

ANNUAL SURVEY OF CATASTROPHIC FOOTBALL INJURIES

1977 - 2012

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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 (quadriplegia or paraplegia). Yearly follow-up is not done, thus neurological status (complete or incomplete recovery) refers to when the athlete is entered into the registry. 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, on-line search engines, and professional associates of the researchers. Data collection would have been impossible without the help of the National Federation of State High School Associations (NFHS), the National Collegiate Athletic Association (NCAA), and the American Football Coaches Association (AFCA). 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 Sports Medicine section 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 2012 Football Rules Book states the following: Illegal helmet contact is an act of initiating contact with the helmet against an opponent. There are several types of illegal helmet contact:

- a. Butt blocking is an act by an offensive or defensive player who initiates contact against an opponent who is not a runner with the front of his helmet.

- b. Face tackling is an act by a defensive player who initiates contact with a runner with the front of his helmet.
- c. Spearing is an act by an offensive or defensive player who initiates contact against any opponent with the top of his helmet.

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.

In the 2010 high school football rule book the concussion rule (3-5-10b) was revised as follows; Any player who exhibits signs, symptoms, or behavior consistent with a concussion (such as loss of consciousness, headache, dizziness, confusion or balance problems) shall be immediately removed from the game and shall not return to play until cleared by an appropriate health-care professional. This time-out, if not charged, is an official's time-out. In Appendix B, page 100, they also have suggested guidelines for management of concussion injuries.

The 2012 NFHS Football Rules Book Points of Emphasis includes concussions, contact to and with the helmet, helmet technology and proper helmet fitting (pages 82-83)

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

Participation numbers changed in 2010 to 4,200,000 from 1,800,000 in previous reports. The change includes 1,135,000 high school players grades 9-12, 100,000 post high school players, and 3,000,000 youth players (estimate by USA Football).

## **SUMMARY**

1. During the 2012 football season there were a total of three cervical cord injuries with incomplete neurological recovery. One of the injuries occurred at the high school level and two at the college level. The 2012 number is eleven fewer than the 14 in 2008, six fewer than the nine in 2009, and five fewer than the eight in 2011. (Table I)
2. The incidence of catastrophic injuries is very low on a 100,000-player exposure basis. For the approximately 4,200,000

participants in 2012 the rate of cervical cord injuries with incomplete neurological recovery was 0.07 per 100,000 participants.

3. The rate of injuries with incomplete neurological recovery in high school and junior high school football was 0.07 per 100,000 players (1,500,000 high school and junior high school players). The rate at the college level was 2.66. (Table II)

4. A majority of catastrophic spinal cord injuries usually occur in games. During the 2012 season two injuries took place in games and one in a weight lifting session.

5. Tackling and blocking have been associated with the majority of catastrophic cervical cord injuries. In 2012, two injuries were caused by tackling and one in a weight lifting session. As shown in Table IV tackling has been associated with 67.0% of the catastrophic injuries since 1977. (Table IV)

6. As indicated in Table III a majority of the catastrophic injuries occur while playing defensive football. In 2012 two players were on defense and one was in a weight lifting session. Since 1977, 228 players with permanent cervical cord injuries were on the defensive side of the ball and 55 were on the offensive side with 44 being unknown. Defensive backs were involved with 113 (34.6%) of the permanent cervical cord injuries followed by members of the kick-off team (9.2%) and linebackers (9.5). (Tables IV & V)

7. During the 2012 football season there were also five brain injuries which resulted in incomplete recovery. Four were at the high school level and one at the college level. That is a decrease of nine when compared to the 2011 data. (Table VI)

8. In 2012 there were also five injuries that involved either a head or neck injury, but the athlete had full neurological recovery. High school athletes were associated with four and college football was associated with one. It should be emphasized that the researchers are confident concerning the number of catastrophic injuries with permanent disability, but also realize that there are cases that we do not have. The researchers are not confident concerning the number of injuries with full recovery and realize those numbers could be double or more. It is impossible to accurately record every catastrophic football injury that takes place in the United States. (Table VII).

## **DISCUSSION**

For the past 36 years there have been a total of 327 football players with incomplete neurological recovery from cervical cord injuries. Two hundred and sixty-six of these injuries have been to high school players, thirty-eight to college players, eight to sandlot players and 15 to pro and semi-pro players. 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 14. 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 numbers for 2010 show seven, 2011 show eight, and the 2012 data show three cervical cord injuries with disability. The 2012 data is the lowest number since 1994 when there were two.

