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DESCRIPTIVE ANALYSIS OF LOWER LIMB INJURIES ON DIFFERENTLY AGED ARTIFICIAL TURF

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ABSTRACT

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Descriptive Analysis of Lower Limb Injuries on Differently Aged Artificial Turf

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The NCAA estimates that about half (50.4%) of the injuries sustained by individuals playing football are lower limb injuries. Research has suggested that artificial turf be replaced every six to eight years. The 2015 artificial turf at the University of Montana Washington Grizzly Stadium was almost 8 years old and the 2016 turf is brand new. This professional paper describes injuries between old and new artificial turf within a college football team season. Information was analyzed from the University of Montana's online injury tracking system, Vivature, from the 2015 and 2016 seasons and the recorded data on the Grizzly football team's lower leg injuries from home practices and games. The information was pulled at the end of the 2016 season. All lower limb injuries were recorded, then subcategorized into the surface type of where the injury occurred and whether or not the injury occurred from contact. Describing the injuries sustained on the two differently aged turf fields may help athletic trainers and their institutions gain knowledge on when to replace artificial turf and health implications for their football teams as well as any other athletic teams that may be utilizing the field. This paper reviewed the literature to compare types of injuries sustained between artificial turf and grass. Preliminary findings show a possible increased risk of injury playing on artificial turf as compared to natural grass for football players. Based off recent research, it is hypothesized that 2016 season injury data would reflect a differentiation in types of injuries and injury numbers compared to the previous season. The results of this study show that there is not significant data to conclude that the age of artificial turf effects the rate of injury in collegiate football athletes. This study showed that new artificial turf could demonstrate a trend toward higher rates of knee injuries. This information should be taken into consideration when potentially replacing the artificial turf for a university. Player safety should come above the aesthetics of a stadium; even if that is the unpopular choice.

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Introduction

While the use of artificial turf in athletics is relatively new within the last 75 years, it is gaining popularity at tremendous speeds. High schools, colleges, and recreational areas are installing artificial turf for all types of athletes to use. The benefits of installing an artificial turf surface include easier maintenance, less expensive to upkeep, customizable playing surface, and it's durable. There are also studies suggesting that it is safer for some athletes to use (Balazs et al., 2014, Ekstrand et al., 2006 & Williams et al., 2011).

The use of artificial turf started for a simple reason; it was easier to care for in a dome compared to natural grass. Groundskeepers found that the sun was unable to nourish the natural grass within the enclosed baseball field in Houston, Texas. Installing artificial turf was less expensive than trying to maintain natural grass indoors (Artificial Turf History, Applications, Advantages & Technical Information, n.d.). Artificial turf comes in different fiber lengths and infill type depending upon the generation. First generation artificial turf was composed of polypropylene or small nylon (Taylor et al., 2012) fibers. These closely-knit carpet fibers were rough and lacked cushion under the carpet. The cushion could be corrected by adding padding under the carpet yet the abrasiveness of the fibers still caused injury to athletes (Taylor et al., 2012). Second generation artificial turf tried to mimic the look and feel of natural grass. The longer softer polyethylene fibers (Taylor et al., 2012) are spaced out further than the first generation and included a sand infill. This created a more grass-like feel as well as a cushion for athletes to decrease the likelihood injury. Third generation artificial turf took this a step further. The fibers became longer and were spaced further apart to replicate the space between natural grass blades (Taylor et al., 2012). This generation also added rubberized pellets as well as sand

to create a surface that was compliant with athletic cleats to create a more comfortable playing surface for the athletes utilizing it (Brief History of Synthetic Turf, n.d.). Yet, the compliance between footwear and artificial turf is not always beneficial to athletes when looking at the research regarding injuries on artificial turf across sports, especially football.

The University of Montana installed artificial turf in Washington-Grizzly Stadium (WGS), in 2001. Most institutions replace the surface of the turf every eight to ten years as recommended by artificial turf installers (Cost Analysis, n.d.). The University of Montana replaced their artificial turf in Washington-Grizzly Stadium twice in the seventeen years of use: once in 2008 and again in 2016. While most of the research has found differences in injury rates on different playing surfaces (ie grass, dirt and artificial turf), little research exists about how the age of artificial turf impacts athletic injuries.

