

ANNUAL SURVEY OF CATASTROPHIC FOOTBALL INJURIES

1977 - 2008

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CATASTROPHIC FOOTBALL INJURIES

INTRODUCTION

In 1977 the National Collegiate Athletic Association initiated funding for the First Annual Survey of Catastrophic Football Injuries. Frederick O. Mueller, Ph.D., and Carl S. Blyth, Ph.D., both professors in the Department of Exercise and Sport Science at the University of North Carolina at Chapel Hill were selected to conduct the research. The research is now being conducted as part of the National Center for Catastrophic Sports Injury Research, University of North Carolina at Chapel Hill, Frederick O. Mueller, Director and Robert C. Cantu, Medical Director.

The Annual Survey of Catastrophic Football Injuries was part of a concerted effort put forth by many individuals and research organizations to reduce the steady increase of football head and neck injuries taking place during the 1960's and 1970's. The primary purpose of the research was and is to make the game of football a safer sport.

DATA COLLECTION

Since 1977 and the initiation of this research, catastrophic injuries were defined as football injuries which resulted in brain or spinal cord injury or skull or spine fracture. It should be noted that all cases involved some disability at the time of the injury. Neurological recovery is either complete or incomplete (quadripareisis or quadriplegia). Yearly follow-up is not done, thus neurological status (complete or incomplete recovery) refers to when the athlete is entered into the registry which is usually two to three months after injury. Injuries, which result in death, are not included in this report.

Data were compiled with the assistance of high school and college coaches, athletic directors, school administrators, physicians, athletic trainers, executive officers of state and national athletic organizations, sporting goods dealers and manufacturers' representatives, and professional associates of the researchers. Data collection would have been impossible without the help of the National Federation of State High School Associations and the National Collegiate Athletic Association. The research was funded by a grant provided by the National Collegiate Athletic Association.

Upon receiving information concerning a possible catastrophic football injury, contact by telephone, personal letter, and questionnaire is made with the injured player's coach, physician and athletic director. The questionnaire provides background data on the athlete (age, height, weight, experience, previous injury, etc.), accident information, immediate and post-accident treatment, and equipment data.

In 1987, a joint endeavor was initiated with the section on Sports Medicine of the American Association of Neurological Surgeons. The purpose of this collaboration was to enhance the collection of medical data. Dr. Robert C. Cantu, Chairman, Department of Surgery and Chief, Neurosurgery Service, Emerson Hospital, in Concord, MA, and the Medical Director of the National Center for Catastrophic Sports Injury Research has been responsible for collecting the medical data.

BACKGROUND

An early investigation into serious head and neck football injuries was conducted by Schneider.(1) He reported 30 permanent cervical spinal cord injuries in high school and college football during the period from 1959 - 1963. A later study by Torg indicated a total of 99 permanent cervical spinal cord injuries in high school and college football from 1971 - 1975. (3) Torg has discontinued his research, but his data show a decline in permanent cervical cord injuries in high school and college from 34 cases in 1976 to 5 cases in 1984. A study published in 1976 reported the incidence of neck injuries based on roentgenographic evidence was as high as 32% in a sample of 104 high school students and 75 college freshmen in Iowa. (2)

In order to help alleviate this problem the National Collegiate Athletic Association and the National Federation of State High School Associations implemented rule changes in 1976 to prohibit using the head as the initial contact point when blocking and tackling. Furthermore, the American Football Coaches Association Ethics Committee went on record opposing this type of blocking and tackling. The National Federation of State High School Associations 2006 Football Rule Book states that butt blocking, face tackling and spearing are illegal. Butt blocking is defined as a technique involving a blow driven directly into an opponent with the face mask, frontal area or top of the helmet as the primary point of contact either in close line play or in the open field. Face tackling is defined as driving the face mask, frontal area or top of the helmet directly into the runner. Spearing, as opposed to butt blocking and face tackling, is defined as the use

of the helmet in an attempt to punish an opponent. All three of these illegal techniques can cause catastrophic head and neck injuries to the athlete. Coaches should not teach these techniques and referees should do a better job of calling these penalties in a game. The rules have also eliminated the word intentional from the spearing rule.

Emphasis on complete physical examinations and improved physical conditioning programs has also been recommended to mitigate the injury issue.

SUMMARY

1. During the 2008 football season there were a total of thirteen cervical cord injuries with incomplete neurological recovery. Ten of the injuries occurred at the high school level, none at the college level, none at the sandlot level, and three at the professional level. This is a greatest number since 2004 when there were also 13. (Table I)

2. The incidence of catastrophic injuries is very low on a 100,000-player exposure basis. For the approximately 1,800,000 participants in 2008 the rate of injuries with incomplete neurological recovery was 0.72 per 100,000 participants.

