

Prehospital Care of the Spine-Injured Athlete



**A Document From
the Inter-Association
Task Force For
Appropriate Care of
the Spine-Injured Athlete**



N A T A

Proper on-the-field management of an athlete with a suspected spinal injury has long been a topic of discussion among certified athletic trainers and other allied healthcare professionals. Because each group has its expertise in a particular area, the question of correct technique or appropriate procedure has been the subject of much debate.

Recognizing a uniform set of guidelines for handling possible spine injuries was needed, the National Athletic Trainers' Association formed the Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete in 1998. More than 30 emergency medicine and sports medicine organizations were invited to participate in two summits to develop recommendations for all healthcare providers who might be involved in the care of this kind of injury.

The result: a complete set of guidelines and recommendations were created and unanimously approved by the members of the task force. This document expands on those guidelines and offers an extensive look at the many aspects of caring for an athlete with a suspected spinal injury.

As certified athletic trainers, we must manage potentially life threatening and catastrophic injuries. This paper provides a resource for our community to use as a reference if ever faced with a situation involving a spine-injured athlete. Although we hope you will never have to utilize the procedures delineated in this document, you must be prepared to meet any eventuality.

We would like to express our thanks to the individuals who served on the Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete for their dedication and commitment to this important project.

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Abstract

Kleiner DM, Almquist JL, Bailes J, Burruss P, Feuer H, Griffin LY, Herring, S, McAdam C, Miller D, Thorson D, Watkins RG, Weinstein S. *Prehospital Care of the Spine-Injured Athlete: A Document from the Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete.* Dallas, Texas, National Athletic Trainers' Association, March 2001.

Objective: The primary purpose of this paper is to provide guidelines for the prehospital management of a physically active person with a suspected spinal injury. A secondary purpose is to provide additional information that, although beyond the scope of prehospital care, may prove to be useful in understanding the need for a comprehensive approach when treating the spine and is valuable to the different types of clinicians for whom this document is intended.

Background: For many years, disagreements have occurred among various healthcare professionals as to the proper management of a spine-injured athlete, because each group of professionals had their own protocols. In 1998, the National Athletic Trainers' Association formed an inter-association task force to develop guidelines for the appropriate management of the catastrophically spine-injured athlete. Although not all catastrophic injuries are spine injuries and not all spine injuries are catastrophic, it is believed that the improper management of a suspected spinal injury can result in a secondary injury. Thus, it was important to develop standard guidelines to be used by all providers of prehospital care that ensured the safe management of the spine-injured athlete.

Recommendations: The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete developed guidelines that were endorsed by the representatives of various healthcare specialties, including certified athletic trainers, physicians, and providers of emergency medical services. This paper provides more details and more thorough information on the guidelines that were developed and endorsed by the task force.

This statement is only a general practice guide for the healthcare professional. Individual treatment decisions should not be based solely on the information contained in this statement. Individual treatment must be tailored to specific facts and circumstances.

The mention of name brands in this statement in no way implies endorsement of the product.

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In 1998, the National Athletic Trainers' Association formed an inter-association task force to develop guidelines for the appropriate management of the spine-injured athlete.

Introduction

Neither the work of the task force nor the information given here is specific to football, but football players sustain a relatively higher incidence of spine injuries than other athletes and the sport of football often poses unique complications, such as the presence of protective equipment.

In 1998, the National Athletic Trainers' Association (NATA) formed the Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete to develop guidelines for the appropriate management of the catastrophically injured athlete.^{1,2} The guidelines developed by and the recommendations made by the Inter-Association Task Force are presented in Tables 1 and 2, respectively. Every effort was made to base these recommendations on current research. Where data were inadequate or unavailable, recommendations were based on the consensus and expertise of task force members. Techniques that have been scientifically validated have been referenced where appropriate.

Neither the work of the task force nor the information given here is specific to football, but football players sustain a relatively higher incidence of spine injuries than other athletes and the sport of football often poses unique complications, such as the presence of protective equipment.³⁻⁷ Protective equipment has always been a source of controversy, in part because athletic protective equipment is so different from other protective equipment. Motorcycle helmets do not usually have a removable face mask, are not always snugly fit to the head, are worn without shoulder pads, and have other limitations, so after trauma they are routinely removed before transportation as to achieve spinal immobilization.^{8,9} However, a properly fitted football helmet holds the head and spine in position, provided the athlete is wearing shoulder pads.^{10,11} Thus, the information presented here is specific to the spine-injured athlete and can be applied not only to football but also to a variety of other sports.¹²⁻²⁶

This document contains guidelines to follow regarding on-the-field management and immediate care, including:

- who should provide prehospital care of the injured athlete
- equipment removal
- immobilization and transportation
- injuries and possible mechanisms
- return-to-play criteria
- prevention
- development of an emergency plan

Some of this information is beyond the scope of prehospital care, but is useful information and is valuable in understanding the complete process of caring for a spine-injured athlete.