With such a contact-driven sport, injuries sustained while playing American football are not surprising. The National Collegiate Athletic Association (NCAA) Injury Surveillance System (ISS) collects and analyzes injuries and injury rates for all participating college and universities. The NCAA ISS defines an injury as "(1) occurred as a result of participation in an organized intercollegiate practice or competition *and* (2) required medical attention by a team certified athletic trainer or physician *and* (3) resulted in restriction of the student-athlete's participation or performance for 1 or more calendar days beyond the day of injury" (Dick, Agel & Marshall, 2007, p. 174). Football players are seven times more likely to be injured in a game than in practice. Each position group also has different rates of injury with linebackers sustaining the largest percentage of injuries. Lower limb injuries are some one the most common injuries in American football followed closely by upper limb injuries (Football Injuries, 2009). The NCAA

estimates that about half (50.4%) of the injuries sustained by individuals playing football are lower limb injuries. It is also known that football has one of the highest rates of sport-related injury in organized sports with twice the injury rate of basketball (Dragoo et al., 2012)**.** These injuries include Anterior Cruciate Ligament (ACL) tears, ankle sprains, acute compartment syndrome as well as turf toe. The severity of injury depends greatly on the playing surface and whether or not the athlete was in contact with another person. The lack of research on how the age of artificial turf impacts athletic injuries is due to the sudden rise in the commercial and widespread use of artificial turfs. It also may be difficult to differentiate what injuries are caused by the artificial turf versus another factor. The goal of this professional paper was to compare lower extremity injuries sustained on aged turf and new turf. This provides insight on how to best prevent, treat and rehabilitate injuries for athletes that utilize artificial turf on a daily basis.

Literature Review

Risk of Lower Extremity Injuries

With a contact sport such as football, the risk for injury is high. Lower limb injuries are the types of injuries that hold a football player out from play for longer periods of time. There are factors that predispose an athlete to sustaining a lower limb injury. Older athletes, athletes with previous injuries, and athletes with decreased range of motion have a higher likelihood of being injured (Arnason, 2004). Playing football alone is a risk factor and regardless of the position played, contact is always a possibility. Even place kickers have the risk of being hit, although this is illegal. Studies have also shown that an athlete is more likely to be injured during preseason and conditioning times than in regular season play (Feeley et al., 2008a &

Feeley et al., 2008b). The risk of injury for these athletes is impacted by what surface they are participating.

Shoe Type as a Risk Factor

Playing on a variety of surfaces (ex. natural grass to artificial turf to dirt fields) week to week increases the likelihood of injury (Kordi et al., 2011). In a study by Orchard (2001), it was found that the higher the traction on the playing surface, the more likely an athlete is injured. Weather may influence traction by altering the surface in which the game is being played. This could be attributed to a decrease in friction from water or snow. In addition, shoe type, specifically athletic cleats, which greatly impacts the traction an athlete has while running and cutting, may increase the risk of injury on turf (Rodeo et al., 1990). There are many different brands and designs of athletic cleats. Typically, football cleats have 7 cleats, each measuring 3/4 inch in length and "turf cleats" have shorter 6.5 millimeter studs (Taylor et al., 2012). The design and cleat shape differs depending upon what position the athlete is playing. For example, a running athlete (wide receivers and safeties) utilize cleats that allows them to grip and release the surface quickly to better advance down the field. Lineman utilize an athletic cleat that allows them to stick into the turf so that they may block or overpower their opponents. Finally, specialists (such as kickers and punters) utilize soccer cleats to assist with the ball dynamics of kicking. The variety of athletic footwear presented within one team is high and the way each position player interacts with the turf can vary greatly. It is also difficult to determine, with all the variables that could occur, that one type of footwear interaction could be the cause of injury (Taylor et al., 2012). With that said, advances in turf design have led to a better simulation of natural grass and athletic cleats fair better on more surfaces because of

this.

Surface as a Risk Factor

It has been found that third generation artificial turf has improved shock absorption (Ekstrand, Timpka & Hågglung, 2006) which decreases injuries by lessening the impact with the playing surface. When comparing artificial surfaces to a dirt field, the rate of injury on the dirt field was higher than that of an artificial field (36.9 to 19.5 injuries per 1000 player hours respectively) (Kordi et al., 2011). This was attributed to the stiffness of the dirt field and friction differences between the field and the athlete's footwear. There are confounding studies stating that some natural surfaces (such as grass) are safer for athletic use (Balazs et al., 2014, Ekstrand, 2006 & Williams et al., 2011). The maintenance of the artificial turf is important as well. The use of the correct tools and regular cleanings recommended by the manufacturer can decrease early wear and tear of the surface (Cost Analysis, n.d.). This is important as the surface ages because after time, the fibers start to break down and the loss or build up in one area of infill could create an unsafe environment for athletes to use. Yet in all, artificial turf is becoming the safer option for athletic use.