3. The rate of injuries with incomplete neurological recovery in high school and junior high school football was 0.67 per 100,000 players and the rate at the college level was 0.00. (Table II)

4. A majority of catastrophic spinal cord injuries usually occur in games. During the 2008 season seven injuries took place in games, two in practice, and four in a scrimmage game.

5. Tackling and blocking have been associated with the majority of catastrophic football injuries. In 2008, eight injuries were caused by tackling, two by being tackled, one while blocking, one tackling on a kick-off, and the activity of one was unknown. As shown in Table IV tackling has been associated with 67.2% of the catastrophic injuries since 1977.

6. As indicated in Table III a majority of the catastrophic injuries occur while playing defensive football. In 2008 nine players were on defense, three on offense, and one was unknown.

7. During the 2008 football season there were also nine brain injuries which resulted in incomplete recovery. Eight were at the high school level, and one in sandlot football. (Table VI).

8. In 2008 there were also 35 injuries that involved either a head or neck injury, but the athlete had full neurological recovery. This is the largest number since the study began in 1977. High school athletes were associated with eight cervical vertebrae fractures, nine brain injuries, two a severe concussions, one herniated disk, one fracture of the lower back, one skull fracture, and one unknown spinal injury.. College athletes were associated with four cervical vertebra fractures, one transient spinal cord injury, one spinal concussion, one lower back spinal fracture, and one unknown spinal injury. Professional players were involved with three cervical vertebrae fractures, and one spinal concussion. It should be emphasized that the researchers are not confident concerning the number of injuries with full recovery, but data collection in 2007 and 2008 produced the highest number of catastrophic recovery injuries since the study was initiated in 1977. (Table VII).

DISCUSSION

For the past 32 years there have been a total of 295 football players with incomplete neurological recovery from cervical cord injuries. Two hundred and forty-three of these injuries have been to high school players, thirty-three to college players, six to sandlot players and thirteen to professionals. This data indicate a reduction in the number of cervical cord injuries with incomplete neurological recovery when compared to data published in the early 1970's. The 2005 data showed a major reduction to five from the 13 injuries in 2004, but the 2008 data show a major increase to 13. If future reports continue to show these high numbers steps will have to be taken for reducing these injuries. Any injury that causes permanent disability is a major concern and future reports must be monitored closely.

The thirteen cervical cord injuries with incomplete recovery in 2004 was a dramatic increase from the years of single digits - 1991-1998. An update in 1999 increased that number to 10. The 2005 data showed a return to single digits, but the 2006 and 2008 put the **numbers back to double digits. Four of the last six** years show double digits. Since 1984 there have also been 121 brain injuries with incomplete recovery. These numbers also are a concern, and if the cervical cord injuries and the cerebral injuries with incomplete recovery are combined, the number of

incomplete recovery injuries is 416. That is an average of approximately 13 injuries with incomplete recovery for the past 32 years. Coaches, players, athletic trainers, physicians and administrators must continue the emphasis on eliminating permanent disability injuries to football players.

The latest participation figures show 1,500,000 players participating in junior and senior high school football and 75,000 in college football. Table II illustrates the incidence of spinal cord injuries for both high school and college participants. The incidence rate per 100,000 participants in 2008 is less than one per 100,000 at the high school level (0.67) and 0.00 at the college level. In looking at the incidence rates for the past 32 years, the high school incidence is 0.65 per 100,000 participants and the college incidence is 1.38 per 100,000 participants.

As indicated in past reports a majority of the permanent cervical cord injuries are taking place in games. In 2008 seven of the 13 injuries took place in games, two in practice, and four in scrimmage games..

Table III indicates that when comparing cervical cord injuries to offensive and defensive players, it is safer playing offensive football. During the 32 year period from 1977-2008, 205 (69.5%) of the 295 players with cervical cord injuries were playing defense. A majority of the defensive players were tackling when injured. In 2008, eight of the 13 injured players were tackling. Coaches have indicated that their players have been taught to tackle with the head up, but for some reason many of the players are lowering their heads before making contact. Sixty-one or 20.7% of the injured players were tackling with the head in a down position (chin to chest and contact with the top or crown of the helmet). These are the only players we are sure had their heads down, but it is possible that there were others tackling with the head down. In addition to tackling with the head down, ball carriers are being injured with their heads in a down position while being tackled. It is important for coaches to emphasize head up tackling, but it is also important to emphasize head up blocking and head up ball carrying when being tackled. Many coaches teach their ball carriers to lower the head before being tackled and to run over the tackler, but this can be a dangerous and can cause cervical spine and brain injuries with incomplete recovery. Ten point two percent of the cervical cord catastrophic injuries took place by being tackled.

