

Incidence of Skin Trauma Associated with Participation in Intercollegiate Soccer

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Abstract

Participation in soccer at the intercollegiate level has increased dramatically in the United States over the past 20 years. Past studies have identified the frequency and mechanisms of musculoskeletal injury among various populations. However, data on the incidence and etiology of skin trauma associated with intercollegiate athletic participation is limited in the literature. The purpose of this study was to measure the frequency of skin trauma and determine the injury rate (IR) based on exposure to injury among male and female soccer student-athletes at a NCAA Division II institution. A case reporting and exposure form was used to collect the data over a competitive soccer season. Descriptive statistics were calculated for the data. A total of 18 wounds were documented, 11 (61%) among males and 7 (39%) among females. The overall IR for males was 4.6 wounds/1000 athletic exposures (AE) and females 3.9 wounds /1000 AE. The most common wounds were blisters (83.3%) and abrasions (16.7%) occurring most frequently to midfielders (61%). The most common mechanism of injury was rubbing/friction (94.4%) through contact with clothing (44.4%). The reported wounds occurred during

practice (77.8%) and competition (11.1%) activities on grass (94.4%). The most frequently injured body locations were the foot (38.9%) and heel (27.8%). As risk factors are identified, steps toward prevention, management, and cost-effectiveness strategies can be developed.

Introduction

The popularity and participation in soccer has increased dramatically in the United States over the past 20 years.¹⁻⁸ The total number of participants in National Collegiate Athletic Association (NCAA) institutions sponsoring soccer has grown from 14,812 student-athletes in 1982 to 38,026 student-athletes in 2002.⁶ The increasing number of participants and growing appeal of soccer at the intercollegiate level increases the exposure of student-athletes to injuries.⁹ There are numerous studies that have examined the incidence of musculoskeletal trauma among youth, club, intercollegiate, and professional soccer athletes which has resulted in the identification of injury mechanisms and incidence rates.^{1-7,10-19} As a result, prevention strategies have been developed in attempts to decrease the risk of injury.^{15,20} A risk that is also present but often ignored is skin trauma to superficial and/or deep tissues, such as blisters, abrasions, lacerations, incisions, avulsions, and punctures. Unfortunately, data on the incidence of skin trauma among athletes participating in soccer is limited in the literature and appears to warrant further investigation. Studies examining injury incidence rates among various populations have excluded skin trauma and focused only on significant musculoskeletal

injuries.^{1,2,21} In the majority of the investigations, reportable injuries were defined by time-loss parameters. These time-loss parameters represented the number of days an athlete missed practice or competition as a result of the injury. Skin trauma typically does not result in time loss from practice or competition. Consequently, data collection techniques and operational definitions of injury utilized by researchers have not recognized skin trauma as an injury.^{1,2} However, skin trauma and proper management requires substantial financial resources and often places a time management burden on the healthcare provider.^{5,22} Determining the incidence of skin trauma among intercollegiate student-athletes will add to the literature and may provide injury rate (IR) and etiology data to determine prevention and cost-effective strategies in the management of these injuries. Therefore, the purpose of this study was to identify patterns of skin trauma associated with participation in intercollegiate soccer. The specific objectives of this study were as follows: 1) to measure the frequency of skin trauma among the subjects; and 2) determine the IR based on exposure to injury among the subjects.

Review of Literature

Many studies have been conducted to examine the incidence of injury among soccer athletes. These studies have examined the rate and etiology of injuries based upon gender, age, player position, activity, and type and body location of injury among youth, club, intercollegiate, and professional soccer athletes.^{2-4,7,11-16,18,23} Skin trauma that fit the operational definitions of a reportable injury were included in several studies.^{2,3,5,6,24,25}

Gender

Studies examining injury rates among soccer athletes based on gender have produced conflicting findings. One study found that males had a significantly higher IR than their female counterparts,¹⁹ while the majority reported significantly higher rates for females.^{4,7,10,11,18}

DeHaven and Lintner¹⁹ examined university students involved in intercollegiate, intramural, and unorganized athletics and professional baseball and hockey athletes during a seven year period and found that 80.3% of the reported cases of injury were sustained by males. Over the same period in university level soccer alone, the researchers found that 92 males reported an injury as compared to 21 females.¹⁹

In contrast, Elias⁷ reported that overall female injury rates were significantly higher than male rates, 10.23 injuries/1000 player-hours (PH) and 8.57 injuries/1000 PH, respectively, while observing 10-year trends in USA Cup Soccer. Player-hours were based on tournament records and game times from schedules and represented actual hours of participation. During three academic seasons, Powell and Barber-Foss⁴ found significant differences between male and female injury rates among high school student-athletes. Female student-athletes sustained a 14% higher IR than males. Nilsson and Roaas¹⁸ reported injury rates for two international youth soccer tournaments and found that females were twice as likely to sustain an injury as males. While males reported an IR of 14 injuries/1000 hours of play, females reported 32 injuries/1000 hours of play.