Grass vs. Turf Playing Surfaces

Dragoo et al. (2012) showed that of 10,000 athlete exposures (AE) (defined as one participant to one NCAA regulated activity), 1.73 ACL injuries were recorded on artificial turf as compared to 1.24 on natural grass. That means that a collegiate football player is 1.39 times more likely to sustain an ACL injury on artificial turf than natural grass (Dragoo et al., 2012). They also discovered that there was a higher rate of acute non-contact ACL injuries on artificial turf compared to natural grass. The player's personal perception of the risk of injury as it relates

to playing surface should be taken into account as well. In a survey conducted by the NFL in 2010, findings suggested that a staggering 82.4% of NFL athletes claimed that artificially infilled turf contributes more to injury than natural grass (NFL Players Playing Surfaces Opinion Survey, 2010). These are athletes that change climate and ground conditions every week, sometimes twice a week. How athletes perceive their levels of safety and likelihood of injury can greatly affect their mental stability within a game. Say an athlete is more focused on the playing surface rather than the opponent trying to tackle him, he is more likely to be injured due to him being distracted. The likelihood for professional athletes who change playing surfaces at a high rate, once or twice a week, have been found to become injured by changing surfaces is higher than other football levels (Williams et al., 2011). This could be extrapolated to collegiate athletes who may practice on one type of surface and play on another on a week to week basis.

Types of Injuries

When athletes use their bodies as a way to hit others, whole body injuries are bound to occur. In collegiate football the most common injury is a ligament sprain (Shankar et al., 2007)**.** This includes any ligament in the body from wrist to knee to ankle. Studies show that college or professional football athletes are more likely to be injured in competition as compared to practices, scrimmages or walkthroughs. The differences in mindset are a contributing factor to why more injuries occur during competition. Practices are a lower stress environment. It is where the athlete can learn and develop skills without outside pressure to perform, whereas competition is where those skills are tested. Shankar et al. (2007) stated that for NCAA football student-athletes, almost half of the injuries sustained resulted in less than a week loss of play. Less than 10% resulted in a career or season ending injury. While football is a violent sport,

studies show that collegiate athletes are sustaining injures but do not miss significant amounts of time (Shankar et al., 2007). This could possibly be due to the differences in consistency or the availability to access of medical staff caring for injuries as compared to high school athletes. For athletic trainers and other medical professionals treating football athletes, knowing the types and occurrences of lower limb injuries is crucial for prudent medical care.

Pelvis, Hip and Upper Leg Injuries

While hip and thigh injuries are unlikely in other sports, these do occur quite often for football players (Kerr et al., 2016). Muscle and tendon strains account for 39% of all NCAA football student-athlete injuries. While these may or may not include muscles of the hip and thigh one can assume that a majority of them could be due to the nature of the sport. Hip injuries account for 3.1% of all injuries in the National Football League (NFL). Hip injuries have been categorized into five categories: strains, contusions, intra-articular, sprains and other. Of the injuries that were recorded in Feeley et al's study (2008a), most injuries to the hip occurred during contact and to those athletes that participated in a defensive position. Hip injuries are difficult to diagnose due to the anatomical complexity with the joint. The use of consistent clinical evaluation and Magnetic Resonance Imaging (MRI) significantly assists the clinician's ability to correctly diagnose and differentiate types of injuries.

Knee and Patellar Injuries

While artificial turf gives more traction than its natural counterpart, it may also lead to more knee injuries. When studying all ages of American Football players, Balazs et al. (2014) found that there is an increased risk of ACL injuries while playing on artificial turf. They found that with higher level of competition and all types of artificial turf, football players have an

increased risk of ACL injuries yet soccer players do not significantly show such an increased risk. The National Football League (NFL) approximates that of the individuals who participate in the NFL combine, 8% have a history of ACL injuries. Dragoo et al. (2012) differentiated injury rates of ACL injuries on generations of artificial turf. They discovered that third generation turf has 1.77 ACL injuries per 10,000 AE while first and second generation turf has 1.43 per 10,000 AE. They also showed that of these exposures, 53.03% were a result of contact while 40.13% were noncontact ACL injuries (Dragoo et al., 2012). It was also reported that on average, 6 ligamentous knee injuries occur in an NFL season (Taylor et al., 2012). In high school football athletes, it was shown that while playing on Field Turf, a third-generation artificial turf company, knee sprains and Medial Collateral Ligament (MCL) sprains occurred at a higher rate as compared to natural grass (Meyers & Barnhill, 2004**)**.