On-the-Field Management and Immediate Care

The ideal care of a specific athletic incident begins with observation of the event that leads to the possibility of a spinal injury.²⁷ The certified athletic trainers and medical staff should make every attempt to closely observe all of the plays because knowledge of the mechanism of injury and degree of contact are often helpful in understanding the likelihood of significant injury (see *Injuries and Possible Mechanisms*).

Initial Assessment. The initial assessment of an injured player begins by forming a general impression of the athlete's condition,²⁸ which includes the consideration of basic life support.²⁹⁻³² If any concerns regarding basic life support are present at this time, the emergency medical services (EMS) system should be activated immediately.³³ The athlete should not be moved unless it is absolutely essential to maintain the airway, breathing, or circulation.³⁴

Airway. The evaluation and maintenance of a functional airway are rapidly performed with full consideration for the potential of a spinal injury.^{29,31,32,34} Any athlete who is suspected of having a spinal injury should not be moved until the appropriate personnel are present, and he or she should be managed as though a spinal injury exists. If unconscious, the player is presumed to have an unstable fracture until it is proved otherwise.³⁵ If it is necessary to move the athlete, he or she should be placed in a supine position while the spine is safeguarded. However, as in any instance of trauma response, whatever method necessary to achieve an adequate airway must be used. If a jaw thrust maneuver is unsuccessful, an oral airway or endotracheal intubation may be required. The team physician and/or EMS personnel should be available if such intervention is required.

Breathing. Next, the presence of sufficient ventilatory exchange is confirmed through either observation of the chest respiratory excursions or listening and feeling for air movement at the upper airway. Ineffective breathing patterns, the use of accessory breathing muscles, or even apnea can be caused by a cervical spinal cord injury. High cervical cord damage may inhibit the output of the phrenic nerve, which controls the diaphragm and arises from the third, fourth, and fifth cervical nerves.

Circulation. Circulation is evaluated. A circulation abnormality with inadequate peripheral perfusion is rare and unlikely to be present in the absence of a primary cardiac event.

Level of Consciousness. The athlete's level of consciousness is assessed.^{29,31,32} The athlete should be oriented to person, place, time, and incident. A fully conscious player is questioned regarding the presence of pain, particularly in the spinal region or a limb, altered sensation or strength of any body part, weakness, and visual and hearing function. In the unconscious player or one who exhibits any abnormal neurological function, the Glasgow Coma Scale may be helpful as a rapid, objective, and reproducible measure of cerebral function and should be used until a more formal neurological examination is carried out.

Neurological Screening. A screening examination is performed to assess motor and sensory function in the four extremities. In a cooperative player, an accurate initial neurological examination of the extremities can be achieved and is vital for a full evaluation of the injury. A cranial nerve assessment should be performed as completely as possible while the helmet is left in place.

Transportation. If the athlete is suspected of having a vertebral column or spinal cord injury, he or she should be transported to an emergency department, where a more formal neurological examination can be conducted and serial assessments can be completed.^{27,36-38} When it becomes necessary to move the athlete, the head and trunk must be moved as one unit, which can be accomplished by manually splinting the head to the trunk as the body is moved (see *Immobilization and Transportation*).^{39,40} Due to the difficulty in attaining a definitive exclusion regarding the possibility of spinal injury in an on-field setting, the Inter-Association Task Force recommends that any player suspected of such be evaluated in a controlled environment, and that any athlete with significant neck or spine pain, diminished level of consciousness, or significant neurological deficits be transported, in an appropriate manner, to a medical receiving facility with definitive diagnostic and medical resources.

To transport the athlete, he or she should be secured to a suitable backboard (specific steps for this vary from situation to situation and are discussed later in *Immobilization and Transportation*). Should the airway, breathing, or circulation be compromised, spinal immobilization must be maintained when removing the face mask (see *Equipment Management*).

Emergency Plan Activation. On-the-field management procedures might include the presence of the team physician and the initiation of additional medical assistance, such as activation of the EMS system (see *The Emergency Plan*). When other medical or allied healthcare personnel arrive on the scene, a briefing of the situation must be completed efficiently and effectively. History, signs, and

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symptoms obtained by the first responder must be shared with all those involved. However, it is imperative that only proper medical or allied health personnel be involved. Good Samaritans who come down

from the stands and who are unfamiliar with the protocols should not be allowed to participate. A potential on-the-field disagreement on protocol can be detrimental to the health and welfare of the injured athlete and should be avoided. Administrative personnel and coaches can be helpful in restricting the access of individuals other than the previously established appropriate personnel on the field while care is being given by the first responders and follow-up personnel.