The fourteen cervical cord injuries with incomplete recovery in 2008 was a dramatic increase from previous years. There were also updated increases in 1997, 1999, and 2006. The fourteen in 2008 was a major concern. Four of the last ten years show double digits.

Since 1984 there have also been 172 brain injuries with incomplete recovery. These numbers are a major concern, and if the cervical cord injuries and the cerebral injuries with incomplete recovery are combined, the number of incomplete recovery injuries is 499. That is an average of approximately 14 injuries with incomplete recovery for the past 36 years. Coaches, players, athletic trainers, physicians and administrators must continue the emphasis on eliminating permanent spinal cord and brain disability injuries to football players at all levels of play.

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 2012 is less than one per 100,000 at the high school level (0.07) and 2.66 at the college level. In looking at the incidence rates for the past 36 years, the high school incidence is 0.52 per 100,000 participants and the college incidence is 1.40 per 100,000 participants. The 29 year incidence rate for brain injuries with disability is 0.36 for the high schools and 0.55 for the colleges.

As indicated in past reports a majority of the permanent cervical cord injuries are taking place in games. In 2012 two of the three injuries took place in games and one in weight training.

Table III indicates that when comparing cervical cord injuries to offensive and defensive players, it is safer playing offensive football. During the 36 year period from 1977-2012, 228 (69.7%) of the 327 players with cervical cord disability injuries were playing defense. A majority of the defensive players were tackling when injured. In 2012, two of the three 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-two or 19.0% 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 activity can be dangerous and can cause cervical spine and brain injuries with incomplete recovery. Ten-point-one percent of the cervical cord catastrophic injuries happened when being tackled.

Past reports (Table V) have revealed that defensive backs were injured at a higher rate than other positions. In 2012 one player was a defensive back and for the past 36 years defensive backs accounted for 34.6% of the cervical cord injuries.

In 2012 there were five brain injuries with incomplete neurological recovery. Four of the injuries were at the high school level and one at the college level. This is a dramatic reduction compared to the 16 in 2011. The football rules state that initial contact with the helmet or face mask is illegal, but many of the injuries are being caused by helmet-to-helmet hits, and many of them are not being called by the referees. It is interesting that brain deaths have been decreasing over the years, but brain injuries with disability have been increasing. (See graphs at end of report - brain data collection not started until 1984)

In addition to the injuries with incomplete recovery, there were five injuries with recovery. As shown in Table VII, high school

football accounted for four and college football one. As stated earlier the researchers do not have full confidence in the full recovery data. It has always been our belief that there are a higher number of catastrophic injuries, both permanent disability and recovery injuries, that we do not receive data on. **What is important is that the National Center for Catastrophic Sports Injury Research has been collecting catastrophic football injury data (fatalities, disability, serious injuries) at the University of North Carolina at Chapel Hill for the past 49 years and has been directly responsible for the reduction of football fatalities from 36 in 1968 to zero in 1990, and the reduction of cervical cord injuries from 30 a year in the late 1960s to single digits in most years since 1991. We will continue to collect this data and to make safety recommendations to the NFHS, the NCAA, and youth football programs.**

**Starting in 2013 the Director of the National Center for Catastrophic Sports Injury Research (NCCSIR) will retire. The Center will continue to gather catastrophic injury data for all sports for both men and women. The NCCSIR will continue at the University of North Carolina at Chapel Hill, but will expand to include two other Universities. The University of Connecticut and the University of Washington will be part of the data collection system in specific areas.**

#### **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 1991 and 1994 data show a dramatic reduction to one permanent cervical cord injury in high school football (two each year for all levels). 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 ten years with 11 in 2003, 13 in 2004, 11 in 2006, and 14 in 2008. These numbers are not acceptable and an all out effort must be made to reduce them. For the past ten years, 2003-2012, there has been an average of 9.0 cervical cord injuries with incomplete neurological recovery, and 8.4 brain injuries with incomplete recovery in football. The prior ten years averaged 7.7 cervical cord injuries with incomplete recovery and 4.9 cerebral injuries with incomplete recovery. The 14 cerebral injuries in 2011 was the highest number 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, the increased concern and awareness of football coaches, and the important helmet research conducted by the National Operating Committee on Standards for Athletic Equipment (NOCSAE). 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 in order to make it easier for the referees to call. There continues to be a number of disability injuries caused by helmet-to-helmet contact and during the 2012 football season there were a number of helmet-to-helmet contacts that were related to disability injuries.