During the 2002-2003 intercollegiate soccer season, the NCAA Injury Surveillance System (ISS)⁶

reported that females suffered 1,194 injuries and males 1,042 during practices and competitions. The data was gathered from 252 NCAA Division I, II, and III institutions. Sallis et al¹⁰ investigated seven NCAA Division III sports, including soccer, for fifteen seasons. In soccer alone, female student-athletes sustained more injuries, 52.5 injuries/100 participant-years, than males, 47.7 injuries/100 participant-years. Participant-years described the number of injuries sustained per 100 participants during one calendar year. Engström et al¹¹ found that the incidence of injury for elite female soccer players was more than twice as high, 12 injuries/1000 hours of participation, as compared to elite male soccer players, 5 injuries/1000 hours of participation.¹⁶

The 2002-2003 NCAA ISS also reported that males sustained eight lacerations and four blisters and females suffered two abrasions and two blisters.⁶ However, these wounds resulted in the restriction of the student-athlete's participation for at least one day. Additional data on the incidence of skin trauma based on gender was absent from the literature. Further research is needed to examine skin trauma among male and female intercollegiate soccer players.

Age

Investigations of injury rates based on age have produced various findings. The study by Elias⁷ of USA Cup Soccer revealed that females in the under-16 and under-14 age groups had the highest IR, 17.68 injuries/1000 PH and 16.92 injuries/1000 PH, respectively. Player-hours represented actual hours of participation. The lowest rates were found to occur in the under-19 female (10.64 injuries/1000 PH), under-12 male (11.22 injuries/1000 PH),

and under-14 male (11.81 injuries/1000 PH) age groups.⁷ Nilsson and Roaas¹⁸ demonstrated that adolescents suffered significantly fewer and less severe injuries than adults, but found that the distribution of injuries were similar for both groups.

DeHaven and Lintner¹⁹ found that the number of reported cases of injury for students involved in intercollegiate, intramural, and unorganized athletics over a seven year period peaked in the 16-19 age bracket (1546 cases; 45% of total cases), followed by 20-25 years (870; 25%) and 13-15 years (542; 16%). Among non-professional club soccer players, Inklaar et al¹⁴ determined that the 17-18 year age group had the highest incidence rate (28.3 injuries/1000 PH), followed by 15-16 years (16.1 injuries/1000 PH), ≥ 19 (15.8 injuries/1000 PH), and 13-14 years (12.8 injuries/1000 PH). Morgan and Oberlander¹² revealed no significant differences between incidences of injury based on age among Major League Soccer players 18 to 38 years of age. The NCAA ISS did not calculate IR based on age, but included incidence of injury based on academic year of the student-athlete. During 2002-2003, freshmen male and female soccer student-athletes suffered the majority of injuries during practice and competition, 780, followed by sophomores, 722, juniors, 592, seniors, 102, and fifth year seniors, 45.⁶ Data determining the incidence of skin trauma based on age was not located in the literature.

Player Position

Incidence of injury based on player position suggested that certain positions are more prone to injury. Athletes of all ages participate in soccer, but there are a fixed number of positions

in soccer as well as specific responsibilities for each position. Forwards are positioned closest to the opponent's goal and are the primary scorers. Midfielders play between the forwards and defenders and can take the role as scorer or defender depending on where they are positioned on the field. Defenders, or backs, play closest to their own goal and are used to stop opponents from scoring. A single goalkeeper on each team protects the goal and prevents opponents from scoring. The goalkeeper is the only player that may legally use his or her hands to pick up the ball within a certain boundary on the playing field.²⁶

Past research has revealed that midfielders sustain the majority of injuries, while goalkeepers are relatively free of injury. The 2002-2003 NCAA ISS reported that male midfielders suffered 228 practice and 220 competition injuries, defenders 111 practice and 166 competition, forwards 92 practice and 142 competition, and goalkeepers 50 practice and 33 competition.⁶ The data also showed that female midfielders sustained a total of 181 practice and 261 competition injuries, forwards 143 practice and 192 competition, defenders 108 practice and 181 competition, and goalkeepers 73 practice and 55 competition.⁶