A defined delegation of duties is essential to maintain on-the-field management and crowd control during a medical emergency. The primary athletic healthcare provider must work quickly and efficiently with full focus on the athlete in distress. Coaches and

administrative personnel should immediately step into action, instructing teammates and bystanders to move away from the injured athlete.^{41,42} If a spinal injury is suspected, athletes and onlookers should be directed to an area away from the injured athlete. It is recommended that athletic teams be educated on the dangers of moving an injured player (well in advance of the onset of contact practices or contests). It is a common response to offer assistance to an injured teammate or an opponent. However, all participants on the field must be cognizant of the dangers of moving a player with a suspected spinal injury and must refrain from moving any player who shows signs of a severe injury.

The National Football League has developed guidelines for its game officials to use during a serious on-field player injury, such as a spinal injury (Table 3).⁴¹ These guidelines are the first of their kind and show the importance of on-the-field management.⁴³ In August 1999, the Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete commended the National Football League for these guidelines.⁴³ The Inter-Association Task Force recommends that teammates and coaches be reminded to not move an injured player. A coach or game official should keep concerned teammates and family away from the injured athlete.⁴¹

Skilled and practiced medical care should be readily available at the athletic event. When this is not possible, such as in many rural areas, a plan to obtain this type of care at the scene when needed must be in place. Deviation from a standard and practiced protocol should be avoided (see *The Emergency Plan*).

Equipment Removal. The face mask should be removed at the earliest opportunity, before transportation and regardless of current respiratory status (see *Equipment Management*). Specific guidelines for helmet removal should be followed (see *Equipment Management*).

Equipment Management

The emergency management of an injured athlete can be made more difficult because of the protective equipment worn by the athlete.⁴⁴⁻⁴⁷ This is especially true in collision sports such as football and hockey, but it can also occur in other sports.^{17,20-25,44,48,49} In much of this section on equipment management, football protective equipment is used as the example, but these guidelines can be applied to other sports as well. In addition, specialized equipment, such as appropriate-size spine boards, cervical collars, accessories, and tools for face mask removal must also be available.⁵⁰

FACE MASK

When to Remove the Face Mask. The face mask should be removed as quickly as possible any time a player is suspected of having a spinal injury, even if the player is still conscious. The Inter-Association Task Force recommends the face mask be removed immediately when the decision is made to transport, regardless of current respiratory status. Formerly the face mask was removed only when cardiopulmonary resuscitation had to be initiated. However, the Inter-Association Task Force recommends that EMS providers not wait until the player stops breathing to begin the task of face mask removal because at that point, time becomes more critical.⁵¹

How to Remove the Face Mask. Regardless of the tools selected, those involved in the prehospital care of injured football players should have the tools for face mask removal readily available and must be familiar with updated equipment. The face mask of the football helmet is usually secured to the helmet with four or more plastic loop-straps that can be cut or removed, thus allowing the face mask to be retracted or taken off completely (removed). This procedure enables rescue personnel to gain access to the airway and vital areas of the face for examination and to administer prehospital care to the football player without having to remove the helmet. When the two lateral loop-straps are cut or removed, the face mask is said to be “retracted,” or “swung away,” using the two anterior loop-straps as a hinge. Face mask retraction has been the protocol used by certified athletic trainers in the past; however, it has been reported that more head and neck movement occurs while the face mask is being retracted than while the straps are being cut.^{52,53}

Reduction in movement of the football player’s head and neck is of primary importance since it is believed that any additional movement that occurs during face mask retraction can cause secondary damage to the football player with an injury to the cervical spine. Therefore, the Inter-Association Task Force recommends that all loop-straps of the face mask be cut and that the face mask be removed from the helmet, rather than being retracted.⁵²

Tools for Removal. Several tools for removing the loop-straps that secure the face mask to the helmet have been cited in the athletic training literature, including saws, the FM Extractor, the Trainer’s Angel, Dremel tools, knives, PVC pipe cutters, pruning shears, and scissors.⁵⁴⁻⁶⁵ A screwdriver seems appropriate, because the loop-straps are fastened to the helmet by a T-bolt, a washer, and a screw. In fact, compared with other tools, the screwdriver has been shown to be very efficient.^{53,66} However, during the length of a football season, moisture can rust the screws and T-bolts, making them difficult to remove with a screwdriver. Other cases have been reported in which the T-bolt that holds the screw turns as the screw is loosened.^{56,67} The screw can also be damaged beyond repair by the screwdriver being used, thus rendering it impossible to remove the face mask. This has even been reported during a research study in a controlled laboratory, with new hardware.⁵³ Hence, the effectiveness of a screwdriver has been deemed limited and unreliable. Because it has been proved to be unreliable, the Inter-Association Task Force does not recommend the screwdriver as the *primary* tool for loop-strap removal.