Lower Leg Injuries

Most lower leg injuries consist of contusions, strains and fractures. Of the strains researched in Australian football, calf strains were cited as the second highest (Orchard, 2001). Medial Tibial Stress Syndrome is also a common injury among athletes. With the nature of the sport, contusions are highly common. Twelve percent (12%) of sports related lower extremity injuries in high school aged athletes for all sports resulted in contusions (Fernandez et al., 2007). In unfortunate cases, a contusion to the anterior compartment of the lower leg may lead to acute compartment syndrome. While this is rare, it is a debilitating and sometimes career ending injury. McQueen and Gaston (2000) discovered that of 169 acute compartment syndrome cases from 1988 to 1995, 39 were only soft tissue injuries and only one of those injuries was the result of sports. The amount of force exerted during tackling results in fractures

to the tibia and fibula. These two bones comprise the majority of the lower leg but also play a role in the knee and ankle joints. For this reason, the categorization of fractures in the tibia or fibula need to take in account where the fracture presents anatomically. It was found in high school athletes that 5% of lower extremity injuries were diagnosed as fractures (Fernandez et al., 2007).

Foot & Ankle Injuries

When one plays a game that includes running and cutting, ankle and foot injuries are to be expected. Ankle injuries were found to be ranked the highest injury sustained in 70 different sports ranging from Australian football to cycling. While football is a high impact sport, 17% of injuries were recorded to be injuries to the ankle and 13.8 instances of ankle injury per 1,000 injuries were recorded in a game (Fong et al., 2007). Fong et al. (2007) discovered that of the ankle injuries sustained while playing football, 94.4% were classified as sprains and 1.3% as fractures. Of the top ten injuries in football, three concern the ankle. Sprains and strains (8.9%), fractures (3.7%) and inflammatory ankle (2.9%) are of the highest complaint to athletes (Dehaven & Lintner, 1986). Lievers and Adamic (2015) found that foot and ankle injuries occurred at a rate of 15 per 10,000 AE. The load placed on the foot during physical activity result in different types of injuries. Plantar fasciitis is a common injury often resulting from poor foot mechanics, shoe cushion or a genetic predisposition to the condition. Foot and toe sprains are common as well with Turf Toe being one of the most football injuries in the area. Within an athletic population, it was found that in males fractures of the foot resulted in 57% tarsal and metatarsal fractures (Matheson et al., 1987). Turf toe, or hallux metatarsophalangeal sprain, is one of the most well-known injuries for the athletic population. In a study by Rodeo et al.

(1990), it was found that 45% of 80 active players had suffered a turf toe injury in their career in which 83% were sustained on artificial turf (Anderson, 2002). Anderson (2002) also deducted that on average four to six turf toe injuries occur over the course of a collegiate football season. The amount of injuries that occur in the career of a football player are numerous. Any type of injury could occur due to the nature of the game or the surface in which the game is played. From hip to toe, football athletes are susceptible to high injury rates.

Purpose

The purpose of this study was to compare the injuries sustained between older artificial turf and new artificial turf. To the best of our knowledge there is no previous research examining the difference between the age of artificial turf and injuries sustained in collegiate football. This study provides insight as to the types of injuries on artificial turf as well as the potential comparison of injury to the age of turf. Informing athletic trainers on what to preemptively prepare for when knowing the age of their playing surfaces or visiting different playing surfaces is the goal of this paper.