Past reports (Table V) have revealed that defensive backs were injured at a higher rate than other positions. In 2008 six of the

injured players were defensive backs, two were on kick-off teams, three were running backs, and two were linebackers.

In 2008 there were nine brain injuries with incomplete neurological recovery. Eight of the injuries were at the high school level, and one was in sandlot football. In addition to the injuries with incomplete recovery, there were 35 injuries with complete recovery. As shown in Table VII, high school football accounted for 23, college football eight, and professional football four. As stated earlier the researchers do not have full confidence in the full recovery data, but the data in 2008 is the highest number of catastrophic injuries with recovery since the study was initiated in 1977. It has always been our belief that there are a higher number of recovery injuries that we are not receiving information on, but the 2008 data show that we are making progress.

RECOMMENDATIONS

As stated in earlier reports, there has been a reduction of permanent cervical cord injuries when compared to data from the early 1970's. The 1995, 1996, 1997, and 1999 data indicated an increase, but were fewer than the early 1970's. The 1991 and 1994 data show a dramatic reduction to one permanent cervical cord injury in high school football. That was a great accomplishment and every effort should be made to continue that trend. The problem is the double digit numbers in four of the last six years with 13 in 2008. These numbers are not acceptable and an all out effort must be made to reduce them. For the past ten years, 1999-2008, there has been an average of 9.4 cervical cord injuries with incomplete neurological recovery, and 5.4 cerebral injuries with incomplete recovery in football. The prior ten years averaged 7.9 cervical cord injuries with incomplete recovery and 4.7 cerebral injuries with incomplete recovery. The eight cerebral injuries in 1997, nine in 2003, and the nine in 2008 were the highest numbers since we started to collect that data in 1984.

The initial reduction of permanent disability injuries was the result of efforts put forth by the total athletic community concerned with safety to football participants. **Major areas of emphasis that once again should receive attention are the 1976 rule change that eliminated the head as the initial point of contact during blocking and tackling, improved medical care both at the game site and in medical facilities, improved coaching techniques in teaching the fundamentals of tackling and blocking,**

and the increased concern and awareness of football coaches. The original 1976 rule defined spearing as "the intentional use of the helmet (including the face mask) in an attempt to punish an opponent". In the new 2005 definition of spearing the word "intentional" was removed from the rule. There continues to be a number of disability injuries caused by helmet-to-helmet contact. During the 2008 football season there were ten catastrophic injuries that were related to helmet to helmet contact.

A concerted effort must be made to continue the reduction of cervical spine and cerebral injuries and to aim for the elimination of these injuries. Following are several suggestions for reducing these catastrophic injuries:

1. Brain and spinal injuries in football have been dramatically reduced since the rules were changed in 1976 to prohibit butt blocking and face tackling, and other techniques in which the helmet and facemask purposely received the brunt of the initial impact. There are still a number of football players that become paralyzed due to cervical cord injury. Because head contact largely caused these injuries it is important to remember the lesson to keep the head and face out of blocking and tackling. Coaches should drill the players in the proper execution of the fundamentals of football - particularly blocking and tackling. **SHOULDER BLOCK AND TACKLE WITH THE HEAD UP - KEEP THE HEAD OUT OF FOOTBALL.**

2. **Preseason physical exams for all participants. Identify during the physical exam those athletes with a history of previous brain or spinal injuries - including concussions. If the physician has any questions about the athlete's readiness to participate, the athlete should not be allowed to play.**

3. Athletes must be given proper conditioning exercises that will strengthen their necks in order to be able to hold their heads firmly erect while making contact during a tackle or block. Strengthening of the neck muscles may also protect the neck from injury.

4. Coaches and officials should discourage the players from using their heads as battering rams when blocking, tackling, and ball carrying. The rules prohibiting spearing should be enforced in practice and games. The players should be taught to respect the helmet as a protective device and that the helmet should not be

used as a weapon. **Ball carriers should also be taught not to lower their heads when making contact with the tackler.**

5. Football officials can play a major role in reducing catastrophic football injuries. The use of the helmet-face mask in making initial contact while blocking and tackling is illegal and should be called for a penalty. Officials should concentrate on helmet-face mask contact and call the penalty. If more of these penalties are called there is no doubt that both players and coaches will get the message and discontinue this type of play. A reduction in helmet-face mask contact will result in a reduction of catastrophic football injuries.

6. All coaches, physicians and athletic trainers should take special care to see that the players' equipment is properly fitted, particularly the helmet.