Morgan and Oberlander¹² found that among 237 Major League Soccer players, midfielders sustained 6.56 injuries/1000 hours of participation, forwards 5.87 injuries/1000 hours, defenders 5.63 injuries/1000 hours, and goalkeepers 5.59 injuries/1000 hours during a season. The IR was determined by the total number of injuries divided by actual exposure time.¹² Examining professional soccer players during one season, Albert² demonstrated the

incidence of injury among midfielders at 1.32, wings 1.04, forwards 1.03, defenders 1.01, and goalkeepers .86. Incidence of injury was defined as the number of injuries sustained by a specific group divided by the number of players assigned to that group.² Examining elite female soccer players, Engström et al¹¹ found an IR of 36% among midfielders, 36% backs, 16% forwards, and 6% goalkeepers.

In contrast to these findings, Engström et al¹⁶ examined elite European male soccer players and determined IR percentages relative to the number of athletes per position. The IR among backs was reported at 30%, forwards 27%, midfielders 23%, and goalkeepers 20%. Over a competitive season, McMaster and Walter³ recorded 60 injuries from a team of 15 players in the American Soccer League. Of these, forwards sustained 23 injuries, midfielders 18, backs 11, and goalkeepers 6. The studies reviewed in the literature did not report the incidence of skin trauma based on player position.

Activity

Past investigations have shown that injuries occur more often during competitions than practices.^{3,11-13,16,17} Powell and Barber-Foss¹⁷ observed high school varsity athletes among ten different sports, including soccer, totaling 3195 team-seasons. Among male and female soccer teams, the researchers¹⁷ found a higher IR during competitions than during practices. Male soccer athletes sustained 10.2 injuries/1000 athlete-exposures (AE) in competition and 2.5 injuries/1000 AE in practice. Female athletes reported 11.4 injuries/1000 AE in competition and 3.1 injuries/1000 AE in practice. An AE was defined as a coach-directed session

involving physical activity. The IR was calculated by the total number of injuries divided by AE.¹⁷

Engström et al¹⁶ reported an IR of 13 injuries/1000 competition hours and 3 injuries/1000 practice hours among elite male soccer athletes. The IR was determined with actual hours of participation. In a subsequent study, Engström et al¹¹ revealed an IR of 24 injuries/1000 competition hours and 7 injuries/1000 practice hours among elite female soccer athletes. Morgan and Oberlander¹² followed ten Major League Soccer teams and noted an overall IR of 35.3 injuries/1000 competition hours and 2.9 injuries/1000 practice hours.

Östenberg and Roos¹³ reported an IR of 14.3 injuries/1000 competition hours and 3.7 injuries/1000 practice hours among eight female Swedish soccer clubs at a variety of skill levels. The researchers also noted that injuries occurred more often during the latter part of competitions and practices.¹³

McMaster and Walter³ reported a total of 35 injuries during competitions and 25 during practices for an American Soccer League team during a season. The 2002-2003 NCAA ISS reported 1,250 competition and 986 practice injuries among 252 institutions sponsoring soccer. In contrast, Albert² observed more injuries during practice (76 total; 53%) than competition (66; 47%) among 56 professional soccer athletes during five seasons. Data on the incidence of skin trauma based on activity was not found in the literature.

Type and Body Location

Researchers have examined the type and body location of injuries among various populations in soccer. The predominant type of injuries for both males and females participating in

soccer were sprains and strains, occurring most frequently to the ankle and foot.^{2,7,15,16}

Elias⁷ examined USA Cup Soccer athletes over a 10-year period and found that the majority of injuries (65.5%) occurred to the lower extremity, with ankle sprains occurring most frequently. Over one season, Ekstrand and Gillquist¹⁵ observed 12 European senior male soccer divisions (mean age 24.6 ± 4.6) and found 88% of all injuries sustained were to the lower extremity. Sprains (73 total; 29%) were the most common type of injury.¹⁵ Albert² found that the majority of injuries (72.5%) suffered by professional soccer athletes also occurred to the lower extremity, most often sprains (27.7%) and strains (28.1%) to the foot and ankle (24.6%) over one season.² Engström et al¹¹ revealed that sprains (26 total; 33%) were the most common type of injury occurring most frequently to the ankle (20 total; 26%) and knee (18; 23%) among elite female soccer players during a one-year period. Engström et al¹⁶ also found a similar trend among elite male soccer players. Sprains (29; 34%) were the most common type of injury and the ankle (19; 22%) and knee (28; 33%) were the most common sites for injury.¹⁶ During a seven-year period, DeHaven and Lintner¹⁹ demonstrated that internal derangement of the knee (22 total; 19.8%) was most common among soccer student-athletes at the university level. While lower extremity injuries have been shown to occur more frequently, some soccer athletes are also at risk for injuries to the upper extremity. Albert² determined that upper extremity injuries occurred most often (63.7%) to goalkeepers because of constant overhead motions involved in that position.

