgical intervention at 8%, compared to 13% from their data^[1,10].

In our study, soccer was the most common sport (22%) and within this category, the most common fracture was tibia diaphysis (47%). Soccer accounted for 4 of the 7 cases requiring plastic surgery intervention: 3 out of the 9 soccer-related tibial fractures were Gustilo-Anderson Grade 3. This represents the severity of these injuries. Robertson *et al.*^[7] have previously reported on soccer-related fractures. Similar to Court-Brown *et al.*^[1], they found that the majority of soccer-related fractures were of the upper limb (68%). In contrast, we found 74% of our soccer-related fractures were of the lower limb. Within our cohort, this reflects a high proportion of tibial diaphyseal, ankle and toe phalanx fractures, which have previously been documented as being high risk for open fractures^[1]. This contrast is likely explained by the higher energy "mechanism of injury" required to sustain an open fracture compared to a closed fracture^[1]: Within soccer, such higher energy "mechanisms of injury" most often involve high-speed collisions between players; with soccer being predominantly a lower limb sport, this then increases the likelihood of soccer-related open fractures being sustained in the lower limb^[1,3,7].

Rugby accounted for 11% of the open fractures secondary to sport. This is similar to the figures reported by Robertson *et al.*^[8] in their paper describing the epidemiology of rugby-related fractures, with rugby accounting for 17% of all sport-related fractures. To note in the present study, six of the nine rugby-related fractures were of the lower limb, with fractures of the ankle comprising half of the lower limb injuries. In contrast, both Robertson *et al.*^[8] and Garraway *et al.*^[11] reported that the upper limb was most at risk of fracture (83% and 42% of injuries respectively); however, as detailed above, there is an increased proportion of lower limb fractures in open fracture cohorts, due to higher proportions of tibial diaphyseal and ankle fractures^[1]. Indeed, Garraway and MacLeod^[11] did record that the lower limb was at greatest risk of dislocations and soft tissue injuries.

Cycling (including road cycling and track cycling) accounted for 9% of all fractures seen in the 15-year period. Mountain Biking accounted for only 5% and this may be a reflection of the protective equipment used in this sport, as road cyclists appear at a higher risk of open fracture compared to their mountain biking counterparts. Both sports showed a preponderance for upper limb injuries, with cycling recording 3 finger

phalanx fractures and 3 forearm fractures (out of a total of 6 fractures) and mountain biking recording 2 forearm fractures. This pattern of injury reflects the findings of Aitken *et al.*^[12], who reported that upper limb fractures occurred 10 times more commonly than lower limb fractures during mountain biking. To note, mountain biking is increasing in popularity, and with our trauma centre being located close to Scotland's largest mountain biking centre (Glentress), one may expect to detect a significant incidence of injuries from this sport. However, Aitken *et al.*^[12], in their comprehensive study on recreational mountain biking injuries 2011, noted a trend away from serious injury in this sport, as a result of the use of personal protective equipment. This likely accounts for the low incidence observed in our study period.

Similarly, hockey accounted for 9% of all open sport-related fractures. This sport also demonstrated a preponderance for upper limb injuries, with all such fractures occurring within the finger phalanx. Court-Brown *et al.*^[13] have already shown that fractures of the finger phalanx is common in hockey, comprising half of all such fractures in the sport^[3]. Furthermore, Aitken *et al.*^[13] found that while field hockey only accounted for 7% of all sport-related finger phalanx fractures, it was the cause of 50% of all of the open sport-related finger phalanx fractures. Comparatively, this study found that hockey accounted for 40% of all open fractures of the finger. Aitken *et al.*^[13] went on to reason that such injuries are likely due to accidental contact between the hand and either a hockey stick or a hockey ball travelling at speed, and this may be further explained by the pattern of grip around the stick. Players often hold the stick low to the ground during tackles thus increasing the chance of contact with the ball or entrapment with another player's stick^[13-15]. This continues to be an area where increased protection may benefit participants and decrease the incidence of these injuries^[13-15].

Horse riding accounted for 7% of the open fractures sustained. The mechanism by which injuries are sustained during horse riding are usually high energy - a fall from height at high speed - therefore, there is a clear potential for an open fracture to be sustained as a result of this mechanism^[16,17]. It is important to note that these fractures are often farmyard injuries and have a high risk of contamination^[16,17]. Therefore these fractures should be managed appropriately in line with BOAST guidelines^[18]. Previous studies on horse riding injuries, have shown that sprains are the most prevalent injury type (42%), followed by lacerations and bruises (40%), and then fractures and dislocations (33%)^[16]. There was a near equal proportion of upper and lower limb fractures in the current series (3 upper limb and 2 lower limb open fractures), and while our paper was specifically looking at open fractures, this finding is reflected in other studies. A retrospective study from the United States looking at horse riding injuries, showed that the lower extremity was injured

22.2% of the time and the upper extremity 21.5%, with the remaining injuries being to the head, chest and abdomen^[17].

Skiing accounted for 7% of all sporting-related open fractures. The majority of these were upper limb fractures (5 of 6), with 1 recorded ankle fracture. The low prevalence of open fractures secondary to skiing may reflect our institution's urban geographical location. However, it should be noted that there is an artificial ski slope on the outskirts of the city.

Within skiing, 50% of fractures were in the hand: This may be linked to the composition of the dry-ski slope material, with a high propensity to entrap fingers.