7. It is important, whenever possible, for a physician to be on the field of play during game and practice. When this is not possible, arrangements must be made in advance to obtain a physician's immediate services when emergencies arise. Each institution should have a team certified athletic trainer who is a regular member of the institution's staff and who is qualified in the emergency care of both treating and preventing injuries.

8. Coaches must be prepared for a possible catastrophic head or neck injury. The entire staff must know what to do. Being prepared and knowing what to do may be the difference that prevents permanent disability. Have a written emergency plan and give copies to all personnel. Areas that should be covered are, 1) an evacuation plan, 2) available transportation, 3) portable and open communication, and 4) game/practice schedule awareness in local hospital emergency department.

9. When a player has experienced or shown signs of head trauma (loss of consciousness, visual disturbances, headache, inability to walk correctly, obvious disorientation, memory loss), he should receive immediate medical attention and should not be allowed to return to practice or game without permission from a medical physician. During the 2008 football season there was the possibility of eight second impact syndrome injuries.

10. Coaches should encourage players to let them know if they have any of the above mentioned symptoms (that can't be seen by others, such as headaches) and why it is important.

11. Both past and present data show that the football helmet does not cause cervical spine injuries, but that poorly executed tackling and blocking technique is the major problem.

Following is a list of post concussion signs/symptoms:

Depression	Numbness/Tingling	Dizziness	Poor Balance
Drowsiness	Poor Concentration	Excess Sleep	Fatigue
Sadness	Sensitive to Light	Headache	Irritability
Memory Problems		Vomiting	Nausea
Nervousness	Ringling in Ears		
Feel "in fog"	Trouble Falling Asleep		

Football catastrophic injuries may never be totally eliminated, but continued research has resulted in rule changes, equipment standards, improved medical care both on and off the playing field, and changes in teaching the fundamental techniques of the game. These changes were the result of a united effort by coaches, administrators, researchers, equipment manufacturers, physicians, athletic trainers and players.

Research based on reliable data is essential if progress is to be made. Research provides data that indicate the problems and reveal the adequacy of preventive measures. It is important to point out that the information in this report is only as good as the data collected. The report only includes data on cases that are reported to us by the NFHS, the NCAA, coaches, athletic directors, and national newspaper and television news. . It is our feeling that we receive information on a majority of the cases, but that it is not possible to state we have information on 100% of the cases.

REFERENCES

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CATASTROPHIC INJURY CASE STUDIES

HIGH SCHOOL

A 17 year old high school football player was injured in a pre-season scrimmage on August 8, 2008. He was assisting on a tackle from his linebacker position. He flipped over and landed on his head to the turf. The player is quadriplegic.

A 16 year old high school football player was injured in a pre-season scrimmage on August 8, 2008. He was a senior linebacker (6'3" tall and weighed 185 lbs.) making a tackle. He fractured cervical vertebra five and has had two surgeries. He is in a wheelchair and has some feeling, but cannot walk. As of 11/6/08 his progress is uncertain and recovery is incomplete.

A high school junior running back was injured during spring practice on May 8, 2008. He had a spinal cord injury and recovery was incomplete. The activity at the time of the injury was unknown.

A 15 year old high school football player was injured in a full contact scrimmage on August 19, 2008 (6'1" and 185 lbs). He was making a tackle from his safety position and injured cervical vertebra three. Recovery is incomplete.

A high school football player injured his spinal cord during a junior varsity game on September 9, 2008. He was a defensive back making a tackle. He is in a rehabilitation center and recovery is incomplete.

A 17 year old high school football player was injured on the first play of a game on September 5, 2008. He was a safety making a tackle and made contact with his head to the opponent's knee. He had surgery and recovery was incomplete.

A high school football player was injured in a game on September 5, 2008. He was a linebacker making a tackle. He injured his spinal cord, had surgery, and recovery is incomplete. He is back in school using a walker to move around.

A 15 year old high school football player was injured during a tackling drill on September 16, 2008. He injured his spinal cord, had surgery, and recovery was incomplete.

A high school junior was injured during a game on October 10, 2008. He was a running back trying to block a linebacker. He

made contact with his head in a down position and fractured a cervical vertebra. He had surgery and at the present time is quadriplegic.

A 17 year old high school football player fractured thoracic vertebrae three and four during an inter-squad scrimmage. He was a defensive back making a tackle and made contact with his head to the thigh of the ball carrier. He had surgery and recovery is incomplete.

A high school football player fractured cervical vertebra six during a game in September 2008. He was a running back and lead with his head down as he was being tackled. He played the full, game and was not diagnosed with the injury until two days after the game. He had a full recovery.

A senior high school football player was injured in a game on October 24, 2008. He was an offensive lineman blocking and the helmet of the opponent hit him under the chin. He had a concussion and a fractured cervical vertebra, lost feeling in his body for five hours, did not have surgery, and had a full recovery.