Skin Trauma

Data on the frequency of skin trauma was found in the literature if the injury resulted in time loss from practice or competition. Thorndike²⁴ examined 50,000 intercollegiate student-athletes over 27-years of observation and reported 434 lacerations and abrasions that resulted in cessation of at least one session of practice or competition. Albert² reported that lacerations resulting in the absence of a practice or competition were 5.2% of the total number of injuries sustained in five seasons of indoor and outdoor soccer. Powell and Barber-Foss¹⁷ noted that general trauma represented 29.9% and 24.9% of the total injuries reported for male and female high school student-athletes respectively during the 1995-1997 academic years. General trauma included contusions, wounds, cramps, and acute inflammations that caused a cessation of at least one session of practice or competition.¹⁷ Jago and Finch²⁵ surveyed patients for four 2-week periods, at three-monthly intervals, over a one-year period at a general practice clinic and reported seven lacerations (8.6%) and one abrasion (1.2%). These researchers placed signs around the clinic seeking participants with sporting or recreational injuries.²⁵ Only one study was found to include all injuries regardless of time loss. During a youth soccer tournament, Nilsson and Roaas¹⁸ recorded all injuries that were treated or referred by a first aid station and found that abrasions and blisters accounted for 39% (336 total) of all injuries.

Several studies have been conducted examining the frequency of skin trauma among intercollegiate student-athletes. During a competitive baseball season at a NCAA Division II

institution, 27 wounds were documented, 13 occurring in practice and 14 in competition.²⁷ The overall IR was 8.57 injuries/1000 AE, with 5.33 injuries/1000 AE in practice and 19.71 injuries/1000 AE in competition.²⁷ Daubenmire, Anderson, and Beam²⁸ recorded 14 practice injuries among NCAA Division I football student-athletes during off-season (spring) practice. The reported IR was 18.15 injuries/1000 AE. The researchers also documented 10 injuries during off-season practice among NCAA Division I male soccer student-athletes, resulting in an IR of 16.20 injuries/1000 AE. In these studies, AE was defined as one athlete participating in one physical conditioning session, practice, or contest where he was exposed to the possibility of skin trauma. The IR was defined as the ratio of the number of wounds in a particular category to the number of AE in that category.

Definition of Injury

Athletes often suffer traumatic injuries as a result of participation due to player-to-player contact, ground contact, ill-fitting equipment, and skin mechanics.^{23,29} Athletic injuries resulting in skin trauma is an assumed risk and part of the game of soccer, but few studies have focused on the incidence rate and effect skin trauma may have on the student-athlete or healthcare provider.²¹ A focused approach to identify the types and mechanisms of skin trauma among student-athletes is limited in the literature.²¹

In 1948, Thorndyke²⁴ stated that the ordinary blister was the most commonly encountered athletic skin injury. Others have reported the frequency of skin trauma associated with athletic participation with terms such as

“common,” “often” and “frequent.”^{8,21,30-33} Foster, Rowedder, and Reese²¹ stated that frequency reports assigning numerical statistics to these descriptions of skin injury have not been found in the literature. These researchers have suggested impressions about skin injury are vivid, but knowledge is vague.²¹ Boden⁸ stated that student-athletes in general have a high risk of soft tissue injuries to the leg, but shin guards in the sport of soccer provide protection; although there is no information regarding reduction of soft tissue injury due to their use.

The most common definition of injury found in the literature is based on the amount of time loss from athletic participation.^{2,7,11-16} In studies, skin trauma is often not recorded since time loss from practice or competition does not occur post injury.^{2,7,11-16,23,29} Bias is inherent in the time loss definition since student-athletes respond differently to the same injury and individual universities, sports, and athletic trainers treat the same injury with different techniques.³⁴ A large proportion of minor injuries, such as blisters and abrasions, were documented when attempts were made to record every injury reported by athletes.^{1,3,18} Some argue that excluding these minor injuries from the data will produce more meaningful conclusions.³⁵

The effects of skin trauma on athletic participation may seem minimal, but the probability of complications following injury exists. Complications such as the development of bacterial infection or scar tissue and the transmission of the human immunodeficiency virus, hepatitis B, and hepatitis C may occur following skin trauma.³⁶ Determining the incidence of skin trauma among intercollegiate

student-athletes could help in the development of injury prevention and cost-effective strategies to decrease the risk and cost of post-injury management.

