



Abstract

Perceptions of Artificial Turf Regarding the Effects of Football  
Playing Surfaces on Injury Rates

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The perceptions of National Collegiate Athletic Association (NCAA) Division III college football coaches (based on their interactions with interscholastic and intercollegiate football players) regarding the effects of football playing surfaces on athlete injury was investigated. The subjects were all (237 total) NCAA Division III football coaches. Based on the existing literature and input from a panel of expert Division III coaches, a questionnaire was formed. Results showed that 48% of the coaches surveyed, strongly agreed or agreed that artificial turf poses a greater risk to injury than natural grass.

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## Chapter 1

### Introduction

In today's sport environment games are played on a variety of surfaces. Field sports are played either on natural grass, artificial turf, or a combination of the two. Artificial turf was first developed to provide inner-city children equal opportunities to play and exercise outside so they could maintain similar fitness levels as children in rural settings (Agel, Levy & Skovron, 1990a). As time went on, artificial turf became more popular, especially in professional and college sports. Artificial turf could hold up to harsh weather conditions and extended periods of use that traditional grass fields could not withstand. As the popularity of indoor multi-use stadiums increased, the need for a field that could be used in the absence of sunlight was required (Agel et al.).

Today artificial turf is used in almost half of the stadiums in the National Football League (NFL) as well as Major League Baseball (MLB) (Wharton, 1999b). Artificial turf is very popular, but not without controversy. Many athletes do not like to play on turf, primarily because there is a perception among athletes that artificial turf causes more injuries compared to playing on natural grass (The Artificial Turf Debate, 2000; Wharton, Gutierrez, 2000; Foster, 1995).

In the past few years several professional athletes, for the purpose of extending their playing career, have asked to be traded to teams playing on natural grass (Barnes, 1999). Athletes believe that playing on turf on a daily basis will put them at greater risk of being injured and therefore shorten their careers (Foster, 1995).

Purists also agree that games were meant to be played on grass and not on turf. The major issue driving the controversy regarding artificial turf is whether or not

artificial turf does indeed increase the incidence of injuries. Most studies that have been conducted have indicated that while the incidence of injury may be more frequent for games played on turf, injuries have not been significantly more frequent or statistically significant (Gleim, Nicholas & Rosenthal, 1988; Wharton, 1999b; Batt, Collop & Dixon, 1999).

### Significance of the Topic

Artificial turf covers the playing fields of many of the professional football and baseball fields in America (Barnes, 1999). It is also widely used in colleges and universities as well as at the high school level. Many people, including coaches, players, and spectators feel artificial turf poses a greater risk of injury to players and therefore do not want to play on it (Pine, 1991; Barnes, 1999; King, 1995). National Football League players have asked the Consumer Products Safety Commission (CPSC) to ban artificial turf (Pine, 1991) and free agents have said that they would lean towards signing with grass teams (Foster, 1995). The current trend in stadium design has teams moving back to grass (Wharton, 1999b; Conklin, 2000).

The literature and studies available do not show a significant increase in incidence of injury from grass to artificial turf, but the current trends are not in compliance with what those studies show (Conklin, 2000; Wharton, 1999b). Conklin stated that in the 1999-2000 season 65% of division 1-A football schools played their games on grass fields compared to 52% in 1993. Conklin also stated that only one division 1-A school (Kent State) has switched from natural grass to artificial turf over the last decade. Individual preferences of coaches and athletic directors play a significant role when decisions are made regarding playing surface type (Conklin). An example of this

occurred in 1998 at the University of Indiana. The football coach, Cam Cameron, engineered the switch to natural grass. He was driven by his own beliefs and several players' beliefs that artificial turf causes more injuries (Conklin). Stadium owners, municipalities, and the general public need to have accurate information so that the decisions made regarding playing surfaces are made with the appropriate knowledge base.

Given that NFL players do not want to play on artificial turf (Wharton, 1999a; Conklin, 2000) it only stands to reason that one would question whether or not high school and college players assume the same stance. A bias towards natural grass may be a detriment to a college with an artificial turf field. Potential recruits may choose another school with a natural grass surface (Conklin). Accurate information and perceptions of coaches on injury rates and how these injury rates may or may not be related to turf and grass will allow the athlete to make an educated decision based on empirical evidence.

The debate over artificial turf and natural grass is a controversial topic (Pine, 1991; Foster, 1995; Wharton, 1999a; Conklin, 2000). Based on the above information and sources that address the issue of artificial turf and injury rates, there is a foundation of literature that supports a call for further research on this topic.

#### Purpose of the Study

The purpose of this study is to investigate the perceptions of Division III college football coaches regarding the effects of football playing surfaces on incidence of injury as well as their perceptions of beliefs of high school and college football players regarding the playing surface. If the results of this study show that coaches perceptions are inconsistent with the current literature (there is not a statistically significant increase

in injuries between artificial turf and natural grass) then this study has value in that it can be utilized as a tool to educate coaches, athletic administrators, and other decision makers. And, if the results are consistent with the literature reviewed, then the same decision makers as above can continue to make similar turf related decisions since this study's results would further support the perceptions of different field surfaces and how they relate to injuries.

### Definitions

Artificial Turf – man made surface used for sporting and other events as an alternative to natural grass surfaces

Carpet Movement – movement of an artificial turf surface caused by participants moving on its surface

Fire Sensitivity – property of the artificial turf surface regarding its potential for it to ignite on fire

Natural Grass – living grass containing no artificial or man made materials

Footlock – an increased fixation between the football shoe and the turf (Wharton, 1999a)

Turf Toe – “a sprain of the metatarsophalangeal joint of the great toe caused by either a hyperextension or hyperflexion of that joint” (Pine, 1991, p.126)

### Assumptions

The following assumptions of the study are noted:

1. The participants responded truthfully to all questions.
2. The participant's answers were based on their experience and perception.
3. The intended party completed the surveys.

### Delimitations and Limitations

The following delimitations and limitations are noted:

1. This study was delimited to NCAA Division III coaches.
2. This study may have been limited in that the time of the year may have affected the survey return rate. Performing the study at a different time of year (football off-season) may have provided for an increased response rate.

## Chapter 2

### Review of Literature

#### *History of Artificial Turf*

When military induction examinations were studied after the Korean War, it was found that the inner-city recruits were not as physically fit as their counterparts from rural areas. The researchers concluded that the difference was due to the lack of playing areas for the children (Agel et al., 1990a). To solve this problem the Educational Facilities Laboratory (EFL) was formed in 1960 by the Ford Foundation to initiate work in school/plant development. The idea was to construct rooftop playgrounds with a grass-like surface (Agel et al.). Three companies were involved in making the surface that would be used: (a) Monsanto, (b) Minnesota Mining and Manufacturing (3M), and (c) Cabin Craft Carpets. Each of these three companies were given the design parameters for construction of the rooftop play areas (Agel et al.). Chemstrand, a subsidiary of Monsanto, was already in the process of developing synthetic fibers to be used in carpeting. From this product, they developed an artificial surface called ChemGrass. Chemstrand's product was selected and with a \$200,000 grant from the EFL, the Chemgrass product was installed in the field house of the Moses Brown School in Providence, Rhode Island in 1964. The field, which was the first artificial turf field, is still in use today (Agel et al.).

