

Nonfatal Cervical Spine Injuries in Interscholastic Football

John P. Albright, MD; James M. Moses, MD; Harley G. Feldick, MD;
Kenneth D. Dolan, MD; Leon F. Burmeister, PhD

• The incidence of nonfatal neck injuries in high school football was determined by performing preseason examinations in 104 active high school players and 75 college freshman candidates. Coaches of all 430 Iowa high schools were asked to recall the number of players experiencing significant neck pain during the season. A detailed questionnaire for each injury was also completed by a sample population of 60 coaches. The incidence of roentgenographic evidence of neck injuries was as high as 32% and was related to years of experience. Injury was most likely to occur to a linebacker or a defensive halfback when they tackled the ball carrier. In the preseason examination, half the players who volunteered a history of significant neck pain had abnormal x-ray films.

(JAMA 236:1243-1245, 1976)

CHANGING patterns of blocking and tackling have made the head an extremely effective weapon in football but the frequency of associated head and neck injuries has not been sufficiently emphasized. The reasons for

For editorial see p 1274.

this evolve from the numerous complaints of minor neck pain on the one hand and the rarity of catastrophic incidents on the other.¹ Since only a few deaths or paraplegias occur each year, even those primarily concerned with safety in athletics have consid-

ered a risk for major injury to the neck to be less than to the lower extremities.^{2,3} We are concerned that many college players have pre-existing injuries that make diagnostic and therapeutic decisions quite clouded even in the youngest collegian.

Since many of the neck injuries have been acquired prior to college, we started our investigation with high school football players. This report concerns questions of incidence, contributing factors, and awareness of these injuries.

SUBJECTS AND METHODS

Two approaches were used to determine the incidence of neck injury from high school football. Initially, a preseason screening examination of 104 active high school and 75 collegiate freshman football players was performed. Also, a postseason questionnaire was sent to the coaches of the 430 Iowa high school teams.

Screening Examination.—Each player completed a questionnaire that detailed circumstances of any neck injury significant enough to have caused him to miss at least one practice or game. The cervical spine was also examined and an x-ray film was made.

Roentgenograms were abnormal if the findings met one of the following criteria: (1) bony deformity of posterior elements, (2) fracture of the vertebral body, with either identifiable fragments or at least a 3-mm loss of vertical height, (3) abnormality of the intervertebral disk, with either disk space narrowing of at least 50% or evidence of cervical spondylosis by osteophyte formation, or (4) disk space instability identified on lateral x-ray films as abnormal motion by the criteria of White et al.⁴

The study population was grouped by level of experience for purposes of data analysis. A control group of 30 men, ages 18 through 23 years, who never played football was also examined and x-ray films were taken.

Coaches Questionnaire.—After the 1973 season, coaches of all 430 Iowa high school football teams reported the number of players they had with significant neck pain. A detailed questionnaire was then sent to a sample population of those coaches reporting such injuries.

RESULTS

Screening Examination.—The incidence of injury by history and x-ray film increased significantly in high school players after the junior year (Table 1). The college freshman group had a much higher incidence of injury (32%), as well as a greater variety of

From the departments of orthopaedic surgery (Drs Albright and Moses), radiology (Dr Dolan), and biostatistics (Dr Burmeister), University of Iowa Hospitals and Clinics, Iowa City. Dr Feldick is the team physician and director of the Department of Student Health.

Reprint requests to Department of Orthopaedic Surgery, University of Iowa Hospitals and Clinics, Iowa City, IA 52242 (Dr Albright).

x-ray film findings (Table 2), than had the high school players.

The history, alone, was not a reliable indicator of major neck injuries. Of the 179 players who reported an abnormal history, one half had actually experienced an injury severe enough to produce roentgenographic changes. On the other hand, all high school players with abnormal x-ray films had also volunteered a history of injury. However, under-reporting was evident in the 19 college freshmen who had significant roentgenographic changes and no history of neck pain.

No correlation existed between physical and roentgenographic findings on these preseason examinations. Compared to the 32 abnormal x-ray films, abnormal physical findings were found in only four instances in the 179 physical examinations. All four of these players had admitted the existence of neck pain, but only two of them were found to have significant roentgenographic changes.

Coaches Questionnaires.—Three hundred forty-seven of the 430 coaches polled responded to the initial questionnaire. Of the 20,189 players on the responding teams, only 258 were reportedly injured (1.2%). The mean number of reported injuries per team was 0.75, with a range of 0 to 12. This rate did not vary with the size of the school, conference, or season record.

Injury profiles were obtained from 60 of the 147 coaches reporting at least one injured player. For this sample group, the average number of injuries per squad, the size of the team, and their win-loss records were comparable to the larger group.

No correlation of injury rate existed with type of equipment, exercise program, individual body build, or estimates of joint laxity. Most of the 89 nonfatal injuries occurred in the tackler early in the season (Table 3) as a result of head impact. However, employment of the illegal "spear" tackle was uniformly denied.