Methods

Subjects

Subjects in this study consisted of male and female intercollegiate soccer student-athletes from a NCAA Division II institution.

Instruments

Two instruments were developed to examine the incidence of skin trauma and to obtain athletic exposure data. A Case Reporting Form was used to obtain individual subject data, which included the following information: date of injury, subject age, year in school, gender, player position, wound type, mechanism of injury, body location of injury, and subject participation status post injury. An Exposure Form was completed for each week during the season to obtain student-athlete exposures to injury during all practices and competitions. Face validity of the instruments was determined with a panel of 6 certified athletic trainers by examining the reporting forms. The Case Reporting and Exposure Forms were pilot tested by the faculty mentor with two local universities. This subject group was chosen because intercollegiate student-athletes were the targeted study population. As a result of the pilot testing, revisions such as the addition of wound types and mechanisms of injury were added and the forms were finalized in March 2003. The reporting forms have been utilized in additional research by the faculty mentor.

Operational Definitions

For this study, a reportable wound was defined as: 1) occurred as a result of participation in an organized intercollegiate physical conditioning session, practice, or competition; 2) required attention by an athletic trainer or physician; and 3) resulted either in non-restriction or restriction of student-athlete participation. A student-athlete was defined as an eligible member listed on the team roster and participating in physical conditioning, practice, or competition. Student-athletes were classified according to their class year corresponding to their participation status: freshman, sophomore, junior, or senior. The reportable wounds were classified as follows: blister, formation of a pocket of fluid between the epidermis and dermis; abrasion, scraped, abraded, or removed epidermis, superficial dermis, or subcutaneous fat layer; laceration, tearing of tissue, producing irregular or jagged-edged cavity; incision, tearing of tissue, producing clean-cut, smooth cavity; and puncture, direct penetration of superficial and underlying tissue producing a cylindrical cavity.

The IR was calculated and defined as the ratio of the number of wounds in a particular category to the number of AE in that category. AE was defined as one athlete participating in one physical conditioning session, practice, or contest where she or he was exposed to the possibility of skin trauma. The IR was expressed as wounds per 1000 AE.

Data Collection

This study used an observational design of intercollegiate student-athletes at a southeastern United States NCAA Division II institution. Data collection

began August 2003 and concluded November 2003. The dates corresponded with the start of pre-season practice and the conclusion of the season. Two athletic training students enrolled in the University of North Florida (UNF) undergraduate Athletic Training Education Program (ATEP) underwent a training session conducted by the student investigator and faculty mentor for the explanation of the study, wound identification, informed consent, data collection and use, and confidentiality issues. A short checklist was provided for each athletic training student to assure appropriate data collection.

Collection of data was conducted by the student investigator and the two athletic training students. These students were assigned to either the men's or women's soccer team as part of their clinical experience rotation within the ATEP. Personal contact with each head coach provided for consent of team participation.

All student-athletes, with a reportable wound, were invited to participate in this study. When an eligible subject sought treatment of a wound, he or she was asked to participate in the study. If the subject agreed to participate, the athletic training student provided explanation of the study, data collection and use, informed consent, and confidentiality issues. Questions were answered prior to administration of the consent form approved by the UNF Institutional Review Board, which also approved this study. Data collection did not affect the treatment provided by a physician, athletic trainer, or athletic training student of any wound. Data for each individual subject was recorded on a Case Reporting Form. The names of individual subjects were not recorded on

the Case Reporting Form and all forms remained confidential. At the conclusion of each reporting week, the athletic training student completed an Exposure Form for that particular week. All Exposure and Case Reporting Forms were returned to the student investigator upon completion each week.

Data Analysis

The data was compiled and entered each week into the Statistical Package for the Social Sciences for Windows (Version 11.5, SPSS, Inc, Chicago, IL). The data was examined with quantitative procedures to determine frequency and incidence rates. The data was reported anonymously and electronically stored by the student investigator during the season. The data will be stored an additional two-years by the faculty mentor and used with subsequent research. Confidential procedures were followed with data reporting and storage. The student investigator computed frequency counts to describe the incidence, IR, and etiology of skin injury among the subjects.

Limitations

The delimitations of this study were as follows: 1) subjects were college aged males and females, ranging from 18-25 years of age; 2) subjects were included on the official team roster in their sport; and 3) the student-athletes in this study were an experimentally accessible population. Results from this study may only be generalized to other populations having similar intercollegiate student-athletes.