In 1965 the Astrodome in Houston, Texas, home of MLB's Houston Astros, was completed. Dunlop (2001) stated, "This opened a new era of stadium design where total enclosure of outdoor sport activities was now possible and economically desirable"(p.74.). The dome was made with skylights, but glare from the sun made it

impossible for the outfielders to see fly balls during baseball games. To solve this problem the skylights were painted over. Without natural light, it was impossible to grow and maintain a grass field inside. Monsanto's artificial turf product, AstroTurf, was then laid down on the dirt infield of the dome. It was modified a year later with a rubber pad between the ground and the turf to provide padding (Agel et al., 1990a).

Monsanto later installed the first outdoor turf sports surfaces at High School Memorial Stadium in Seattle, Washington and Indiana State University in Terre Haute, Indiana in 1967 (Agel et al., 1990a). In 1968, the Monsanto product covered four major sporting event fields. Monsanto also released injury statistics that suggested artificial turf could reduce injury rates by as much as 80%. The injury reduction statistics are thought to have stimulated other installations (Morehouse & Morrison, 1975). By 1980 Monsanto's AstroTurf covered over 300 fields in the United States and abroad (Agel et al.). From this point on, artificial turf as a playing surface spread to various levels of sporting events: professional, collegiate, and recreational. Included in the many brands of artificial turf are AstroTurf, PolyTurf, Durra Turf, Tartan Turf, Poligrass, Chemgrass, Wyco Turf, Desso Turf, Super Turf, Omniturf, and All-Pro Turf (Ruggerio, 1993).

Current trends in artificial turf surfaces are designed to be a near replica of natural grass. Products like Astroplay, Nextturf, and Field Turf feature longer fibers with a rubber infill that create blades of artificial grass that mimic real grass (Agel et al., 1990a). Other products involve the combination of real grass and synthetic fibers that produce a stronger turf that can withstand greater stresses (Schnirring, 1999).

Today, artificial turf is utilized at all levels of sport. In 1999, the NFL had 14 of 31 teams playing on artificial surfaces (Wharton, 1999b). According to Barnes (1999)

artificial turf covered half of the fields at the professional level and more than 1,500 high school and small college fields. Gutierrez (2000) has upheld the point of view that multi-use stadiums that require a turf surface in order to sustain the wear and tear that goes along with playing surfaces are becoming less and less prevalent. Finally, Wharton stated that the new single use stadiums host a smaller number of events, which decreases the need for artificial turf, as the natural grass surface has more time to recover. Recently constructed fields in the NFL including Cleveland, Baltimore, Carolina, Jacksonville, Seattle, Cincinnati, and Pittsburgh have all installed natural grass surfaces (Wharton).

### *Types of Artificial Turf*

Artificial turf has evolved a great deal since it was first used in 1964. Early artificial turf installations involved placing a rubber carpet with plastic blades of grass on top of a 5/8-inch polyurethane pad. The sub-base for this installation was a mix of gravel and asphalt (Millman, 1984). Standard synthetic turf consists of carpets, usually of heavily textured polypropylene or nylon yarn, tufted into a woven polypropylene backing cloth. The cut pile height of 10-14mm is the norm for unfilled turfs, and it is longer for filled turfs - from 20-70mm (Dunlop, 2001).

Regarding the structural architecture of artificial turf surfaces, there are two types: (a) first-generation, or (b) second-generation types. With first-generation turfs, the fibers are the playing surface, which is accomplished by creating a "wear surface" that has a high density of grass fibers. Architectural components and design can vary, but the grass fibers support the athlete and the ball (Agel et al., 1990a).

Second generation systems use granular infill for the playing surface. Less densely arranged fibers act to stabilize the granular infill, improve appearance, and create

appropriate “ball roll” characteristics. The fibers of these second generation systems are longer than their first-generation counterparts and are often tufted through a porous backing that is held in place by a porous binder. The reported advantage of sand-filled systems includes “reduced footlock,” reduced fire sensitivity, and decreased carpet movement because of the substantial weight of the granular infill (Agel et al., 1990a). Current trends in artificial turf are moving away from the traditional carpets and becoming more like natural grass. Astroplay, NeXturf, FieldTurf and Sprinturf use long fibers with a granulated rubber infill. The long fibers simulate blades of grass and a lower thatch layer provides resiliency while encapsulating the rubber infill and also preventing compaction. The result is a surface that is very similar to real grass that can withstand harsh weather and climate conditions, extended use, and a variety of activities.

FieldTurf is the surface of choice in more than 400 stadiums worldwide and was recently approved for World Cup soccer play (Banks, 2002). FieldTurf will be installed in the fall of 2002 in the two NFL stadiums located in Seattle and Detroit. Additionally, eleven NFL teams use FieldTurf in their practice facilities (Banks). Chad Brown of the NFL’s Seattle Seahawks is quoted (as cited in Banks) as saying “This is an unbelievable turf, probably the best in the league. I love it. I’m not as physically exhausted and sore like you would be from a typical game on other hard surfaces.”

Another product, Sportsgrass, uses synthetic fibers mixed with real grass (Whiteman, 1996). Whiteman stated that the synthetic fibers supplement the root structure and act as a second level of support. “To understand SportGrass, imagine the synthetic grass as a carpet with fibers an inch and a quarter long. A sand-based soil is laid down on the carpet on top of the fibers. Natural grass is then planted in that sand.

The strands of plastic help root the grass, in effect tugging back when a player's cleat or the ball pulls the grass from the ground" (Whiteman, p. 11). The Green Bay Packers of the NFL have played on SportGrass at Lambeau Field for the past several years.

Another trend that is becoming more prevalent is the use of natural grass in trays. The trays are brought into the facility and put together like a puzzle (Popke, 2000). Popke stated that the trays allow the grass to be replaced as needed when certain sections are no longer fit for play, due to wear and tear. The trays are heated and cooled by an underground system. Giants Stadium, home of the New York Jets and New York Giants of the NFL, had used the container system each time the New York-New Jersey Metrostars of Major League Soccer (MLS) played at the facility. The containers were removed each time, but in the 2000 NFL season, both the Giants and Jets began playing on the grass. The trays are rotated as needed for wear and tear with substitute trays housed in the parking lot. The Meadowlands has enough trays to compile 2.2 football fields, which are used to host around 160 events each year (Popke).

These new surfaces offer somewhat of a compromise between real grass and standard artificial turf. There are no hard statistics that support these new types of turf, but many players and coaches have praised them (Sherbourne, 2000). Sherbourne quoted The University of Nebraska at Lincoln's Director of Athletic Facilities, John Ingram, as saying "Our environment makes it difficult for us to grow natural grass...so, we have gone to what we feel is the most grass-like surface available. We can use it in almost any weather" (p. 30). Ingram was referring to the FieldTurf surface on which Nebraska's football team plays and practices. The new generation of artificial turf surfaces may serve to quiet some of the opposition to artificial turf.