Another recommendation has been to use a sharp knife, scalpel, or box cutter to cut the loop-straps. However, new-generation loop-straps are being made of harder plastics and are more difficult to cut.^{68,69} Injuries to subjects (the rescuers) during research studies have been reported when the knife slipped while the rescuers tried to cut through the loop-straps.⁵³ Because of the risk of injury to the victim and the rescuer, the Inter-Association Task Force does not recommend the use of knives or similar products to cut loop-straps.

DuraShears, or “EMT scissors,” are popular tools in the field for cutting seat belts, shoulder pad straps, clothing, and so on but are not recommended for cutting loop-straps.⁶⁰ It has been previously shown that the time it takes to remove the face mask with the DuraShears is unacceptable, with most times being greater than 8 minutes and one subject taking as long as 35 minutes in one study.⁶⁰

At the present time, the most popular and widely used tool for face mask removal is the Trainer’s Angel, which was the first tool specifically designed to cut the loop-straps that secure the face mask to the helmet.^{54,59} However, compared with other tools, the Trainer’s Angel was found to cause more head movement. In addition, many individuals are unaware of the recommended technique for the use of this tool.⁵⁹ The Trainer’s Angel was the gold standard tool for many years but appears to be less effective with new-generation loop-straps.^{62,68,70}

Face mask removal should be accomplished as quickly as possible and with as little movement of the head and neck as possible. The best tool that is used for face mask removal should be efficient with regard to both time and movement.^{53,58} The anvil pruner, which is commonly used for gardening, has been shown, repeatedly, to be the most efficient tool for removal of the loop-straps.^{51-53,57,68,69,71-75} Regardless of the tool selected, the Inter-Association Task Force recommends that those involved in the prehospital care of injured football players have the tools they select for face mask removal readily available, and be practiced in their use.^{54,76}

Difficulties Encountered. Face mask removal can be a difficult task under the best of circumstances.⁷⁰ However, many other factors can complicate the efficient removal of the face mask,^{65,69,72,74,76} including hardware that has been exposed to the elements, the effects of environmental temperature on the loop-strap, the effects of hand size and gender, and the sharpness of the rescue tools.

For example, many equipment managers modify the loop-strap arrangement and frequently use four loop-straps to secure the face mask to the lateral sides of the helmet (two on each side).⁷⁰ This arrangement makes it

very difficult, if not impossible, to remove the loop-straps with the tools that are currently available.

Cra-Lite Face Mask. The Cra-Lite face mask is a solid plastic face mask (as opposed to the usual plastic-coated metal) supplied by Riddell, and it must be secured to the helmet with four lateral loop-straps. As indicated by the manufacturer, this unique face mask should be removed with a PVC pipe cutter (also sold by Riddell) rather than by cutting or removing the loop-straps.

Another complication occurs when the face mask is not secured by loop-straps but rather is bolted directly to the helmet.

This is the way face masks were originally secured to the helmet, before loop-straps came into existence. Today, many youth leagues, such as Pop Warner, use helmets that are not approved by the National Operating Committee on

Standards for Athletic Equipment (NOCSAE) and have a face mask bolted directly to the helmet. The Inter-Association Task Force recommends that football helmet face guards be attached by loop straps, and not bolted on, to facilitate appropriate emergency management by medical personnel. Additional recommendations regarding equipment are provided in Table 2.

Summary. *Certified athletic trainers and other initial responders should have the appropriate removal equipment available at all times and should be familiar with the use of this equipment before an emergency occurs.⁵⁴ They should also practice face mask removal with the tools they intend to use and on the helmets used in the competition.^{55,56,67,70,71,73,75}*

The Inter-Association Task Force recommends that football helmet face guards be attached by loop straps, and not bolted on, to facilitate appropriate emergency management by medical personnel.

HELMET

Most football helmets consist of a polycarbonate shell (approximately 4 mm thick) lined with either padding, air cells, or a combination of both to provide a secure fit to the athlete's head.¹⁰ A chin strap further secures the helmet to the head. The helmet and chin strap should be left in place unless they do not hold the head securely enough for immobilization. The helmet should only be removed if the airway cannot be maintained or if the face mask cannot be removed. If the helmet is removed, spinal immobilization and alignment must be maintained. The potential for injury during helmet removal can be further complicated by the presence of shoulder pads that elevate the trunk; proper alignment is maintained by removing the shoulder pads simultaneously with the helmet.