Results

The purpose of this study was to identify patterns of skin trauma

associated with participation in intercollegiate soccer and measure the frequency and IR among the subjects.

Gender

A total of 18 wounds were recorded during the competitive season. Male student-athletes accounted for 61% (11) and females 39% (7) of the total wounds.

Age

The average age of the subjects was 20 years old, males 20.6 and females 19. Overall, 19 year old subjects reported the majority of the wounds (9 total; 50%), followed by 22 (4; 22.2%), 20 (3; 16.7%), and 18 (1; 5.6%) and 23 year old subjects (1; 5.6%). Among males, the majority of the wounds occurred to 19 (4; 36.4%) and 22 (4; 36.4%) year old subjects, followed by 20 (2; 18.2%) and 23 year old subjects (1; 9.1%). Among females, 19 year old subjects reported the majority of the wounds (5; 71.4%) followed by 18 (1; 14.3%) and 20 year old subjects (1; 14.3%).

Player Position

Based on player position among all subjects, the data revealed that midfielders reported the majority of the wounds (11; 61.1%) followed by defenders (3; 16.7%), forwards (1; 5.6%), and goalkeepers (1; 5.6%). Among males, midfielders accounted for 8 (72.7%) wounds, defenders 1 (9.1%), forwards 1 (9.1%), and goalkeepers 1 (9.1%). Among females, midfielders reported 3 (42.9%) wounds, defenders 2 (28.6%), forwards 1 (4.3%), and goalkeepers 1 (14.3%).

Activity

Among male and female subjects, the data showed that skin trauma occurred more frequently during practice (16 total; 88.8%) than during competition (2; 11.1%). Examining male subjects, 10 reported cases of skin trauma occurred during practice (5; 45.5% during pre-season and 5; 45.5% during in-season) and one (9.1%) occurred during a pre-season scrimmage. With female subjects, 4 reported cases occurred during practice (3; 42.9% during pre-season and 1; 14.3% during in-season) and one (14.3%) occurred during a pre-season scrimmage. Two cases of skin trauma (28.6%) were also recorded for female subjects during in-season competition.

Type of Skin Trauma

Among male and female subjects, blisters (15 total; 83.3%) and abrasions (3; 16.7%) accounted for the reported skin trauma. Male subjects reported 10 blisters (90.9%) and one abrasion (9.1%) and female subjects reported 5 blisters (71.4%) and 2 abrasions (28.6%).

Body Location of Skin Trauma

The data demonstrated that the majority of skin trauma occurred to the lower body (17 total; 94.4%), most commonly to the foot (7; 38.9%) and heel (5; 27.8%). Among male subjects, skin trauma was sustained to the foot (7; 38.9%), heel (2; 18.2%), toes (1; 9.1%), and lower leg (1; 9.1%). Female subjects reported skin trauma to the heel (3; 42.9%), toes (1; 14.3%), knee (1; 14.3%), hips/buttocks (1; 14.3%) and elbow (1; 14.3%).

Mechanism of Injury

The frequency of skin trauma based on the mechanism of injury revealed that 17 (94.4%) of the total cases were the result of rubbing/friction. Rubbing/friction was the mechanism of injury reported for all cases (11) of skin trauma among male subjects. Female subjects reported 6 wounds (85.7%) resulting from rubbing/friction and one as the result of shearing (14.3%). Overall, contact with clothing was the most common cause of skin trauma (8; 44.4%), followed by contact with equipment (4; 22.2%), contact with ground (4; 22.2%), and contact with tape/brace (2; 11.1%). Among male subjects, contact with clothing (7; 63.6%), contact with equipment (2; 18.2%), contact with ground (1; 9.1%), and contact with tape/brace (1; 9.1%) was recorded. Among female subjects, contact with ground (3; 42.9%), contact with equipment (2; 28.6%), contact with clothing (1; 14.3%), and contact with tape/brace (1; 14.3%) was reported. The majority of reported cases occurred on a grass surface (17; 94.4%) with one case occurring on a rubberized surface (5.6%).

Time Loss

The data revealed that only one case of skin trauma reported by a male subject resulted in time loss from participation. The time loss was one day. The remaining reported cases (17) did not affect participation status following injury.

Injury Rate

Male student-athletes reported an IR of 4.6 wounds/1,000 AE. Female student-athletes reported an IR of 3.9/1,000 AE.