### *Rationale for Artificial Turf*

Modern artificial turf fields serve a multitude of purposes. They are a grass substitute where grass will not grow, an alternative to multiple fields when field availability is low, and a multi-purpose grass alternative that maximizes economic earning potential (Ruggerio, 1993). Artificial turf offers many advantages over natural turf including a more uniform and controlled surface and opportunities to host sporting events more frequently due to the fact that the surface will not deteriorate as the season progresses or from periods of wet weather (Dunlop, 2001). Also according to Dunlop, lower maintenance costs are an advantage for turf when compared to natural grass. Grass requires much upkeep in mowing, watering, and fertilizing. The only upkeep turf requires is vacuuming, and occasional repainting. New England Patriots owner Bob Kraft (as cited in King, 1995) stated that his natural grass field at Foxboro Stadium cost him about \$500,000 more than what artificial turf would have cost. Kraft considers himself a traditionalist and therefore preferred the grass (King). Foster (1995) stated that the main reason teams have not switched to natural grass is cost. It is more economical to install turf in multi-purpose stadiums. It costs between \$1.2 million and \$1.7 million to install an artificial surface, which typically lasts 7 to 10 years. Grass costs about \$750,000 to install, but maintenance costs make it more expensive in the long haul (Foster). Chaker (2002) stated that many high schools and city parks have made the switch to artificial turf to save money. For example, the Poudre School District in Fort Collins, Colorado spent over \$500,000 on an artificial turf field (Chaker). They feel that

the initial cost will save the district money in the long run by eliminating \$80,000 per year spent on watering and upkeep (Chaker).

Artificial grass has undeniable advantages. In cases of limited land, high field use, and harsh climates, artificial grass withstands use better than natural grass. When funds are limited, decreased maintenance costs may make an artificial grass field more attractive (Agel et al., 1990a). The disadvantages include the concerns over alterations in field characteristics as well as a concern that playing on artificial grass will increase the risk for injury (Agel et al.).

The surface requirements of the playing field differ with different sports. Interaction between the player and the ball depends on the surface and its properties. The major properties of the surface are: surface resilience, friction, uniformity and smoothness, ball/surface interaction, ball roll, and angled bounce (Dunlop, 2001).

Surface resilience refers to how the surface absorbs some of the shock of the athlete (Dunlop, 2001). Surface resilience is important in most sports involving movement, such as running. If it is too low, it will be tiring for the players, and if it is too high, it may cause injury (Dunlop). Harder surfaces allow for faster movement at times, but they are also less forgiving and create higher mechanical forces on the athlete (p. 74). Some teams have recognized this property of turf (harder surface) and have built their teams accordingly. The St. Louis Rams Vice President in Charge of Player Personnel, Charley Arney (as cited in Wishart, 2000) stated that they built their team around the number of games they play on turf. They wanted to take advantage of the fact that turf allows for faster movement. Arney also stated that his team cannot perform the way they do on turf when playing on natural grass (Wishart).

The athlete, when moving on the surface, creates friction. A low coefficient of friction results in athlete slippage and poor traction while increased friction can result in injuries to the athlete (Dunlop, 2001). Ligaments and tendons can be compromised when joints cannot withstand the pressures placed on them. Agel et al. (1990a) stated that an athlete's skills are limited by the quality of the fixation of that player to the athlete's present playing surface. Artificial turf surfaces create more friction resulting in the football player moving faster on synthetic turf than on natural grass. The shoe-surface interface is where player-surface interaction can be most dramatically affected (Agel et al.). However, there is a tradeoff. An increase in fixation increases the risk of injury. Unlike a natural surface where fixation on a given field is predominately dictated by the footwear, on an artificial surface it is possible to influence both sides of the fixation interaction, the shoe and the surface (Agel et al.). Artificial turf allows players sound traction. The increased traction allows the athlete to accelerate more quickly, but the tradeoff is it that the increase in acceleration results in an increased deceleration. The athlete's feet are able to grip the turf and stop, but the muscles, ligaments, tendons, and connective tissue cannot accommodate the quick stop (Agel et al.).

On the other hand, natural grass surfaces are more likely to be affected by adverse weather conditions. A long period of rain could leave a grass field in poor shape and possibly unplayable, whereas an artificial surface would remain unaffected - for the most part. The fact that some sports require the ability to slide over the surface should also be considered when selecting a surface (Dunlop, 2001).

Uniformity and smoothness affecting the ball/surface interaction are a large determinant of whether artificial turf is a viable alternative to natural grass playing

surfaces. The play of the ball is sometimes much different on artificial turf than on natural grass (Dunlop, 2001). Ball roll, specifically deceleration, is often lower on the shorter artificial turf when compared to natural grass (Dunlop). Ball surface interaction is an important aspect in soccer and field hockey since the distance the ball travels is greatly influenced. Game tactics and player skills need to be altered at times to compensate for the changes in surfaces (Dunlop).

The biggest need for artificial turf exists in domed stadiums. The absence of sunlight had previously made it impossible for grounds crews to maintain a grass field and keep it alive indoors (Agel et al., 1990a). However this may be changing since newer turf technology, which was discussed earlier, has made it both more appealing and possible to have natural grass surfaces indoors (Schnirring, 1999).

#### *Public and Players Perceptions*

Whether or not artificial turf causes more injuries may not be the most important factor considered when decisions are made on field surface type. Public opinion and most participants on turf feel that turf does, in fact, cause more injuries (Barnes, 1999; King, 1995). Perception alone could warrant the use of real grass instead of artificial turf regardless of whether factual information supports higher frequencies of injuries to athletes on artificial turf when compared to natural grass. Pine, (1991) stated that the public's perception of artificial turf as a dangerous surface may be have a lot to do with the media. When an athlete is injured playing on artificial turf, the turf surface is often blamed. Injuries occurring on natural grass are not perceived as being caused by the surface and the injury is attributed to the game (Pine).

According to Barnes (1999) and King (1995) many professional athletes are opposed to playing on artificial turf. Cincinnati Reds baseball player Barry Larkin demanded to be traded to a team with a natural grass field in 1998 (Barnes). Larkin believed playing on real grass would better protect him from injury and therefore extend his playing career (Barnes). Additionally, the Green Bay Packers requested that their pre-season game in 1998 against the New Orleans Saints be played on natural grass. To pacify the Packers, a temporary grass field was brought into the New Orleans Superdome for the game (Barnes). On the night before the 1995 NFL draft, agent Leigh Steinberg informed his client, Ki-Jana Carter, that it was highly probable that the Cincinnati Bengals (who play on an artificial surface at Riverfront Stadium) would pick him. Carter (as cited in King, 1995) replied "Oh, AstroTurf" in disappointment. In the third week of the pre-season, in a non-contact injury, Carter severely injured the anterior cruciate ligament (ACL) in his knee on the turf at the Pontiac Silverdome (King).