A junior varsity high school football player was injured during a scrimmage on August 8, 2008. He got hit at the end of the scrimmage, collapsed, and had surgery to remove a blood clot from the brain. He recovered from the injury.

A high school football player was injured in a game on September 19, 2008. He was a linebacker, but the actual activity that caused the injury was unknown. During the game he was credited with recovering a fumble, four tackles, and one sack of the quarterback. The injury was diagnosed as a subdural hematoma. He did not have surgery and had a full recovery.

A high school football player was injured in a scrimmage in September 2008. He was a quarterback and was hit in the head by the knee of an opposing player. He suffered two herniated disks and no other information was available.

A 17 year old high school football player received a spinal injury during a game on September 5, 2008. He was a linebacker at the time, but the exact activity was unknown. He had transient paralysis, but had a full recovery.

A high school football player was injured in a state semi-final play-off game on November 29, 2008. He was a quarterback being

tackled and fractured cervical vertebra seven. He had to wear a neck brace for six weeks and had a full recovery.

A 16 year old high school football player suffered a subdural hematoma during spring practice on May 9, 2008. The exact activity at the time of the injury was unknown. He recovered, but was told to not play anymore contact sports.

A high school football player was injured in a game after he took a hit to the head. He was a quarterback at the time. The injury was diagnosed as a subdural hematoma. He had headaches the week before the game and may have suffered second impact syndrome, but he was cleared by a physician to play in the game. He had headaches and dizzy spells for three weeks after the injury, and lost 30 pounds. He recovered from the injury.

A high school football player was injured in a game on November 31, 2008. It was his second game back after an earlier concussion. He was a linebacker and took a hit to the head. He had surgery for a subdural hematoma and was diagnosed with second impact syndrome. He has recovered.

A 16 year old high school football player was injured in a game on September 5, 2008, after a helmet to helmet hit with a defender. He was playing tight end when hit. He was diagnosed with a subdural hematoma, had surgery, and was expected to recover.

A 15 year old high school junior varsity player was injured on the first day of practice - August 15, 2008. He dropped his head during a tackling drill and fractured a cervical vertebra. He had surgery and has recovered.

A high school football player was injured on October 31, 2008 while playing defensive back in a game. He was hit on the side of the head by the knee of a second tackler. He was unconscious and not breathing after the hit, but regained consciousness on the way to the hospital. He was diagnosed with a severe concussion and has recovered.

A high school football player was injured on November 8, 2008 in a state play-off game. He had a brain bruise and a severe concussion, but the activity at the time of the injury was unknown. He was in the hospital for a week and had a full recovery.

A high school football player was injured in a junior varsity game when he received a blind sided helmet to helmet hit while

returning a kick-off. He was diagnosed with a fractured skull, was out for six weeks, and recovered.

A high school football player missed the first two games of the season with three fractured vertebrae in the back. He was tackling a teammate during a squad scrimmage. He returned to play and has recovered.

A 16 year old high school football player received a brain injury during a game on September 12, 2008. He was a linebacker and received a helmet to helmet hit while being blocked. He was unconscious on the field and was in critical condition. He recovered from his injury, but was advised to never play a contact sport.

An 18 year old high school football player was injured in a game on September 5, 2008. He was a linebacker tackling the quarterback. He fractured cervical vertebra #5, had surgery, and has recovered with a limited range of motion.

A high school football player received a chip fracture of a cervical vertebra in the first game of the season while making a tackle. He had a full recovery.

A high school senior football player was making a tackle in a game on October 24, 2008, when he collapsed on the field. He had surgery for a brain injury, was in the hospital for a week, and officials were optimistic for a full recovery.

A senior high school football player was injured in a game on October 24, 2008. He had a first quarter concussion that was not diagnosed, and received another hit in the fourth quarter. He was diagnosed with a subdural hematoma, had surgery, and was lucky to have a full recovery. It was also diagnosed a second impact.

A 17 year old high school football player was injured while tackling during a game. He was a defensive tackle and the hit was helmet to helmet. He had surgery for a blood clot on the brain and has recovered, but was advised to not play anymore football.

A 14 year old high school football player was injured in practice on October 29, 2008. He was participating in a practice drill and was hit on the left side of the head four times during the drill. He had surgery for a blood clot on the brain, was in a medically induced coma, had surgery, and was scheduled for another surgery in three months. Recovery was incomplete.

A 17 year old high school football player was injured in a game on September 26, 2008. He took a hard hit during the game, had surgery for a subdural hematoma, and recovery was incomplete.