When adjusting the number of injured for the average number playing each defensive position, the linebackers and defensive backs were at the greatest risk (Table 4). On offense, the backs were more often the victims than their linemen. Only 25%

High School Competition, yr	Year in School	Average Age, yr	Sample Size	No. (%) of Abnormal X-ray Films	No. (%) of Abnormal History Results	No. (%) of Abnormal Physical Examination Results
0	Controlst	20	30
1	Sophomores	15	31	1(3.2)	2(6.4)	...
2	Juniors	16	36	1(2.8)	3(8.3)	...
3	Seniors	17	37	6(16.2)	12(32.9)	2(5.0)
4	College freshmen candidates‡	18	75	24(32)	10(13)	2(2.7)

*Current high school players were examined two weeks into the 1974 season. The college freshmen candidates were given preseason examinations over two consecutive seasons.

†Control group of college students never participating in contact sports.

‡All freshmen candidates, including those without scholarships.

Injury	No. of College Freshmen Recruits	No. of Active High School Players	Total
Compression fracture	8	4	12
Abnormal motion	7	4	11
Narrowed disk space	5	0	5
Neural arch fracture	4	0	4

	% of Men	
When injured	First one third of the season	63
	At game	80
	At practice	20
Type of play at injury	Running	80.0
	Passing	4.6
	Special teams	11.8
	Not recalled	3.6
How injury was sustained	By head impact	70
	Not by head impact	30
	Tackling	57.4
	Blocking	25.3
	Ball-carrying	16.0
	Not recalled	1.3

Position	No. Injured	No. at Position	Incidence per Position
Defense			
Linebackers	19	3	6.3
Backs	13	3	4.3
Linemen	16	5	3.2
Total	48	11	4.6
Offense			
Backs and wide receivers	18	5	3.6
Linemen and tight ends	21	6	3.5
Total	39	11	3.5

of the injuries were sustained by a blocker.

At the instant of injury, approximately one of three players experienced more than neck pain. This often included upper extremity weak-

ness and numbness, headaches, or transient visual disturbances.

Only 55% of the injured players were examined by a licensed physician, while another 11% were seen by a chiropractor. Even when the injury

was severe enough to require referral, it was the coaches' recollection that roentgenograms rarely had been taken. On return to play in the same season, the reinjury rate was 17.2%.

COMMENT

Death rates do not accurately reflect the real incidence of neck injuries in high school football. The risk of injury is higher in junior and senior years possibly because the size, speed, and skill of the athlete prior to this time are not sufficient to cause such injuries.

In the preseason examination, the x-ray film should remain a keystone to diagnosis since neither a normal history nor a normal physical examination result is a reliable indicator of an old injury. On the other hand, an abnormal history or physical examination result in this same setting should be noted carefully, as 50% in each category will have abnormal roentgenographic findings.

The inherent limitations and pitfalls of using questionnaires alone^{2,3} are readily apparent when the results of the 104 direct examinations are compared to those of the questionnaires obtained from the coaches of these players. Seventeen players volunteered an abnormal history, six had abnormal x-ray film residuals, and two were even symptomatic at examination. However, only one injury had been reported between the two coaches.

If we assume the population examined to be representative of all play-

ers in the state, the lack of awareness of injury to the neck on the part of coaches and physicians becomes very impressive. The physicians' lack of awareness is suggested by their reliance on examination alone rather than the routine use of cervical spine roentgenograms. Based on the coaches' estimate, it is possible that only one of the 64 injured players in each eight-team conference had x-ray films taken.

Of course, the situation is likely to be overstated for many reasons. Firstly, we recognize that the x-ray film incidence we are reporting is cumulative over more than one year and the detected injuries may have happened prior to the 1973 season. Secondly, transient neck pain is commonplace and it may have been unfair to ask the coaches for the information on a retrospective basis. Thirdly, because a normal roentgenogram may not be as likely to be communicated by the physician or recalled by the coach, the actual number of x-ray films taken may have been greater than reported. Finally, the yearly injury rate may be quite cyclic,⁵ making the combination of the two data sets somewhat tenuous. To better evaluate the postseason coaches questionnaire against the accumulation of roentgenographic changes, the questionnaires would need to be repeated for several years.

The actual effect of teaching head-butting techniques on the incidence and mechanisms of neck injuries will not be adequately approached by any-

thing short of a prospective study that includes this preinjury data, game film analysis, and repeated examinations complete with roentgenograms at the time of each injury. However, our questionnaires and our present collegiate experience suggest that impact to the head at the time of a tackle or a block is the common denominator. Whether or not the recent rule changes in interscholastic football, making the use of the head as a weapon illegal, will have significant effects on the incidence of neck injury remains to be seen.

The results of this pilot study are of value primarily for the orientation of the coaches and team physicians and as a baseline for further investigators. Each player who misses a practice or a game because of neck pain should be seen by a physician for an examination including a history of the mechanism of injury as well as a physical and roentgenographic examination of the cervical spine.

References

1. Schneider RC: *Head and Neck Injuries in Football: Mechanisms, Treatment and Prevention*. Baltimore, Williams & Wilkins Co, 1973.
2. Blyth C, Mueller F: *An Epidemiologic Study of High School Football Injuries in North Carolina: Final Report of PHS Grant No. FDA00032-02*, bulletin 5203-0054. US Government Product Safety Commission, 1974.
3. Alley R: Head and neck injuries in high school football. *JAMA* 188:418-422, 1964.
4. White AA III, Johnson RM, Panjabi MM, et al: Biomechanical analysis of clinical stability in the cervical spine. *Clin Orthop* 109:85-96, 1975.
5. Chrisman OD, Snook G, Stantis J, et al: Lateral flexion neck injuries in athletics. *JAMA* 192:613-615, 1965.