A strong opponent of artificial turf is Clark Gaines, chairman of the National Football League Players Association (NFLPA) (Schlabach, 1999b). Gaines (as cited in Schlabach) has said, "When you look at the non-contact injuries that occur on grass versus the non-contact injuries that occur on artificial turf, it's no contest. It's probably two or three times higher on turf" (Schlabach, p. E3). Gaines has been conducting locker room interviews with players since 1994. In a survey conducted in 2000 by the NFLPA, 957 NFL players responded to questions intending to determine the best and worst NFL playing surfaces. Results indicated that the five best fields were natural grass fields (Tampa Bay, Carolina, Jacksonville, Miami, and Baltimore). On the other hand, four of the five worst fields were found to be fields that consisted of artificial turf surfaces

(DiPaola, 1999). Furthermore, it was found that 86% of the NFL players preferred to play on natural grass; 94.2% believed turf was more likely to contribute to injury; 95.9% felt turf caused more soreness; and 89.9% felt turf was more likely to shorten their careers. Over half, 56.7%, felt turf was to blame for increased fatigue (DiPaola). A similar study done in 1998 showed that 72.2% of NFL players felt that a natural grass home field was very important or somewhat important when deciding to sign with a team (Boughton, 2000).

The perception that artificial turf causes more injuries is also believed to be true by high school football players and coaches (Schlabach, 1999a). The 1999 Georgia-Florida All-Star Football game was the last one to be played in the Georgia Dome because of the artificial turf surface (Schlabach). The event's organizers were worried about injuries that had happened in previous years, which were blamed on the turf. Also, several players declined the opportunity to play in the game - citing the injury potential of the artificial turf (Schlabach).

Conklin (2000) stated, that field surface type has become a recruiting issue for colleges. Vanderbilt University surveyed its students before they switched from an artificial turf field to a natural grass field. The perceived increase in injury potential of artificial turf was one of the deciding factors to make the switch to natural grass (Conklin). It was felt that the switch may help the school land prized recruits, but at the same time the switch might decrease the multi-purpose capabilities of the surface and economic earning potential (Conklin).

It should be noted however that, although the above literature seems to suggest that artificial turf causes more injuries than natural grass, not all of the literature is

supportive of this belief. Randolph L. Pearson, MD, is the team physician and associate professor in the Department of Family practice at Michigan State University. Pearson (as cited in Schnirring, 1999) admits that some players have difficulty adjusting from a grass surface to artificial turf, but the medical staff has not experienced any discernable differences in injury rates between games played on natural grass and artificial turf (Schnirring).

### *Studies*

Anecdotally the majority of player and public perception *does favor* the use of natural grass over artificial turf (DiPaola, 1999). However, it is necessary to examine scientifically based studies in order to gain a more credible indication as to the relationship of injuries as they relate to artificial turf as well as natural grass. In 1973, the NFLPA petitioned the CPSC, to ban artificial turf (Pine, 1991). In response to the petition, the Monsanto Company, makers of AstroTurf, submitted a study of their own to the CPSC that claimed artificial turf helped prevent injuries (Pine). Since the above companies have conflicting views, the debate over which surface causes more injuries has been on-going. Although the differences were not significant, most studies performed in the past, found slight increases of injuries occurring on artificial turf (Gleim, Nicolas & Rosenthal, 1988; Wharton, 1999b; Batt et al., 1999).

During the 1980's the NFL commissioned an Iowa sports-injury consultant to conduct a study (Wharton, 1999a). Powell (as cited in Wharton) collected injury reports from athletic trainers of all teams and concluded that there was no significant difference in the number of serious injuries occurring on artificial turf and natural grass. Another study involved regular season games of the New York Jets from 1960-1985. The authors

of the study found no statistically meaningful differences between the turf and grass surfaces (Gleim, Nicholas, & Rosenthal, 1988). Batt et al. (1999) went on to state that there are indications that there is an increased incidence in both overuse and accidental injuries when participating in sports on artificial surfaces, but there is a lack of good science to demonstrate clear relationships between surface characteristics and specific injuries.

In more recent studies the results have favored the use of natural grass (Agel et al., 1990b). Agel et al. reviewed several epidemiological studies regarding turf-related injuries. Data from the National Athletic Injury/Illness Reporting System (NAIRS) was reviewed as well as injury data reports from the NFL and National Collegiate Athletic Association (NCAA). The NAIRS report review covered injury rates for 53 high school teams and 148 college teams from 1975 to 1977 with approximately 16,000 athletes in all. The report found that there was an increased rate of injury for artificial turf, but it was not statistically significant. The injury risk was more, but only resulted in about one more injury per team per season (Schnirring, 1999). The NFL report monitored injuries from 1969 to 1974 and found the injury rate on artificial turf to be 2.8 per game compared to 2.2 per game on natural grass (Agel et al.). It was also concluded that play and practice on artificial turf is associated with an increased risk of injury to lower extremities by 30-50%. However, they (Agel et al.) did go on to say that most of the data indicating increased injury frequencies on artificial turf was from the late 1970s and early 1980s and since then, newer turfs have been designed that may be safer.

A more recent report in 1997 by Dr. Willibald Nagler found similar results (Bernard, 1995). Nagler (as cited in Bernard), the Anne and Jerome Fisher Physiatrist in

Chief at the Cornell Medical Center in New York City, and his colleagues collected reports from 25 medical journals. It was concluded that foot and knee injuries occurred 50% more often on artificial turf than on natural grass. It was also concluded that the injuries were more serious and more difficult to heal as opposed to injuries that occurred on grass. Nagler (as cited in Bernard) also believed artificial turf may aggravate injuries and slow the healing process. Nagler (as cited in Bernard) concluded – as many others have – that the main factor for the injuries is foot fixation. When playing on artificial turf, the foot cannot slide on the ground like it does on natural grass. This creates a great deal of stress on the ligaments of the knees and feet, causing them to rupture (Bernard). Nagler (as cited in Bernard) went on to state, according to the published scientific articles, that football played on natural grass, results in fewer ligament injuries and the injuries that do occur are less severe.

The Athletic Injury Monitoring System reviewed data from the 1998 college football season. The study used a stratified sample of 33 college teams that comprised a proportional sample of approximately five percent of football playing institutions (Zemper, 2001). The author stated that the injury rate, which had been higher for artificial turf in previous years, continued a downward trend – coming closer to the rate of natural grass. Injuries on turf and injuries on grass in 1998 were essentially equal at the collegiate level of play (Zemper, 2001). However, Zemper did find that the injury rate for games was 10% higher on artificial turf than on natural grass, based on the amount of games played on each surface.

It was reported that in 1999, NFL teams (based on the average salary) paid a combined \$60,477,000 to players who could not play due to injury (Gutierrez, 2000).

Also according to the same report, all of these injuries cannot be attributed to artificial turf. This figure involves all injuries, which may or may not have occurred on artificial turf. In 1999, 12 of 14 teams that played their games on turf (85.7%) had 10 or more players sidelined for injuries, compared to 9 of 17 (52.9%) that played their games on grass. Teams who played on turf had 192 players injured (13.7 per team) compared to 175 injuries to grass teams (10.3%). The league average was 11.8. The five teams with the most injuries, played on artificial turf (Gutierrez).