A high school football player was injured in a junior varsity game in October 2008. He was cleared to play after a head injury early in the season, and received another blow to the head in the October game. He had surgery for a subdural hematoma and was released from the hospital a week later. He still suffers from dizziness and headaches. Recovery is incomplete and the injury was a possible second impact syndrome.

A high school football player was injured in a practice session on August 26, 2008. He collapsed and was taken unconscious to the hospital. He had surgery for a subdural hematoma, and recovery was expected. He also had two serious concussions in 2007.

A 16 year old high school football player suffered a brain injury during a game on October 3, 2008. He had been complaining of headaches prior to the injury and the exact time or date of the injury was unknown. Recovery was incomplete.

A high school football player was injured in a game on October 14, 2008. He was complaining of headaches the day before. He had surgery for a brain bleed, and recovery was incomplete. He was a wide receiver and defensive back, but the exact activity that caused the injury was unknown.

A 16 year old high school football player was injured in a pre-season scrimmage while tackling and receiving a blow to the head. He had a brain injury and no other information was available. Recovery was incomplete.

A 16 year old high school football player was injured during a game on September 12, 2008. He was playing defense, had a brain injury, but the exact cause was unknown. He had nausea and headaches the previous week, but did not tell anybody. Recovery was incomplete and the injury was probably second impact syndrome.

2004 UPDATE

A 14 year old high school football player was a defensive end making a tackle in a game on October 14, 2004. The player is quadriplegic. No other information was available.

2005 UPDATES

A 15 year old high school football player was a participant in a junior varsity game when injured while blocking on a kick-off return. He fractured a cervical vertebra, had two surgeries, and is confined to a wheel chair. The hit was helmet to helmet with the opponent. The player was 5'8" tall and weighed 188 pounds. Recovery was incomplete.

A 16 year old high school football player was injured in a game on September 23, 2005. He fractured a cervical vertebra while making a tackle. Recovery is incomplete.

A high school football player was injured in a game on September 27, 2005. He was a linebacker making a helmet to helmet tackle. It was his third hard hit of the game. He was diagnosed with a subdural hematoma, did not have surgery, and was in the hospital for 18 days. Recovery was incomplete due to no peripheral vision on right side. May have been a second impact syndrome.

2006 UPDATES

A high school football player was injured during a game in the fall of 2006. He had a compression fracture of the fifth and sixth cervical vertebra and spent several weeks wearing a neck brace. Recovery was complete.

A high school football player was injured during a game in 2006. He was a running back and was tackled when injured, but it was reported that he had a number of other hits to the head during the game. He collapsed on the field and later had surgery for a subdural hematoma. Recovery was incomplete.

2007 UPDATE

A high school football player was injured in a game in the fall of 2007 after making a tackle from his defensive back position. After the tackle he had no feeling in his right arm. The injury was diagnosed as a brachial plexus injury. Since the injury he has not regained feeling in his arm. Recovery is incomplete.

OTHER INJURIES

A 14 year old high school football player was injured in a scrimmage on August 23, 2008. He was tackled and hit in his mid-section while returning an interception. He suffered a torn renal

artery and had to have a kidney removed. He has recovered from the surgery.

A high school football player collapsed in pre-game warm-ups on September 6, 2008. His heart stopped, but with the use of an AED his heart started to beat again. He has recovered.

A 15 year old high school football player suffered a seizure at a football practice on August 4, 2008. He had no pulse at the time of the seizure and was saved with the use of an AED. He did have a physical exam prior to the start of the season.

SANDLOT

A 12 year old youth league football player was injured in a game on September 6, 2008. He was a running back at the time of the accident and was tackled by two opposing players. He was diagnosed with subdural hematomas on both sides of the brain, and had two surgeries. Recovery was incomplete.

COLLEGE

A college football player was injured during a spring practice scrimmage. He was a defensive end being blocked at the time of the injury. He was taken to the hospital in an ambulance and was diagnosed with a sprained cervical vertebra and transient paralysis. He was treated and released. Recovery was complete.

A college football player was injured during a practice session on September 9, 2008. He was blocking from the fullback position when injured and was hit in the head with the knee of the defensive player. The injury was diagnosed as a spinal cord concussion. Recovery was complete, but he was not able to play for the remainder of the season.

A college football player was injured in a game on August 30, 2008, when he had a helmet to helmet collision with a teammate. His helmet was cracked and his facemask bent. He suffered a fractured cervical vertebra and a concussion. He had surgery to fuse CV 4-5. He has recovered, but was out for the rest of the season.

A college football player was injured in a game on September 20, 2008, when he was tackled (sacked) by a defensive opponent. He

fractured a lumbar vertebra, was out for six weeks, and has recovered.