Anatomically, the most common location of fracture was the finger phalanx comprising 35% of all fractures. This again is in keeping with the findings from Court-Brown *et al.*^[3], who found the most common location for sport-related fractures was the finger phalanx, followed by distal radius, metacarpals, clavicle and ankle^[3]. Similar findings have been reported by Aitken *et al.*^[4] in another comprehensive series of sport-related fractures. In contrast, the current study found the next most common fracture locations for sport-related open fractures to be tibial diaphysis, forearm, ankle and metacarpal. This is in keeping with the incidence of open fractures within the general population, with the five most common fracture locations being finger phalanx, tibial diaphyseal, distal radius, toe phalanx and ankle^[1]. It would appear there is a difference between the common presenting locations for sport-related open fractures and sport-related closed fractures^[1,3,4,6]. The exact reasons behind this are difficult to fully define, though it appears that certain fracture locations (tibial diaphysis and ankle) are at an increased risk of open fractures: This is likely due to a combination of the common fracture patterns observed at these sites as well as the volume of surrounding soft tissue cover in these regions^[1]. As such, these fracture locations are more likely to be present within observational open fracture cohorts^[1]. Nevertheless, the number of fractures described in this series are low, and, while this reflects a low incidence of this injury type, we would recommend further large-scale studies on this topic, to better define the epidemiology of open fractures in sport^[1,3,4,6]. Similarly, as with previous papers from our institution, our study reflects the experience of our region: It is likely that the incidence of such fractures will vary in other centres, according to the types of sports that predominate in the studied area^[1,3,4,6].

Regarding further limitations of our study, patient outcomes were not obtained, and this certainly could be an area for future work. Obtained information on the time taken to return to sport or work after injury would be of significant relevance for sporting regulators: A high incidence of injuries requiring long periods of rehabilitation may lead to a review of rules and personal protective equipment: This can serve

to reduce the economic impact of such injuries in professional and recreational sport^[1,3,4,6,15].

In conclusion, the epidemiology of sport-related open fractures from one orthopaedic trauma centre over a 15-year period was reviewed. Soccer and rugby were the most common causative sports, while the finger phalanx and tibial diaphysis were the most common fracture locations. Only 14% of fractures were Gustilo Grade 3 and only 8% required plastic surgical intervention. While open fractures in sport are uncommon, they frequently occur on muddy sport fields or forest tracks and must be treated appropriately. A robust set of guidelines is in place from the British Orthopaedic Association and British Association of Plastic Reconstructive and Aesthetic Surgeons to enable this to be achieved, and these should be followed accordingly. Furthermore, a good understanding of the range and variety of sport-related open fractures is beneficial for clinicians and sports therapists, as this allows planning for treatment protocols, rehabilitation and injury prevention.

COMMENTS

Background

Open fractures are uncommon in the United Kingdom sporting population, accounting for less than 2% of all sport-related fractures. However they have a high morbidity, which makes the patient group significant. Currently there is limited evidence in the literature describing the epidemiology of open fractures in sport.

Research frontiers

Despite comprising less than 2% of all sport-related fractures, open fractures in sport represent a very significant injury for the athlete, often resulting from a high energy mechanism and being sustained in an environment with high risk of wound contamination. However, due to the limited incidence of this fracture type, minimal research has been previously performed regarding its epidemiology. Given the potential significant morbidity associated with such injuries, an accurate understanding of the range and variety of sport-related open fractures will allow clinicians and sports therapists to better plan treatment protocols, rehabilitation and injury prevention methods for these fractures.

Innovations and breakthroughs

In the study, the authors analysed the epidemiology of open fractures in sport within our population over a 15-year period. Open sport-related fractures occurred at an annual incidence of 0.01/1000 population. The mean age at injury was 29.2 years; the gender ratio was 7.4:1 (male:female). Soccer and rugby were the most common causative sports while fractures of the finger phalanx and of the tibial diaphysis were the most common sites. 14% of the fractures were Gustilo-grade 3; 8% required plastic surgical intervention. This is the first study to provide a comprehensive description of the epidemiology of this injury type.

Applications

A comprehensive understanding of the predicted patterns of injury and most common causative sports, with this fracture type, can allow sports teams and medical personnel to appropriately plan for such injuries, producing treatment protocols and instigating injury prevention measures. This allows both optimization of the management and outcome of these injuries, as well as potential reduction in their future incidence.

Terminology

An open fracture is a fracture with an associated skin wound which allows the

external environment to communicate with the fracture. The Gustilo-Anderson Classification is a classification system which grades the severity of open fractures into three grades, based on the wound size, the underlying damage to the peri-osteal and neuro-vascular structures, and the ability to achieve direct wound closure. Please refer to the provided reference for the formal classification. A Split Skin Graft is a skin graft which comprises the epidermis and a portion of the dermis: the full thickness of the dermis is not excised in this graft type. An Adipofascial Flap is a portion of adipose and fascial tissue that is based on a perforating artery. This is dissected and elevated from its native location, maintaining the perforator blood supply, and transferred locally to the damage area requiring soft tissue coverage. A Fasciocutaneous Flap is a portion of skin, subcutaneous tissue and fascial tissue that is based on a perforating artery. This is dissected and elevated from its native location, maintaining the perforator blood supply, and transferred locally to the damage area requiring soft tissue coverage.

Peer-review

It is very interesting finding.

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