A concerted effort must be made to reduce both cervical spine and brain injuries and to aim for the elimination of these injuries. The ten year increase in brain injuries with disability needs immediate attention. 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 has in recent years been an increase in the number of football players that have permanent disability due to cervical cord and brain injuries. Because head contact largely causes 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. A recent unpublished report has indicated that neck strength may also be associated with reduced concussion injuries. This is an area that needs additional research.

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 (helmet-to-helmet 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-to-helmet 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 National Athletic Trainer's Association (NATA) 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) immediate first aid 3) available transportation, 4) portable and open communication, and 5) game/practice schedule awareness in local hospital emergency department.

9. Concussion injuries are a major concern. 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 or other qualified health professional. Coaches should never make the decision whether a player should return to practice or games.

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

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 to sleep		

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.

12. The National Federation of State High Schools released the following statement on February 23, 2010: Effective with the 2010 high school football season, any player who shows signs, symptoms or behaviors associated with a concussion must be removed from the game and shall not return to play until cleared by an appropriate health-care professional. The new concussion language is being placed in all NFHS rules books for the 2010-2011 season as well as the "NFHS Suggested Guidelines for Management of Concussion".

13. The National Collegiate Athletic Association revised its 16 year-old guideline on treatment of concussion in the NCAA Sports Medicine Handbook to better advise member institutions on responses to concussion injuries and procedures for returning athletes to competition or practice - "it is essential that no athlete be allowed to return to participation when any symptoms persist, either at rest or exertion". It details circumstances in

which an athlete should be withheld from competition pending clearance by a physician.

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. The new concussion recommendations by the NFHS and the NCAA should play a major role in reducing brain injuries that often result in death or disability. They will also play a role in the reduction of second impact syndrome.

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. As stated earlier in this report we know that it is not possible to collect all catastrophic injury data in American football, but these reports have been responsible for the reduction of football fatalities and catastrophic injuries.

## REFERENCES

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## CATASTROPHIC INJURY CASE STUDIES

### HIGH SCHOOL

On 10/26/2012 a 17 year old high school football player collapsed on the sideline during a game. He suffered a subdural hematoma and was in the hospital for three weeks. He was a defensive end and an offensive tackle. The athletic trainer noticed his odd behavior on the sideline and did not allow him to return to the game. Recovery was incomplete.

A high school senior was injured in a game on 9/7/2012. He was hit by two tacklers as he attempted to make a block - one from the front and one from behind. He was unconscious and had two fractured cervical vertebrae. He had initial paralysis but is recovering from the injury, but will not be able to play football again.

A high school football player was injured in a play-off game while making a tackle on November 6, 2012. He was a senior linebacker. The injury involved surgery to a fractured cervical vertebra #6. Recovery was incomplete.

A high school senior linebacker was injured in a game on November 1, 2012. The injury was a diagnosed as a brain bleed. He collapsed on the field and later had emergency surgery. He had a concussion earlier in the season and had to sit out one game before being cleared to play by a physician. Recovery is incomplete.

A high school football player was injured in a game on September 21, 2012 while playing quarterback/linebacker. The exact play involved in the injury was unknown. The injury was a subdural hematoma. Emergency surgery was performed and recovery was incomplete.

A 7<sup>th</sup> grader collapsed at football practice on September 17, 2012. He had emergency surgery for a brain bleed and recovery is incomplete. The football activity at the time of the injury was unknown.

A high school offensive lineman suffered multiple concussions and had a brain bleed in a game on September 7, 2012. He was 6' 4" tall and weighed 285 pounds. He has recovered from the injury, but was advised by the physician to not continue playing football.

A high school football player was injured in a game on September 7, 2012. He was tackling at the time of the injury which was

diagnosed as a fractured cervical vertebra. The athlete has recovered.

A high school running back suffered a brain bleed during a game on October 26, 2012. The athlete did not have surgery and has recovered.

### **2008 UPDATE**

A high school running back was tackled from the side during a game one week after suffering a concussion in a game. He had emergency surgery and recovered from the injury. He was cleared to play in the game by a physician if he did not complain of concussion symptoms. He did not complain and played in the game.

### **2009 UPDATE**

A high school football player suffered a concussion in a game during the 2009 season. He was instructed by a physician to stay away from practice for 4 days and contact for 7 days. Coaches put him in practice after 6 days and he was knocked unconscious. Recovery was incomplete.