An NFL commissioned study found that there could be an increased rate for certain knee injuries: sprains, ACL tears, and medial collateral ligament (MCL) tears (Gutierrez, 2000). However, the results obtained in a recent study by Seattle Seahawks team physician, Pierce Scranton (as cited in Cawley et al. 1996), were quite different from the aforementioned NFL commissioned study. Scranton and his colleagues (as cited in Cawley et al.) studied non-contact ACL injuries over five years, taking into account many factors including grass vs. turf, wet vs. dry conditions, and spatted vs. unspatted shoes. Scranton's results showed that most ACL injuries occurred in dry conditions on natural grass. In 61 injuries, 40 occurred on grass as opposed to 21 that occurred on artificial turf. Scranton (as cited in Cawley et al.) suggested that if all games had been played on turf, approximately 10 of the injuries would not have occurred.

Boughton (2000) stated that at best, the studies on injuries and artificial turf have been contradictory. A major problem with studies done in the past is that they cannot rule out many variables that affect injury rates and the surfaces involved (Conn & Foshee, 1991). Conn & Foshee stated that the study designs and inappropriate statistical tools failed to control for contamination effects, such as the type of artificial and/or

natural surfaces, the type of surface underneath the artificial surface, the description of footwear, condition of the playing surface, fatigue and previous condition of the injured athlete, mass of the individuals, strength and skill differential of opponents, proper mechanics, levels of arousal, game or practice conditions, violations of rules, etc. All of these variables contribute to injury potential. Agel et al. (1990b) reinforced the above assertions by Conn & Foshee, and stated that the problems of variability in reporting practices can be avoided by special studies. A research team, supervised by the investigators, needs to collect information on exposures, related important conditions, and injuries. Agel et al. also stated that such studies are difficult to mount on the large scale necessary for reasonable statistical power to detect uncommon events. If a study cannot control all external variables that affect injury rates, a valid conclusion cannot be drawn from the data.

### *Common Injuries*

#### *Turf toe.*

One injury that seems to be more prevalent when associated with artificial turf, but may also occur on natural grass, is turf toe (Braver, 2001). Turf toe is a capsular or ligamentous sprain of the first metatarsophalangeal joint. In most cases the great toe is pushed into a hyperdorsiflexion injury, but the condition is also caused from hyperplantarflexion as well (Braver). In the first case, the joint is hyper-extended as the heel is raised off the ground. In the case of hyperplantarflexion, the ankle and toe are flexed downward and the leg moves forward as the athlete falls. Cartilage injuries to the surrounding joints are also common. Additional soft tissue and bone structures may also be damaged if any rotary motion occurs during the injury (Braver).

Symptoms of turf toe include pain, swelling and tenderness of the first metatarsophalangeal joint of the great toe. Pain is often experienced when the athlete pushes off during running. Turf toe injuries are graded into three categories: grade I, grade II, and grade III (Goss, 2001). A grade I injury is the mildest. The soft tissue structures of the great toe are sprained or stretched, causing some swelling and tenderness. A grade II injury involves more swelling and tenderness as well as some restricted movement and some black and blue coloration. A grade III injury - the most severe - involves swelling, pain on palpation, range of motion restriction, black and blue color, and the inability to bear weight on the foot. There may also be tears to the joint capsule, ruptured ligaments, and possible compression damage to the articular cartilage of the great toe (Goss).

A study by Bierhals, Gorse and Mickey (1997) showed that turf toe injuries are more prevalent on artificial turf when compared to natural grass, but it should be noted again, that turf toe injuries *do* occur on other types of surfaces as well. Barnes et al. (1990) stated that turf toe is more common on artificial turf than natural grass, primarily due to the increased hardness and reduced shock absorbing characteristics of artificial turf compared to natural grass. Barnes stated that the hard artificial turf surfaces transmit the force of a tackle directly to the joint, creating an overload to the plantar capsule ligament: resulting in turf toe. Shoe choice is also believed to play a major role in injuries on artificial surfaces (Cawley et al. 1996). Light mesh shoes are often worn on artificial surfaces. These shoes offer more flexibility, but lack the stability of the rigid, plastic cleated shoes – increasing the likelihood of injury (Cawley et al.).

Full-length orthotics and steel spring plates are common treatments for turf toe and enhance many athletes' ability to return to play. Taping, splinting, medications, physical therapy, and shoe changes are often used as well (Braver, 2001). A hard cast is usually not used, as it often ends the season of the athlete involved. Bone growth stimulation may be used when there is a known fracture, and surgery to explore and remove a bone fracture, is sometimes used (Braver).

#### *Other injuries.*

In addition to turf toe there are other injuries that are not exclusively associated with artificial turf, but may be more likely to happen on artificial turf. As discussed earlier, injuries to lower extremities have been found, in some studies, to more commonly occur on artificial turf (Agel et al., 1990b; Bernard, 1995). Agel et al. found a 30-50% increase for lower extremity injuries on artificial turf and reports by Nagler (in Bernard) concluded that foot and knee injuries occur 50% more often on turf. Many people and players (Wharton, 1999a; Gutierrez, 2000; Foster, 1995) also believe that turf causes more soreness after competing and slows the healing process of current injuries.

A third category of injuries that may be more prevalent on artificial turf is concussions. In a study done by Garret, Guskiewicz, Padua and Weaver (2000), it was concluded that contact with artificial turf appears to be associated with more serious concussions than did natural grass. According to Garrett et al., the hardness of the surface is the likely reason for higher incidences of concussions on artificial turf than on natural grass.

#### *Footwear choice and its effect on injuries.*

The type of shoe an athlete wears may play a large role in injury potential when playing on artificial turf (Rogers et al., 1996). Rogers et al. studied the relationship between five different shoe types and the amount of fixation they had with artificial turf. A flat-soled basketball type shoe, natural grass soccer style shoe, and three different multi-studded turf shoes were studied at five different temperatures. Rogers et al. concluded that only the flat-soled basketball type shoe could be designated safe at all temperatures studied. Results of the study by Scranton (as cited in Non-contact knee injuries in the NFL, 1997) showed that a cleated shoe worn on a dry natural grass surface would pre-dispose the athlete to injury. Scranton also believed that spattung the shoe, which refers to taping the shoe to the foot or ankle, would reduce injuries. Scranton suggested that in dry grass situations, a molded rubber cleat should be worn, that conventional cleats should be worn in wet grass, and a court shoe should be worn on dry artificial turf. With a limited budget, a partially spat turf shoe might commonly be used. Footwear selection is most likely the biggest factor concerning injuries that the athlete can control (Batt et al., 1999). Proper footwear selection for the type of field and conditions of the field may determine the injury risk to the athlete (Scranton as cited in Non-contact knee injuries in the NFL; Rogers et al.).