A college football player was injured in a game on September 20, 2008. He had just caught a pass and ducked his head as he was being tackled. It was a helmet to helmet hit. He fractured a cervical vertebra, had surgery, and was in rehabilitation. Recovery was complete, but was told that his football days were over.

A college football player was injured in a game on September 20, 2008, while making a tackle from his linebacker position. He was taken to the hospital with a possible neck injury and was released the next day. He was going to miss at least two games.

A college football player suffered a cervical spine injury during a game on November 22, 2008. The injury caused transient paralysis, but the player had a full recovery. He was advised that his football career was over.

A college football player suffered a fracture to cervical vertebra seven during a game on September 20, 2008. He was released from the hospital the next day wearing a neck brace. He was going to have a three to four month recovery period. He was a quarterback being tackled by the safety. It was a helmet to helmet hit.

A college football player was injured in a game on September 13, 2008. He was a corner back making a tackle. He had a hairline cervical vertebra fracture and will have a complete recovery.

PROFESSIONAL

A semi-professional football player was injured in a game in March 2008. He was a running back being tackled by three opposing players and hit his head to the turf. He fractured three cervical vertebrae and had surgery. Recovery was incomplete.

A professional football player from the Canadian professional league was injured in a game in July of 2008. He was playing in the offensive backfield and collided helmet to helmet with a defensive back while being tackled. He had a fractured and dislocated cervical vertebrae six and seven. Recovery was incomplete.

A professional football player was injured in a game on August 22, 2008. he was attempting to make a tackle on a kick-off and

collided with a teammate. He had surgery to repair a fractured cervical vertebra. Recovery was incomplete.

A professional football player was injured in a game on October 12, 2008. He fractured a cervical vertebra while tackling from his safety position. He had surgery and a full recovery.

A professional football player was injured in a game on September 21, 2008. He was attempting to make a tackle when the knee of the ball carrier hit him in the head. He was diagnosed with a spinal cord concussion and recovery was complete.

A professional football player was injured in a game while covering a kick-off on November 9, 2008. The player's facemask struck the ball carrier's chest during the tackle and drove his neck back. He suffered nerve damage in his neck. He had a full recovery.

2003 UPDATE

A semi-professional football player was injured in a game on February 29, 2003. He suffered a compression fracture of a cervical vertebra. He was an offensive lineman and was flipped onto his helmet and the turf. He had a full recovery.

TABLE I
CERVICAL CORD INJURIES 1977 - 2008*

YEAR	SANDLOT	PRO AND SEMI-PRO	HIGH SCHOOL	COLLEGE	TOTAL
1977	0	0	10	2	12
1978	0	1	13	0	14
1979	0	0	8	3	11
1980	0	0	11	2	13
1981	1	0	6	2	9
1982	1	1	7	2	11
1983	0	0	11	1	12
1984	1	0	6	0	7
1985	0	0	6	3	9
1986	0	0	4	0	4
1987	0	0	9	0	9
1988	0	0	10	1	11
1989	0	1	12	2	15
1990	0	0	11	2	13
1991	0	1	1	0	2
1992	0	1	6	0	7
1993	0	1	8	0	9
1994	0	0	1	1	2
1995	0	0	8	1	9
1996	0	0	6	3	9
1997	0	1	7	1	9
1998	0	0	4	0	4
1999	1	0	8	1	10
2000	0	0	6	2	8
2001	0	0	8	0	8
2002	0	0	6	1	7
2003	0	1	9	1	11
2004	1	1	11	0	13
2005	0	0	5	0	5
2006	0	0	8	2	10
2007	1	1	7	0	9
2008	0	3	10	0	13
TOTAL	6	13	243	33	295

*Figures are updated annually due to new cases investigated after publication.

TABLE II
INCIDENCE PER 100,000 PARTICIPANTS 1977-2008*

YEAR	HIGH SCHOOL	COLLEGE
1977	0.77	2.67
1978	1.00	0.00
1979	0.62	4.00
1980	0.85	2.67
1981	0.46	2.67
1982	0.54	2.67
1983	0.85	1.33
1984	0.46	0.00
1985	0.46	4.00
1986	0.31	0.00
1987	0.69	0.00
1988	0.77	1.33
1989	0.80	2.66
1990	0.73	2.66
1991	0.07	0.00
1992	0.40	0.00
1993	0.53	0.00
1994	0.07	1.33
1995	0.53	1.33
1996	0.40	4.00
1997	0.47	1.33

TABLE II CONTINUED

1998	0.27	0.00
1999	0.53	1.33
2000	0.40	2.66
2001	0.53	0.00
2002	0.33	1.33
2003	0.60	1.33
2004	0.73	0.00
2005	0.33	0.00
2006	0.53	2.66
2007	0.40	0.00
2008	0.67	0.00

*From 1977-1988 Based on 1,300,000 High School - Junior High School Players and 75,000 College Players. In 1989 High School and Junior High School Figure Increased to 1,500,000.