### **2011 UPDATE**

A 15 year old high school football player was injured during practice in October 2011. He was involved in a linebacker drill and felt dizzy after one of the hits. He continued to practice. The injury was diagnosed as frontal lobe nerve damage possible from a series of small hits. Recovery was incomplete.

A 15 year old high school football player was injured during a practice session. He was in the backfield running a fake up the middle when he was hit by three players - front, back, and side. He collapsed in the locker room after practice. He suffered brain and nerve damage. Recovery was incomplete.

A youth league football player was injured in a game in December 2011. He was the leading rusher on the team and after a hard hit to the head and being unconscious he was taken to the hospital. He suffered a brain injury and it took eight months to recover. Plans were for him to play high school football during the fall of 2012.

### **COLLEGE**

A 20 year old college football player was injured during a weight lifting accident in July 2012. He was doing a stair stepping

exercise with weights weighing 320 pounds on his back. He slipped and fell with the weights falling on him. He damaged his spinal cord and recovery is incomplete. He played for an NAIA college.

A senior college football player was injured during an intra-squad scrimmage on August 18, 2012. He was a safety and was tackling at the time of the injury. He suffered a severe brain injury, had surgery, and recovery is incomplete. He played for an NAIA college.

A Division 1 NCAA football player was injured in a game on September 8, 2012. He was playing safety when making a tackle on a receiver. There was a helmet-to-helmet hit with his teammate during the tackle. He fractured a cervical vertebra, had surgery, and recovery was incomplete.

A Division 11 NCAA college football player was injured on October 27, 2012. The injury took place in a game and the player was a cornerback. The exact activity was not clear, but the athlete suffered damage to his spinal cord and recovery is incomplete.

A Division 111 NCAA college football player was injured in a game on September 15, 2012. He was blocking on a kick-off and had a collision with an opponent. He suffered damage to cervical vertebra 3 and had no feeling for a short time. He recovered and was wearing a neck brace.

#### **2010 UPDATE**

A Division 1 NCAA college football player was injured in a game on September 11, 2010 while tackling. He had surgery for a fractured cervical vertebra and has recovered.

#### **NOT FOOTBALL**

In August of 2012 a high school football player suffered a stroke during a practice session. He had a headache after practice and could not control the left side of his body. He had brain surgery to relieve pressure on the brain. The diagnosis was a stroke caused by a blood clot in his carotid artery. The physician stated that this is very rare for a 17 year old - one in a million.

TABLE I

CERVICAL CORD INJURIES 1977 - 2012\*

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	9	3	12
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	1	1	7	1	10
1998	0	0	4	0	4
1999	1	0	8	1	10
2000	0	0	6	2	8
2001	0	0	9	0	9
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	9	2	11
2007	1	1	7	0	9
2008	0	3	11	0	14
2009	0	1	7	1	9
2010	0	0	5	2	7
2011	1	1	6	0	8
<b>2012</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>

**TOTAL            8                    15                    266                    38                    327**

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

**TABLE II**  
**INCIDENCE PER 100,000 PARTICIPANTS 1977-2012\***

<b>YEAR</b>	<b>HIGH SCHOOL</b>	<b>COLLEGE</b>
1977	0.77	2.67
1978	1.00	0.00
1979	0.69	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	0.60	0.00
2002	0.33	1.33
2003	0.60	1.33
2004	0.73	0.00
2005	0.33	0.00
2006	0.60	2.66
2007	0.40	0.00
2008	0.67	0.00
2009	0.46	1.33
2010	0.33	2.66
2011	0.40	0.00
<b>2012</b>	<b>0.07</b>	<b>2.66</b>

\*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 - 2012\***

<b>YEAR</b>	<b>OFFENSE</b>	<b>DEFENSE</b>	<b>UNKNOWN</b>	<b>TOTAL</b>
1977	0	7	5	12
1978	2	11	1	14
1979	1	6	5	12
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

**TABLE III CONTINUED**

1997	5	5	0	10
1998	1	3	0	4
1999	3	7	0	10
2000	3	5	0	8
2001	0	5	4	9
2002	0	5	2	7
2003	1	9	1	11
2004	1	11	1	13
2005	3	2	0	5
2006	4	5	2	11
2007	3	5	1	9
2008	3	10	1	14
2009	0	8	1	9
2010	2	5	0	7
2011	1	5	2	8
2012	0	2	1	3
<b>TOTAL</b>	<b>55</b>	<b>228</b>	<b>44</b>	<b>327</b>

\*Figures updated with availability of new information.