Following the initial development of artificial turf for the purpose of creating rooftop playgrounds and to give inner-city children similar opportunities in playing areas like their country counterparts as stated by Agel et al., (1990a); early uses of artificial turf in domed stadiums spread to use in indoor and outdoor applications at all levels of sport. The public, as well as past and present players, who have played on artificial, turf agree, for the most part, that turf, does in fact, present a higher potential for injury (DiPaola,

1999, Barnes, 1999). Multi-purpose facilities that host many events as well as domes, use artificial turf because natural grass is not possible, financially feasible, or not durable enough. These facilities will continue to use artificial surfaces to meet their needs. At the same time because of player opposition, new technology, and the rise of single use stadiums, the trend has become one of moving from artificial turf back to grass (Barnes).

This review of literature gives credence to the notion that injury potential is not noticeably different for playing on artificial turf when compared to natural grass. Past studies were inconclusive and did not show significant differences between injury rates on turf and grass fields (Gleim et al.; 1988, Batt et al. 1999; Wharton, 1999a). However, more recent research has shown that there is a higher rate of injury, especially for the lower body, when playing on turf (Agel et al., 1990b, Bernard, 1995).

Public and player opinion is likely to play a large role in the use of artificial surfaces. A survey by Athletic Business showed that, in many cases, the surface chosen is largely dependent on the perception of the coach or athletic director (Conlkin, 2000). As a coach or school recruits players, an artificial turf field may be both an advantage and disadvantage for selling a sports program. People's beliefs, whether or not supported by empirical data, can be a decisive factor in reselection of surfaces by athletic personnel and athletes. Newer artificial products are also dramatically changing the decisions with which athletic personnel are confronted. Innovations in field maintenance have made it possible to accomplish things unheard of in the past (Popke, 2000; Whiteman, 1996).

## Chapter 3

### Methods and Procedures

The purpose of this chapter is to present the methods and procedures used to determine the perceptions of NCAA division III football coaches regarding football playing surface and its effect on injury rates. The study was approved by the SUNY Brockport Institutional Review Board (IRB) (see Appendix A). As required by the SUNY Brockport IRB, the investigator, in compliance with federal regulations, completed a three-hour, online modular training course on the protection of human subjects in research (see Appendix B for certificate of course completion). In accordance with IRB procedures, anonymity was ensured by instructing head coaches who were interested in receiving the project's results to include their name and address on a separate piece of paper and return it with the survey.

#### *Selection of Subjects*

In this study, all NCAA Division III schools with football programs (237 in total) were selected to be surveyed. Division III NCAA institutions, were selected as a means to increase the likelihood of responses. The head football coach at each institution was selected as a subject, and a database of the institutions was compiled via an internet search to determine the names and addresses of each coach.

#### *Instrument*

A survey instrument was developed (appendix C) based on the existing literature related to football playing surfaces. After receiving feedback from a panel of experts (local division III coaches with over 23 years of experience and a representative from Astroplay with extensive knowledge on the subject) modifications were made and the

content of the survey was validated. The survey was predominately composed of a five-point Likert scale with responses ranging from strongly agree to strongly disagree.

Surveys were mailed on October 10, 2002 to all participants. Included in the mailing was a cover letter (see Appendix D), the survey instrument, and a self addressed stamped envelope for return to the principle investigator. All data were collected by the principle investigator.

### *Statistical Analysis*

Due to the lack of similar studies like this in the past, there were no expected results to compare using chi square statistics. For this reason, descriptive statistics were most appropriate in analyzing the data. Upon receiving the data from the returned surveys, the data was entered into a Microsoft Excel spreadsheet. The frequencies of the responses of each question were tabulated along with the mean, median, and mode for each survey question.

## Chapter 4

### Results

Surveys were mailed to 237 NCAA Division III college football coaches. Eighty-six surveys were returned for a return rate of 36%. A summary of the responses is included (see Appendix E).

#### *Demographics*

Sixty-seven percent of the respondents were between the ages of 41 and 60. Fifty-six percent were employed at their current institutions 10 years or less and 59% have been coaching for 21 years or more. Seventy-three percent reported their annual salary to be \$50,000 or more.

#### *Background Questions*

The majority (54%) of respondents felt that from an initial cost standpoint artificial turf is not more cost effective compared to natural grass. From a field maintenance and durability standpoint, the majority (84% and 86% respectively), did feel that artificial turf is more cost effective when compared to natural grass. Overall, 55% felt that artificial turf is more cost effective when compared to natural grass. Regarding playing surface type, it was reported that 75% of schools do not have artificial turf as a playing surface on any of their fields, but 77% do play on artificial turf for some of their games and/or practices.

#### *Injury Potential*

Regarding the injury potential of artificial turf, when asked if artificial turf poses a greater risk of injury to players when compared to natural grass, 48% agreed or strongly agreed. Nineteen percent remained neutral while 33% disagreed.

Forty percent agreed, 27% were neutral and 33% disagreed that artificial turf may shorten a player's career. The majority of respondents (52%) felt footwear choice is a strong factor resulting in injuries that occur on artificial turf.

The majority of respondents answered no opinion, neutral or disagreed when asked if overuse injuries (66%), non-contact injuries (52%), injuries to lower extremities (55%), overall knee injuries (52%), MCL sprains (62%), ACL sprains (62%), injuries to quadriceps (92%), injuries to hamstrings (88%), and concussion injuries (72%) are more prevalent on artificial turf. However, many respondents did agree that non-contact injuries (48%), injuries to lower extremities (45%), and overall knee injuries (48%) are more prevalent when participating on artificial turf. The majority of respondents (70%) felt that turf toe injuries are also more prevalent when participating on artificial turf.

The majority of respondents had no opinion, were neutral, or disagreed that knee sprains (64%), post training muscle soreness (69%), and concussions (67%) are generally more severe when occurring on artificial turf as opposed to natural grass. Sixty percent of the coaches surveyed agreed that artificial surfaces lose shock absorption capabilities as the surface ages.

#### *Perceptions Regarding Players*

When asked their perception of high school and college football players, surveyed coaches felt that 67% of high school football players and 66% of college players believe artificial turf causes more injuries. When asked if high school football players would prefer to play on natural grass instead of artificial turf to avoid injuries, 37% agreed, 34% had no opinion or were neutral, and 29% disagreed. When asked the same question

regarding college players, 50% agreed, 23% had no opinion or were neutral, and 27% disagreed.

### *Recruiting*

Fifty-one percent of the respondents felt that playing surface type plays a major role in athlete recruitment. When the coaches were asked if high school athletes would rather attend schools with natural grass surfaces, 29% agreed, 38% had no opinion or were neutral and 33% disagreed. When asked if natural grass surfaces (as opposed to schools with artificial turf) provide a recruiting advantage, 80% had no opinion, were neutral, or disagreed. Fifty-eight percent of the coaches agreed that the preferred surface for football players (in the coaches opinions) is natural grass; whereas 25% disagreed that natural grass is the preferred surface.