TABLE III

OFFENSIVE VS. DEFENSIVE FOOTBALL 1977 - 2008*

YEAR	OFFENSE	DEFENSE	UNKNOWN	TOTAL
1977	0	7	5	12
1978	2	11	1	14
1979	1	5	5	11
1980	3	8	2	13
1981	3	5	1	9
1982	3	8	0	11
1983	2	10	0	12
1984	1	5	1	7
1985	1	8	0	9
1986	0	3	1	4
1987	1	6	2	9
1988	2	9	0	11
1989	0	14	1	15
1990	2	11	0	13
1991	1	1	0	2
1992	2	3	2	7
1993	0	7	2	9
1994	0	2	0	2
1995	0	6	3	9
1996	1	6	2	9
1997	4	5	0	9

TABLE III CONTINUED

1998	1	3	0	4
1999	3	7	0	10
2000	3	5	0	8
2001	0	4	4	8
2002	0	5	2	7
2003	1	9	1	11
2004	1	11	1	13
2005	3	2	0	5
2006	3	5	2	10
2007	3	5	1	9
2008	3	9	1	13
TOTAL	50	205	40	295

*Figures updated with availability of new information.

TABLE IV
CATASTROPHIC INJURIES 1977 - 2008

ACTIVITY	NUMBER	PERCENT
Tackling	118	40.0
Tackling Head Down	61	20.7
Tackling on Punt	4	1.4
Tackling on Kick-Off	15	5.1
Tackled	27	9.2
Tackled on Kick-Off	3	1.0
Collision	8	2.7
Blocking on Kick	4	1.4
Blocking on Kick-Off	4	1.4
Blocking	6	2.0
Contact After Interception	2	0.7
Blocked	4	1.4
Hitting Tacklematic Machine	1	0.3
Drill Hit Indoor Wall	1	0.3
DRILL	2	0.7
Unknown	34	11.5
TOTAL	295	100.0

TABLE V
CATASTROPHIC INJURIES 1977 - 2008
POSITION PLAYED

POSITION	NUMBER	PERCENT
Defensive Back	103	34.9
Kick-Off Team	25	8.5
Defensive Line	11	3.7
Linebacker	28	9.5
Kick-Off Return	12	4.1
Defensive End	7	2.4
Offensive Back	16	5.4
Quarterback	9	3.1
Flanker	2	0.7
Wide Receiver	6	2.0
Punt Coverage	3	1.0
Punt Return	1	0.3
Drill	5	1.7
Offensive Lineman	5	1.7
Unknown	62	21.0
TOTAL	295	100.0

TABLE VI
CEREBRAL INJURIES 1984 - 2008*
INCOMPLETE RECOVERY

YEAR	SANDLOT	PRO AND SEMI-PRO	HIGH SCHOOL	COLLEGE	TOTAL
1984	0	0	5	2	7
1985	0	0	4	1	5
1986	0	0	2	0	2
1987	0	0	2	0	2
1988	0	0	4	0	4
1989	0	0	6	0	6
1990	0	0	2	0	2
1991	0	0	3	1	4
1992	0	0	4	0	4
1993	0	0	5	0	5
1994	0	0	4	1	5
1995	0	0	4	0	4
1996	0	0	5	0	5
1997	0	0	7	1	8
1998	0	0	4	0	4
1999	0	0	4	0	4

TABLE VI CONTINUED

2000	0	0	6	1	7
2001	0	0	2	0	2
2002	0	0	1	1	2
2003	0	0	8	1	9
2004	0	0	2	1	3
2005	1	0	4	1	6
2006	0	0	8	0	8
2007	0	0	4	0	4
2008	1	0	8	0	9
TOTAL	2	0	108	11	121

*Figures are updated annually due to new cases investigated after publication.

TABLE VII
CATASTROPHIC INJURIES 2008*
COMPLETE RECOVERY

INJURY	SANDLOT	PRO	HIGH SCHOOL	COLLEGE	TOTAL
Brain (subdural)	0	0	9	0	9
CV FX	0	3	8	4	15
Severe Concussion	0	0	2	0	2
Transient	0	0	0	1	1
Herniated Disk	0	0	1	0	1
Spinal Concussion	0	1	0	1	2
Fx Lower Back	0	0	1	1	2
Fx Skull	0	0	1	0	1
Spinal (unk)	0	0	1	1	2
TOTAL	0	4	23	8	35

*Researchers realize that this data may not be complete due to the difficulty of receiving non-disability injury information.