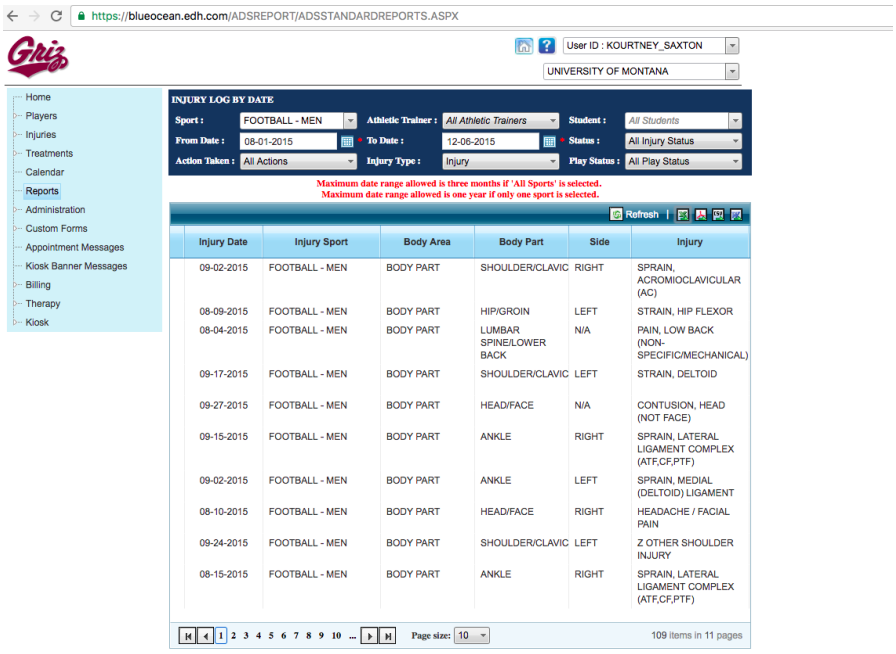
Methodology

Setting

At the conclusion of the season, a certified athletic trainer collected injury data from the University of Montana's Electronic Medical Record System (EMR), Vivature. The information collected is only from the University of Montana's football team and only lower limb injuries from the 2015 and 2016 seasons. Reports from Vivature were generated from the program's "injury report" feature (See figure 1) with date ranges of August 1, 2015 to November 21, 2015 and August 1, 2016 to November 20, 2016. The report was then exported to Microsoft Excel for

examination. The summer, winter and spring training injuries was excluded from the data to maintain approximate even season numbers and due to the fact that a certified athletic trainer may or may not have been present during those training times.

Figure 1: Vivature's "Injury Report" Output



Procedures

Once the time frame was established, the names and any student identification were removed as to not violate the Health Insurance Portability and Accountability Act (or HIPAA) regulations. The researcher recorded the total number of reported injuries for each year to determine percentage of lower limb injuries as compared to total number of injuries. Then the researcher identified any injury that was not of the lower leg (hip to toes) and those were excluded. The researcher examined row by row of data, crossing out each injury not of the lower limb. The researcher eliminated the data row from the injury Excel sheet that was of a non-lower limb (Figure 2). The injury dates were compared to the game schedules and those

injuries that occurred during away games were also be excluded. The injuries included in the study are those that occurred in Washington-Grizzly Stadium, during a monitored practice or game and limited to lower limb injury. The final data was separated into different sections of the lower limb. These categories include Hip and Thigh, Knee, Lower leg, Ankle, and Foot and Toes. An injury was classified in each category if the anatomical structure injured is within the category's area. For example, a quadriceps strain was categorized as a hip and thigh injury while patellar tendonitis was categorized as a knee injury. Frequency counts were tabulated for each category and year when an injury appeared on the final data sheet.

Figure 2: Elimination Process of Injuries

Athletic Trainers Student : All Students From Date : 08-01-2015 To Date : 12-06-2015 Status : All Injury Status Action Taken : All Actions Injury Ty