## Chapter 5

### Discussion

The survey results showed that the knowledge of NCAA division III football coaches is more consistent with the literature than expected by the investigator. A strong bias favoring natural grass, in accordance with NFL players (DiPaola, 1999), was expected. Foster (1995) showed that initial costs of artificial turf installation were greater than that of natural grass. Turf installations typically range from \$1.2-1.7 million, while natural grass installations are around \$750,000 (Foster). The majority of respondents were consistent with Foster and said from an initial cost standpoint, natural grass was more cost effective. According to Agel et al. (1990a) decreased maintenance costs are listed as a benefit of artificial turf. The general feelings of the respondents of this study were consistent with the previous statement in that the respondents believed that artificial turf is more cost effective when compared to natural grass, especially when considering durability and field maintenance. The responses were also consistent with the literature that stated artificial turf surfaces lose shock absorbing capabilities as they age (Bierhals et al., 1997).

Surprisingly, the responses regarding injury potential were different than those expressed by NFL players. Where a majority of NFL players (94.2%) in a study by DiPaola (1999) felt that artificial turf poses a greater risk of injury to players when compared to natural grass, only 48% of the coaches in this study shared this same opinion. A similar difference was shown when asked if artificial turf could shorten a player's career. Forty percent of the coaches in this study agreed with this, as compared to 89.9% of NFL players (DiPaola).

When asked if the following injuries are more prevalent when participating on artificial turf: overuse injuries, non-contact injuries, injuries to lower extremities, overall knee injuries, MCL sprains, ACL sprains, injuries to quadriceps, hamstrings, and concussion injuries, it was expected that the perception would be that injuries would be more prevalent on artificial turf as opposed to natural grass. However, the responses did not show this. The responses from the coaches did not favor either artificial turf or natural grass in terms of either resulting in higher rates of injuries than the other. No opinion and/or neutral comprised a large percentage of the answers for these questions. This suggests that more research is needed in this area. The surveyed coaches may not have the knowledge base and the existing literature may not provide clear answers to these questions to elicit a response in favor or against the notion that artificial turf or grass results in more injuries. Research performed in this area will give coaches more knowledge on the subject enabling them to establish stronger opinions regarding it.

As previously stated, recent literature has pointed towards a higher incidence of injury to lower extremities on artificial turf (Agel et al., 1990b; Bernard, 1995). These questions *did* result in only 45% agreeing that artificial turf causes more lower extremity injuries than does natural grass.

The survey results showed what was expected regarding the perceptions of coaches on high school and college football players' opinions on injury rates of artificial turf. Coaches felt that both groups of players (67% of high school and 66% of college) perceived artificial turf to cause more injuries. The perceived opinions of high school and college players were likely fueled by the great deal of media attention that focuses on an increased injury rate when participating on artificial turf. The majority of coaches felt

that college football players would rather play on natural grass to avoid injuries, but the responses were unclear regarding high school players. Although high school players were perceived to believe artificial turf does cause more injuries, these same players would *not* select natural grass as their surface of choice to avoid injuries.

Currently there is limited literature regarding the issue of athlete recruitment and the effect playing surface may have on it. Most of the references to it are anecdotal. Conklin (2000) stated that some colleges have switched from artificial turf to natural grass because they have lost recruits to schools with natural grass. In the 1970's there was a trend that favored playing on artificial turf, but the current trend is back to natural grass (Conklin). A majority of the respondents (51%) *did* feel that playing surface type does play a role in athlete recruitment. However, it was not shown that high school athletes would rather attend schools with natural grass (29% agreed) and natural grass was also not shown to be a recruiting advantage for a particular school as only 20% agreed. Results showed that although there were some feelings that playing surface is a recruiting issue, there was not overwhelming evidence of it. It could be that beliefs toward recruiting, and how different surfaces may affect recruiting may vary across divisions. For example, division I players who have a stronger possibility of a professional playing career after college, may have stronger feelings regarding artificial turf and injury rates. If the same survey was sent to division I coaches, the responses regarding recruitment and playing surface may be more heavily biased towards natural grass.

#### Conclusion

The survey responses have shown that NCAA division III football coaches are quite educated and have a knowledge base that relates well with the current literature. Conklin (2000) stated that coaches often have great influence over the type of surface on which their teams will play. Taking this and the results of this study into account, coaches can help their institutions make educated decisions regarding types of playing surfaces on which their teams play and practice. The literature reviewed shows that public, player, and the media's perception still remain biased towards natural grass. This perception is likely to persist, as definitive studies on injury rates are rare since the amount of variables that effect injury rates are very difficult to control (Agel et al., 1990b). Coaches are one group that can help educate people who make decisions on future stadium and field development. With accurate information municipalities, stadium owners and other athletic administrators will be able to make educated decisions that have both the participants safety in mind and are financially sound.

#### Areas for Future Research

This project has developed a survey and a set of responses for NCAA division III coaches regarding playing surface and its effect on injuries. It would be beneficial to administer the same survey to division I coaches. The survey would show the differences in the opinions of division III and I coaches, if any, and also may show differences in the beliefs – related to field surfaces – of division I and division III athletes as perceived by their coaches.

Similar surveys should also be administered to athletic trainers. By working with injuries and the athletes directly, athletic trainers have first hand experience regarding the properties of the playing surface and the possible injury potential of it. Athletic trainers

also have first hand accounts of the athlete's description of the injury and the possible mechanism for its occurrence.

Additional studies should be performed on the new artificial turf technology (second generation turf). Schnirring (1999) stated that there are not many current studies available, if any, regarding the second generation turfs. These products are changing the way artificial turf is perceived. Given the popularity and increased use of second generation turfs, it makes sense to call for research, with the goal being to understand the surface and how injuries relate to the surface. Accurate, well-planned studies may provide information that can be used to better educate the general public on the characteristics of various field surfaces when considering injury potential.

## Appendices

**SUNY BROCKPORT**

Grants Development Director

Date: October 4, 2002  
To: James Hammond  
From: Colleen Donaldson for  
Institutional Review Board  
Re: Project IRB #2002-21

Your proposal "Perceptions of Division III football coaches regarding the effects of football playing surfaces on injury rates" has been approved. If you wish to continue this project beyond one year, federal guidelines require that the information below (items 1-6) will need to be provided to the IRB before the project can be approved for a second year. Please note also that if the project initially required a full meeting of the IRB (Category III proposal) for the first review, then continuation of the project after one year will again require full IRB review.

Information required by the IRB for continuation of the project past the first year includes the following:

1. number of subjects involved in year one, a description of any adverse events or unanticipated problems involving risks to subjects or others, withdrawal of subjects from the research, or complaints about the research during the previous year;
2. a summary of any recent literature, findings, or new information about any risks associated with the research;
3. a copy of the current informed consent document;
4. a general summary of research findings from year one;
5. reason why project needs to be continued into a second year or more.

Please contact Colleen Donaldson, Office of Academic Affairs, immediately if:

- the project changes substantially,
- a subject is injured,
- the level of risk increases.

A final report of less than one page that focuses on human subjects participation in the process is due on or before October 4, 2003.