Discussion

Few studies in the literature have examined the frequency and IR of skin trauma among intercollegiate soccer student-athletes. This study begins to identify patterns of injury to determine the rate and mechanism of skin trauma in this population. Results from this study demonstrate the need for additional investigations of skin trauma among intercollegiate student-athletes. This study revealed that male subjects sustained a greater frequency and higher rate of skin trauma than females during the competitive season. Skin trauma recorded by the NCAA ISS also showed a higher IR among male subjects, although these wounds resulted in an absence of at least one practice or competition.⁶ In contrast, the majority of past studies examining musculoskeletal injuries revealed a higher IR among females. Previous studies suggested that female athletes are more prone to injury due to lack of training, experience, or skill.^{11,18} Elias⁷ noted that the differences in IR between males and females in USA Cup Soccer was becoming less significant, which may be the result of improved conditioning and experience among the female participants. Basler et al²³ stated that females tend to have thinner skin than males which may result in a higher incidence of callous formation and friction blisters. An explanation for the higher rate of skin trauma among males in this study is unclear. Further research is needed to determine possible factors related to injury rates based on gender.

The frequency of skin trauma based on age revealed a decrease in the number of wounds as the age of the subject increased. Researchers investigating the incidence of

musculoskeletal injury have found the opposite, an increase in frequency of injury with an advancement in age.^{1,14,18} Keller et al¹ suggested that the intensity of play may be a primary determinant for injuries in the sport of soccer. The intensity of play increases with age and younger athletes are generally less skilled and compete at a lower level of intensity. Typically, a younger athlete will have a smaller body mass and produce less momentum which decreases joint reaction and impact forces, resulting in lower injury rates.¹ This study examined subjects between the ages of 18 and 25 and comparisons to past studies is difficult because of the wide range of subject ages. Comparisons between this study and the NCAA ISS results can perhaps be made because of the similarity in age among the subjects. The NCAA ISS demonstrated that the frequency of injury decreased as the subject's academic year increased.⁶ There is a possibility that as the subject advances in age and gains maturity and experience in the classroom and athletic environments at the intercollegiate level, they are less likely to be injured.

The results of this study supported past research findings examining the frequency of skin trauma based on player position. The data demonstrated that midfielders reported the majority of skin trauma, followed by defenders, forwards, and goalkeepers. Past studies have also shown that midfielders sustained the majority of musculoskeletal injuries followed by defenders or forwards, and goalkeepers.^{2,3,6,12} It is possible that the total playing time and time actually spent in control of the soccer ball among midfielders during practice and competition may explain these findings. It is common for midfielders to control

the ball for large amounts of time at both ends of the playing field, increasing their exposure to injury. Further investigation is needed to examine the high IR based on the midfielder player position.

Previous studies have examined the incidence of musculoskeletal injury based on activity.^{3,11-13,16,17} The data indicated a higher IR during competitive activities when examined along with practice. However, studies reporting the total number of musculoskeletal injuries had conflicting results, some found a higher frequency in competition^{3,6} while others found a higher frequency in practice.² The current study revealed a higher frequency of skin trauma in practice. Several factors may explain this higher frequency of injury. During the competitive season, practices are commonly scheduled each day that a competition is not held. Practices are also longer in duration than a competitive match. The practice frequency and duration increased the exposure of the subjects to injury. This increase in exposure may have resulted in the greater frequency of skin trauma found in practice activities.

Blisters were the most common type of skin trauma reported among male and female subjects as a result of a rubbing/friction mechanism. While sprains and strains have been reported as the predominant type of musculoskeletal injury among soccer players,^{2,7,15,16} Thorndyke²⁴ has stated that blisters are the most commonly encountered skin injury in athletics. The high frequency of blisters in this study may be attributed to the tactile sensation required between the foot and ball in the sport of soccer. In all player positions except goalkeeper, the ball is dribbled, passed, and shot through contact with the foot. Precise contact and neurosensory stimulation is

needed to successfully complete these movements. To achieve this, many soccer athletes purchase and wear athletic shoes much smaller than their normal street or casual shoes. It is possible these smaller or ill-fitting shoes caused the high frequency of blisters found in this study.