Injury Date	Injury Sport	Body Area	Body Part	Side	Injury	Action Taken
09-02-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	RIGHT	SPRAIN, ACROMIOCLAVICULAR (AC)	
08-09-2015	FOOTBALL - MEN	BODY PART	HIP/GROIN	LEFT	STRAIN, HIP FLEXOR	TREATED BY STAFF
08-04-2015	FOOTBALL - MEN	BODY PART	LUMBAR SPINE/LOWEI	N/A	PAIN, LOW BACK (NON-SPECIFIC/MECHANICAL)	
09-17-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	LEFT	STRAIN, DELTOID	
09-27-2015	FOOTBALL - MEN	BODY PART	HEAD/FACE	N/A	CONTUSION, HEAD (NOT FACE)	
09-15-2015	FOOTBALL - MEN	BODY PART	ANKLE	RIGHT	SPRAIN, LATERAL LIGAMENT COMPLEX (ATF,CF,PTF)	
09-02-2015	FOOTBALL - MEN	BODY PART	ANKLE	LEFT	SPRAIN, MEDIAL (DELTOID) LIGAMENT	
08-10-2015	FOOTBALL - MEN	BODY PART	HEAD/FACE	RIGHT	HEADACHE / FACIAL PAIN	TREATED BY STAFF
09-24-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	LEFT	Z OTHER SHOULDER INJURY	
08-15-2015	FOOTBALL - MEN	BODY PART	ANKLE	RIGHT	SPRAIN, LATERAL LIGAMENT COMPLEX (ATF,CF,PTF)	
08-09-2015	FOOTBALL - MEN	BODY PART	ANKLE	LEFT	SPRAIN, LATERAL LIGAMENT COMPLEX (ATF,CF,PTF)	
08-25-2015	FOOTBALL - MEN	BODY PART	ELBOW	RIGHT	BURSITIS, OLECRANON	
10-11-2015	FOOTBALL - MEN	BODY PART	FOOT/TOES	LEFT	FRACTURE, 5TH METATARSAL	
08-04-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	RIGHT	DYSFUNCTION, SCAPULOTHORACIC	
10-20-2015	FOOTBALL - MEN	BODY PART	ARM (UPPER)	LEFT	CONTUSION, UPPER ARM	
11-14-2015	FOOTBALL - MEN	BODY PART	ANKLE	RIGHT	SPRAIN, LATERAL LIGAMENT COMPLEX (ATF,CF,PTF)	
09-26-2015	FOOTBALL - MEN	BODY PART	KNEE	RIGHT	SPRAIN, MEDIAL COLLATERAL LIGAMENT (MCL)	
09-19-2015	FOOTBALL - MEN	BODY PART	HEAD/FACE	N/A	CONCUSSION	
09-01-2015	FOOTBALL - MEN	BODY PART	SACRUM/PELVIS	MIDLINE	DYSFUNCTION, SACROILIAC (SI)	
08-11-2015	FOOTBALL - MEN	BODY PART	ANKLE	RIGHT	SPRAIN, LATERAL LIGAMENT COMPLEX (ATF,CF,PTF)	
09-19-2015	FOOTBALL - MEN	BODY PART	KNEE	RIGHT	SPRAIN, MEDIAL COLLATERAL LIGAMENT (MCL)	
09-11-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	RIGHT	TEAR, GLENOID LABRUM (NON-SLAP)	
08-08-2015	FOOTBALL - MEN	BODY PART	HIP/GROIN	RIGHT	STRAIN, HIP FLEXOR	
11-28-2015	FOOTBALL - MEN	BODY PART	KNEE	RIGHT	SPRAIN, MEDIAL COLLATERAL LIGAMENT (MCL)	
09-15-2015	FOOTBALL - MEN	BODY PART	KNEE	RIGHT	HYPEREXTENSION, KNEE	
10-02-2015	FOOTBALL - MEN	BODY PART	ANKLE	LEFT	SPRAIN, MEDIAL (DELTOID) LIGAMENT	
08-03-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	RIGHT	INSTABILITY, MULTI-DIRECTIONAL	
11-22-2015	FOOTBALL - MEN	BODY PART	HIP/GROIN	LEFT	Z - OTHER HIP INJURY	
09-19-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	RIGHT	SPRAIN, ACROMIOCLAVICULAR (AC)	
10-25-2015	FOOTBALL - MEN	BODY PART	HAND/FINGERS	RIGHT	FRACTURE, METACARPAL (THUMB), NONDISPLACED	
09-01-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	LEFT	SPRAIN, SHOULDER	
11-23-2015	FOOTBALL - MEN	BODY PART	LUMBAR SPINE/LOWEI	RIGHT	SPASM, LOWER BACK	
11-22-2015	FOOTBALL - MEN	BODY PART	SHOULDER/CLAVICLE	LEFT	CONTUSION, SHOULDER	
11-22-2015	FOOTBALL - MEN	BODY PART	THIGH	RIGHT	CONTUSION, QUADRICEPS	
09-20-2015	FOOTBALL - MEN	BODY PART	LOWER LEG/ACHILLES	RIGHT	FRACTURE, FIBULAR	
08-30-2015	FOOTBALL - MEN	BODY PART	SACRUM/PELVIS	LEFT	CONTUSION, TESTICULAR	
09-01-2015	FOOTBALL - MEN	BODY PART	KNEE	RIGHT	TEAR, LATERAL CARTILAGE OR MENISCUS	
09-20-2015	FOOTBALL - MEN	BODY PART	HEAD/FACE	N/A	CONCUSSION	
08-17-2015	FOOTBALL - MEN	BODY PART	ANKLE	RIGHT	SPRAIN, CAPSULAR	
09-16-2015	FOOTBALL - MEN	BODY PART	HAND/FINGERS	RIGHT	DISLOC/SUBLUX, INTERPHALANGEAL (PIP/DIP) JOINT (	
09-15-2015	FOOTBALL - MEN	BODY PART	HAND/FINGERS	RIGHT	CONTUSION, HAND/FINGER	
09-15-2015	FOOTBALL - MEN	BODY PART	KNEE	LEFT	BURSITIS, INFRAPATELLAR	

Verification of Data

The data was reviewed and verified by Dr. Valerie Moody using the same inclusion criteria. All unedited and edited data sheets were turned into and evaluated by Dr. Moody and the same procedures were followed. The statistical analysis was performed with the assistance of Dr. Daniel Lee.