CD:mlm

*State University of New York  
College at Brockport*

# *Certificate of Completion*

*awarded to:*

**James Hammond**

*by the*

*Office of Academic Affairs  
At SUNY College at Brockport*

*For Completion of the computer-based training course offered by CITI on the  
Protection of Human Research Subjects*

*Colleen Donaldson*

Colleen Donaldson  
IRB Administrator

August 2002

Date

## Appendix C

## Perceptions of Artificial Turf Regarding the Effects of Football Playing Surfaces on Injury Rates

Please circle your answer for the following questions. Questions are either multiple choice, yes/no or use a likert scale.

### Legend

1 (SA)	Strongly agree
2 (A)	Agree
3 (N)	No opinion or neutral
4 (D)	Disagree
5 (SD)	Strongly disagree

### Demographics

1. What age category do you fall in (years)?

20-30    31-40    41-50    51-60    61 & above

2. How many years have you been at your current school?

0-5    6-10    11-15    16-20    21 & above

3. How many years have you been coaching?

0-5    6-10    11-15    16-20    21 & above

4. What is your salary range?

0-\$20K    \$20K-\$30K    \$30K-\$40K    \$40K-\$5K    \$50K & above

### Background questions

5. From an initial cost standpoint artificial turf is more cost feasible than natural grass.

1        2        3        4        5  
(SA)    (A)    (N)    (D)    (SD)

6. From a field maintenance standpoint, artificial turf is more cost effective when compared to natural grass.

1        2        3        4        5  
(SA)    (A)    (N)    (D)    (SD)

7. From a durability standpoint, artificial turf is more cost effective when compared to natural grass.

1        2        3        4        5  
(SA)    (A)    (N)    (D)    (SD)

8. Artificial turf is a more cost effective when compared to natural grass.

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

9. Does your school have artificial turf as a playing surface on any of its playing fields?

1 (Yes)      2 (No)

10. Do you currently play on artificial turf surfaces for any games or practices?

1 (Yes)      2 (No)

### **Injury Potential**

11. Artificial turf poses a greater risk of injury to players when compared to natural grass.

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

12. Participating on artificial turf may shorten a player's career.

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

13. Footwear choice is a strong factor in injuries that occur on artificial turf.

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

14. The following injuries to players are more prevalent when participating on artificial turf.

a) Overuse injuries:

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

b) Non-contact injuries:

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

c) Injuries to lower extremities:

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

d) Overall knee injuries:

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

e) Medial collateral ligament (MCL) sprains:

1      2      3      4      5  
 (SA) (A) (N) (D) (SD)

f) Anterior cruciate ligament (ACL) sprains:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

g) Injuries to quadriceps:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

h) Injuries to hamstrings:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

i) Concussion injuries:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

j) Turf toe injuries:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

15. The following injuries that occur on artificial turf are generally more severe than those occurring on natural grass.

a) Knee sprains:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

b) Post training muscle soreness:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

c) Concussions:

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

16. Artificial turf surfaces lose shock absorption capabilities as they age.

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

### Perceptions Regarding Players

17. In your professional opinion do:

a) High school football players believe artificial turf causes more injuries.

1	2	3	4	5
(SA)	(A)	(N)	(D)	(SD)

b) College football players believe artificial turf causes more injuries

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

18. To avoid injuries, high school football players would prefer to play on natural grass instead of artificial turf.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

19. To avoid injuries, college football players would prefer to play on natural grass instead of artificial turf.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

### Recruiting

20. Playing surface type plays a major role in high school athlete recruitment.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

21. In your professional opinion:

a) High school athletes would rather attend schools with natural grass surfaces than artificial turf.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

b) Natural grass surfaces, (as opposed to schools with artificial turf) provide a recruiting advantage.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

c) If I had my choice, I would prefer that my teams play on natural grass.

1      2      3      4      5  
(SA) (A) (N) (D) (SD)

## Appendix D

September 18, 2002

State University of New York College at Cortland  
Dan MacNeill, Head Football Coach

[REDACTED]  
[REDACTED] [REDACTED]  
Dear Coach:

My name is James Hammond and I am seeking your expertise and assistance by requesting that you complete the enclosed survey. As a graduate student at SUNY Brockport, I am required to complete a thesis as a culmination of my graduate program.

Given that this survey is anonymous in nature, your identity and your organizations identity will be protected and will remain anonymous at all times. Please note that you are not obligated to participate in this study and may, at any time, exercise this right by choosing not to complete the enclosed survey prior to returning it.

Not only will your responses assist me in fulfilling my graduate requirement, they will provide me with the necessary information to arrive at results and conclusions pertaining to my topic. If you wish to receive the results of this study, please express this desire on a separate piece of paper and return it along with the completed survey.

Finally, I wish to sincerely thank you for your time spent in assisting me with this important research endeavor. If you have any questions please do not hesitate to contact me at [REDACTED]. You may also contact my advisor, Dr. Robert C. Schneider at [REDACTED].

Yours truly,

Mr. James Hammond  
Graduate Physical Education Student  
The State University of New York at Brockport

Enc.

Perceptions of Artificial Turf Regarding the Effects  
of Football Playing Surfaces on Injury Rates  
Survey Summary

Question	# of responses	Mean	Median	Mode	5's	4's	3's	2's	1's
1	86	3.01	3	3	5	20	38	17	6
2	86	2.49	2	1	12	9	17	19	29
3	86	4.19	5	5	51	16	8	6	5
4	81	4.49	5	5	59	13	4	0	5
5	82	3.38	4	4	14	30	18	13	7
6	84	1.75	2	1	0	4	9	33	38
7	84	1.82	2	2	0	5	7	40	32
8	82	2.37	2	2,3	1	11	25	25	20
9	85	1.75	2	2	0	0	0	64	21
10	85	1.22	1	1	0	0	0	19	66
11	85	2.84	3	2	9	19	16	31	10
12	85	2.96	3	2	9	19	23	28	6
13	84	2.35	2	2	1	8	23	39	13
14a	85	2.93	3	3	6	13	37	27	2
14b	84	2.74	3	2	5	15	24	33	7
14c	85	2.8	3	2	5	17	25	32	6
14d	85	2.74	3	2	5	15	24	35	6
14e	85	2.91	3	3	6	14	33	30	2
14f	85	2.89	3	3	6	14	33	29	3
14g	84	3.35	3	3	6	24	47	7	0
14h	84	3.29	3	3	6	22	46	10	0
14i	85	3.02	3	3	7	15	39	21	3
14j	83	2.35	2	2	4	8	13	46	12
15a	85	2.91	3	3	5	18	31	26	5
15b	85	3	3	3	4	18	37	26	0
15c	85	3.02	3	3	8	17	32	25	3
16	84	2.48	2	2	3	9	22	41	9
17a	84	2.48	2	2	3	10	15	52	4
17b	83	2.48	2	2	3	10	15	51	4
18	83	2.93	3	2	3	21	28	29	2
19	84	2.75	2	2	3	20	19	37	5
20	85	2.6	2	2	3	12	27	34	9
21a	84	3.12	3	3	6	22	32	24	0
21b	84	3.19	3	3	6	23	38	15	2
21c	84	2.42	2	1	6	15	14	22	27

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