Further examining the mechanism of injury, this study found that contact with clothing was the most frequently occurring cause of skin trauma. For this study, contact with clothing included footwear. The result of this contact may have caused the high frequency of blisters, which can occur through contact with clothing, specifically shoes. All but one case of skin trauma occurred on a natural grass surface. The wound occurred on a rubberized surface. Since the majority of practices and competitions were held on natural grass surfaces, it is likely for this result to occur. Since past research has not examined the incidence of skin trauma based on these variables, no comparisons can be made about mechanisms of injury or playing surface. The majority of skin trauma in this study occurred to the lower body, specifically the foot and heel. Researchers have shown that musculoskeletal injuries occurred most often to the lower body with the ankle and foot as the most prevalent.^{2,7,15,16} Soccer is primarily a lower body sport; only the goalkeeper may use his or her hands on the soccer ball. Since the use of the lower body is universal in soccer, skin trauma to the lower body would seem to occur more frequently than to the upper body. Examining other intercollegiate soccer student-athletes, researchers²⁸ have revealed a higher IR of skin trauma among NCAA Division I males as compared to the IR found in this study.

The previous study was conducted during off-season practice and it is possible that injuries occur more frequently during this period. A competitive season begins with several weeks of pre-season practice to develop optimal levels of cardiovascular fitness and skill movements. Student-athletes enter the competitive season at peak levels and maintain these throughout the season with minimal changes, excluding the occurrence of injury. Following a competitive season, a period of rest is typically scheduled. The next active period for many teams is off-season practice. It is possible the subjects entered this period with sub-maximal cardiovascular fitness and skill levels, resulting in fatigue and susceptibility to injury. Further research is warranted to examine possible differences in skin trauma based on activity periods.

Conclusion

Studies examining the incidence and etiology of musculoskeletal injury among soccer athletes based on gender, age, player position, type, and location of injury have resulted in the identification of possible causes and subsequent prevention strategies. Skin trauma is another risk faced by soccer athletes which is often ignored. Participation in intercollegiate soccer, as well as other sports, entails risk of injury.¹⁹ To date, a focused approach examining skin trauma among this population is absent from the literature and needs to be evaluated. Understanding how and why skin trauma occurs should lead to the development of prevention strategies and the reduction of these injuries.

Skin trauma associated with participation in intercollegiate soccer is

common. However, numerical statistics to describe the frequency and IR is limited in the literature. The absence of skin trauma data in the literature appears to be the result of multiple operational definitions used to determine the inclusionary and exclusionary criteria for data collection. The definition of injury for most studies includes time loss parameters which often excludes skin trauma. Determining the frequency and IR of skin trauma may require a definition of injury without a time loss component. The definition utilized in this study, subjects reporting skin trauma to an athletic trainer, was highly inclusive. The results of this study demonstrate that skin trauma can occur without a loss of participation in practice and/or competition activities.

Using a highly inclusive definition of injury, future studies examining other intercollegiate sports, playing positions, mechanisms of injury, and wound types will add to the literature. A focused epidemiologic investigation of skin trauma must follow a step-by-step approach to first determine the extent, description, and mechanism of injury. When these factors are known, strategies to reduce injuries through preventive programs can be implemented.

As previously mentioned, skin trauma commonly does not result in time loss from athletic participation. Skin trauma has been considered inconsequential in past studies, but the probability of complications following injury exist.³³ The development of infection, scar tissue, and the transmission of infectious diseases may occur.³⁶ These complications not only place the student-athlete at risk, but also the healthcare provider who is responsible for wound management.

Student-athletes seek to avoid skin trauma. Prevention of injury is perhaps the most preferred and cost-effective method of providing health care.³⁷ When risk factors known to cause skin trauma are established, attempts to reduce injuries through preventive programs can be implemented. Additionally, with the high incidence of skin trauma, questions regarding appropriate cleansing, debridement, and dressing protocols and the cost-effectiveness of wound management techniques should be considered.

This study begins a focused epidemiologic investigation of skin trauma associated with intercollegiate participation in the attempt to identify the frequency, types, and mechanisms of injury. Although the data from this study only represented two soccer teams during a competitive season, the incidence of skin trauma among intercollegiate student-athletes warrants further investigation.

Acknowledgment

This project was funded by the University of North Florida Undergraduate Research Award Program under the auspices of the Undergraduate Academic Enrichment Program directed by Dr. Mary O. Borg.

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Vita

Charlotte June Bargar was born on June 20, 1982 in Ft. Bragg, North Carolina. She began her education at Sportfield Elementary School, located on a military base in Germany, followed by Junction City Middle School, Kansas, and Branford High School, Florida. Charlotte graduated as Valedictorian from Branford High School and continued her education at the University of North Florida (UNF). Charlotte was accepted into the CAAHEP Accredited Athletic Training Education Program (ATEP) at UNF where she worked with the UNF women's basketball team, Jacksonville University football team, FirstChoice Physical Therapy Clinic, and Bishop

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