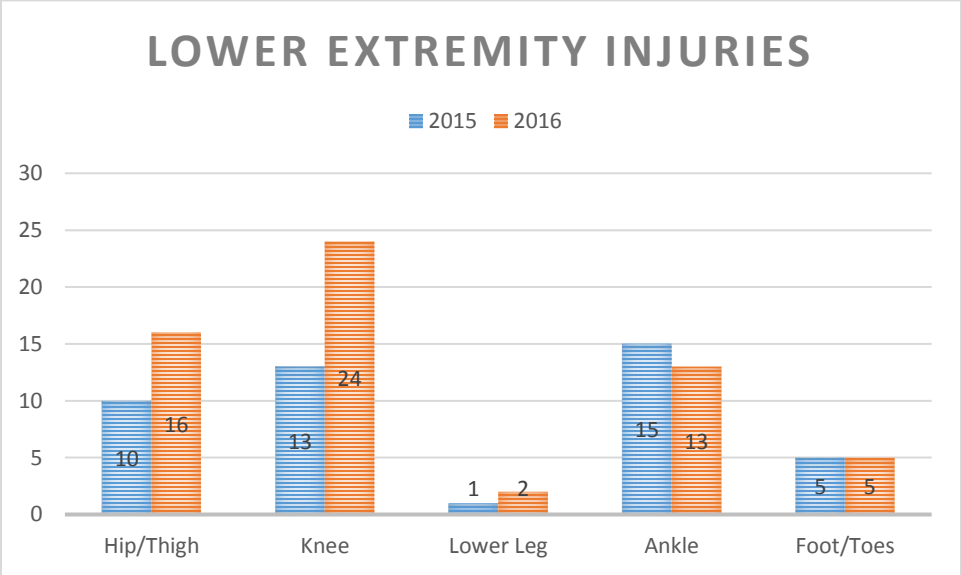
Data Analysis

First, appropriate classification of injuries by body part and injury type was conducted. Subsequently, frequency counts on types of injuries and location of injuries was conducted. Descriptive statistics were calculated for the total number of injuries for each year, location of injuries for each year and types of injuries for each year. A Chi-Square analysis was used to examine potential relationships and differences between age of turf and type/location of injuries recorded with alpha *a priori* set at 0.05. A Fishers' exact test was also performed to determine if differences between specific injuries between years were significant (alpha set *a priori* at 0.05).

Results

After the injury reports were generated, the total number of injuries for the 2015 season was recorded as 104 injuries, 52 of those being of the lower body and after excluding the injuries that occurred away from Washington Grizzly Stadium, 44 injuries were included in the study. For the 2016 season, the number of injuries recorded was 123, 68 of the lower body and after excluding the injuries that occurred away from Washington Grizzly Stadium, 60 injuries were included in the study. The categorization for each of the lower body injuries is shown in Figure 3 for the injuries included within the study.

Figure 3: Lower Limb Injury Counts for Football 2015 and 2016 seasons



A chi-square goodness of fit test was used on each year to determine whether five categories of injuries: ankle, foot & toes, knee, and lower leg & Achilles occurred equally. Injuries for the 2015 season were not equally distributed, χ^2 (4, N = 44) = 15.09, p = .01. The observed value for χ^2 (15.08) for the 2015 season was higher than the critical value of 13.277. Injuries for the 2016 season were not equally distributed, χ^2 (4, N = 60) = 25.82, p = .01. The observed value for χ^2 (25.82) for the 2016 season was higher than the critical value of 13.277. Finally, a Chi-square test was performed to compare the years together. Injuries for each season the χ^2 (4, N=104) = 2.73. With a p-value of 0.60 this result was also not significant at p < 0.05. The Fisher's Exact test statistic was calculated comparing ankle and knee injuries for each season and hip and knee injuries for each season The value was calculated to be 0.206 and 0.79 respectively. This result is not significant with a p < 0.05. These results show that the age of the

artificial turf does not have an effect on the number of lower extremity injuries in collegiate aged football players. It shows that there might be a trend of higher knee injuries on new artificial turf but it cannot be definitively answered by this study. This study shows that there may not be a reason to replace the artificial turf as often as the manufacturers recommend.