**TABLE IV**  
**CATASTROPHIC INJURIES 1977 - 2012**

ACTIVITY	NUMBER	PERCENT
Tackling	134	41.0
Tackling Head Down	62	19.0
Tackling on Punt	4	1.2
Tackling on Kick-Off	19	5.8
Tackled	30	9.2
Tackled on Kick-Off	3	0.9
Collision	11	3.4
Blocking on Kick	4	1.2
Blocking on Kick-Off	5	1.5
Blocking	6	1.8
Contact After Interception	2	0.6
Blocked	4	1.2
Hitting Tacklematic Machine	1	0.3
Drill Hit Indoor Wall	1	0.3
DRILL	3	0.9
Unknown	38	11.6
<b>TOTAL</b>	<b>327</b>	<b>100.0</b>

**TABLE V**  
**CATASTROPHIC INJURIES 1977 - 2012**  
**POSITION PLAYED**

<b>POSITION</b>	<b>NUMBER</b>	<b>PERCENT</b>
Defensive Back	113	34.6
Kick-Off Team	30	9.2
Defensive Line	11	3.4
Linebacker	31	9.5
Kick-Off Return	13	4.0
Defensive End	7	2.1
Offensive Back	19	5.8
Quarterback	10	3.1
Flanker	2	0.6
Wide Receiver	6	1.8
Punt Coverage	3	0.9
Punt Return	1	0.3
Drill	6	1.8
Offensive Lineman	6	1.8
Unknown	69	21.1
<b>TOTAL</b>	<b>327</b>	<b>100.0</b>

**TABLE VI**  
**BRAIN INJURIES 1984 - 2012\***  
**INCOMPLETE RECOVERY**

<b>YEAR</b>	<b>SANDLOT</b>	<b>PRO AND SEMI-PRO</b>	<b>HIGH SCHOOL</b>	<b>COLLEGE</b>	<b>TOTAL</b>
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	8	1	9
1998	0	0	4	0	4
1999	0	0	5	0	5

**TABLE VI CONTINUED**

2000	0	0	6	1	7
2001	0	0	2	0	2
2002	0	0	2	1	3
2003	0	0	8	1	9
2004	0	0	3	1	4
2005	1	0	7	1	9
2006	0	0	9	0	9
2007	0	0	6	0	6
2008	1	1	10	0	12
2009	1	0	11	0	12
2010	0	0	5	0	5
2011	1	0	15	0	16
<b>2012</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>5</b>
<b>TOTAL</b>	<b>4</b>	<b>1</b>	<b>155</b>	<b>12</b>	<b>172</b>

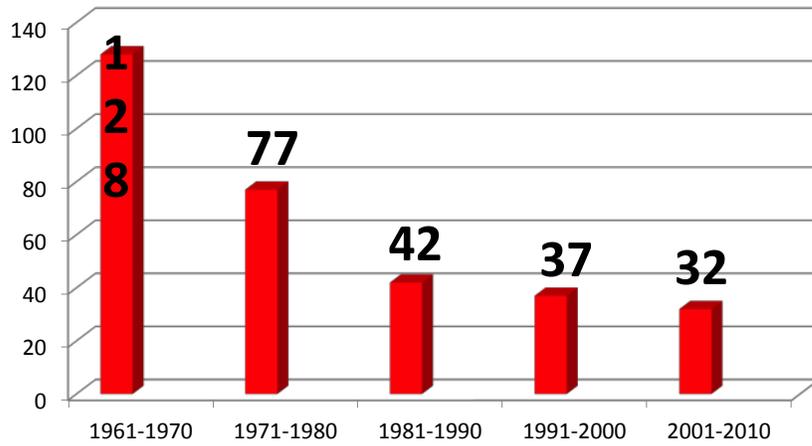
\*Figures are updated annually due to new cases investigated after publication.

**TABLE VII**  
**CATASTROPHIC INJURIES 2012\***  
**COMPLETE RECOVERY**

<b>INJURY</b>	<b>SANDLOT</b>	<b>PRO</b>	<b>HIGH SCHOOL</b>	<b>COLLEGE</b>	<b>TOTAL</b>
Brain	0	0	2	0	2
CV FX	0	0	2	1	3
<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>5</b>

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

## FOOTBALL BRAIN FATALITIES 1961-2010



## FB BRAIN DISABILITY INJURIES 1961-2010