Discussion

This study shows that there is not a significant difference between the two ages of artificial turf for lower extremity injuries. Many artificial turf companies suggest the replacement of the carpet every 6 to 8 years. High schools, universities and professional teams are installing artificial turfs every year largely to appease benefactors and keep up appearances with other institutions. Many times, institutions use “player safety” as an argument to receive the funding to replace their facilities. They use this argument to convince financial officers of each institution that the new artificial turf will save them money by reducing insurance costs of the student-athletes.

While this study did not show a significant result with injuries compared to the age of the artificial turf, this information shows a consistency in types of injuries sustained by football players. In a study done by Saal (1991), American football showed to have 50% of the injuries sustained in the lower limb. Strains and sprains were found to make up 40% of those injuries. The findings of this study showed consistent findings. In the 2015 season, 50% of all the injuries were of the lower body with 61% of those consisting of strains and sprains. Also in the 2016 season, 55% of all the injuries sustained were of the lower body with 52% of those consisting of strains and sprains. This may not seem noteworthy but it shows that the two seasons observed were not out of the ordinary compared to other football teams and their seasons. The age of

the artificial turf did not have an effect on the injuries in comparison to how many injuries occur in a typical season. Even the number of lower limb injuries analyzed in this study and that had occurred in the 2015 and 2016 seasons (44 and 60 respectively) was not significantly different from one another.

The specific injuries that occurred were similar to those in previous studies. Knee and ankle injuries are known to be the highest complaints among athletes (Saal, 1991 and Fong et al., 2007). In this study, knee and ankle injuries were two of the highest recorded injury areas. Ankle injuries were the only category that was higher on the older turf (2015 season) than the new turf (2016 season). Although insignificant, a number of factors may be attributed to the difference including the frequency of taping and bracing of ankles, variability in shoe type, changing weather conditions, or the artificial turf surface itself. Knee injuries increased over the two years. This study shows a possible trend of an increased knee injuries with new artificial turf. With that being said, season or career ending lower limb injuries (such as an ACL sprain) decreased in number in the 2016 season.

This study did not show specifically if the age of artificial turf has a positive or negative effect on collegiate football athletes. What it does show is that no matter the age of turf, the numbers and types of injuries most likely will stay consistent with published literature. As previously stated, there are many factors that can influence an athlete's probability of injury. Footwear, traction, previous injuries and time of year all have an effect on how football athletes sustain injuries. This study cannot definitively state that the age of an artificial turf playing surface has the deciding effect on whether or not an athlete will sustain a lower extremity

injury. Football is an injury prone sport that will consistently have areas that need research to better the sport.

Limitations

As with any study, there are limitations to this research. It was assumed that the ground and climate conditions of each season are similar and do not need to be taken into account. As stated previously, weather can affect traction and therefore injuries for athletes participating on artificial turf. The weather may or may not have been reported on Vivature's injury report or within the athletic trainer's note on the injury. It was also assumed that the fields were cared for and the fill on the fields was redistributed the same amount of times throughout the season. The number of injuries included in the study was dependent upon certified athletic trainers and students within the Athletic Training Education Program entering any and all injuries into the EMR system. The 2015 season was the first year of Vivature being used by the athletic training staff and therefore may have led to underreporting of injuries. The information is also limited to two seasons and within one sports team. It is also assumed that each athlete had no previous injury and the footwear provided was appropriate to the surface. The researcher also assumed that all athletes were in a good conditioned state prior to the seasons starting and that no injuries occurred while weight training. It was also assumed that each athlete was adhering to team rules, such as the ankle taping policy, even if the team rules did not change between the seasons. These limitations could decrease the significance of the findings.

Conclusions

While there was not a significant finding in different reported injuries, it brings questions to the use of artificial turf. Injuries to collegiate football athletes will occur every season despite the playing surface. Further research is needed to determine if the age of the same generation of artificial turf has an effect on injury rates in collegiate football athletes. The variability in the current research leaves too much room to make definitive conclusions on what could cause the differentiation in injury rates. A longitudinal research study should be conducted to determine whether age of the same artificial turf has an impact on athletic injury rates. Studies should be conducted on playing fields throughout the Big Sky Conference considering the variety of playing surfaces available. Athlete safety should be the number one priority to all institutions instead of the aesthetic quality of their stadiums.

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