When to Remove the Helmet. Because motorcycle helmets do not usually have a removable face mask, are not snugly fit to the head, and are worn without shoulder pads, they are routinely removed before transportation to achieve neutral spinal alignment and adequate stabilization of the injured motorcyclist on a spine board while access to the airway and chest is obtained for resuscitation efforts.^{8,9} However, a properly fitted football helmet holds the head in a position of neutral spinal alignment, provided the athlete is wearing shoulder pads.^{10,11} Therefore, the Inter-Association Task Force recommends that neither the football helmet nor the shoulder pads be removed before transportation (see *Guidelines for Removal*).^{1,77-80}

In the management of a football player with a suspected spinal injury, both NATA and the American College of Sports Medicine have promoted statements that advise against the removal of football helmets in an uncontrolled environment.⁷⁸ Reduction in the amount of head and neck movement that occurs during helmet removal is very important because any additional motion can cause further damage to the football player with a cervical spine injury.⁵¹

The Inter-Association Task Force recommends that only the face mask be removed from the helmet. The helmet itself should not be removed unless the rescuer is unable to access the airway by all other means (or if the helmet does not adequately secure the head).⁸⁰

Furthermore, by removing only the face mask and not the entire helmet, the spine will remain in a neutral position. If the helmet is removed, the athlete's head hyperextends, particularly when the athlete is wearing shoulder pads.⁸¹ Unless the shoulder pads are removed at the same time, it would be very difficult to maintain in-line neutral stabilization. Spinal immobilization and alignment must be maintained during removal of the helmet. The design and fit of the helmet and shoulder pads require careful removal of each to maintain spinal alignment. The helmet and shoulder pads significantly elevate the athlete's trunk and head when in the supine position; the removal of only one piece of equipment can cause a significant change in spinal alignment.

Guidelines for Removal. In general, any athletic helmet should be removed on the field only under any of the following circumstances:

- If after a reasonable period of time, the face mask cannot be removed to gain access to the airway.^{1,79}
- If the design of the helmet and chin strap is such that even after removal of the face mask, the airway cannot be controlled or ventilation provided.^{1,10,77,83,84}
- If the helmet and chin straps do not hold the head securely such that immobilization of the helmet does not also immobilize the head.^{1,10,83,85}
- If the helmet prevents immobilization for transport in an appropriate position.^{1,10}

How to Remove the Helmet. The Inter-Association Task Force acknowledges that specific guidelines for helmet removal need to be developed and, in the interim, offer the following general guidelines. The Inter-Association Task Force recommends that the helmet be removed in a controlled environment after radiographs have been obtained and only by qualified medical personnel with training in equipment removal.^{42,86} Helmet removal should never be attempted without thorough communication among all involved parties. One person should stabilize the head, neck, and helmet while another person cuts the chin strap. Accessible internal helmet padding, such as cheek pads, should be removed, and air padding should be deflated before removal of the helmet, while a second assistant manually stabilizes the chin and back of the neck, in a cephalad direction, making sure to maintain the athlete's position.⁸⁷ The pads are removed through

the insertion of a tongue depressor or a similar stiff, flat-bladed object between the snaps and helmet shell to pry the cheek pads away from their snap attachment.^{1,88,89} If an air cell--padding system is present, deflate the air inflation system by releasing the air at the external port with an inflation needle or large-gauge hypodermic needle. The helmet should slide off the occiput with slight forward rotation of the helmet.^{11,77,88} In the event the helmet does not move,

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slight traction can be applied to the helmet which can then be gently maneuvered anteriorly and posteriorly, although the head/neck unit must not be allowed to move.⁴⁶ The helmet should

not be spread apart by the ear holes^{42,87} as this maneuver only serves to tighten the helmet on the forehead and occiput region.

SHOULDER PADS

The padded plastic shell of a football player's shoulder pads is of sufficient thickness that the pads elevate the torso of the supine player to the same height as the helmeted head.^{11,83,90,91} It is important to note that shoulder pads used in lacrosse, ice hockey and field hockey are not as thick as those used in football. As such, the removal of equipment from a spine-injured athlete in any of these sports could vary. Shoulder pads are held in place with straps that clip to the front sternal plate. Neck rolls may be attached to the shoulder pads or be independent of them. In most cases, the front of the shoulder pads can be opened to allow the rescuer access to the athlete's chest for evaluation, auscultation of breath and cardiac sounds, and chest compression during cardiopulmonary resuscitation and for defibrillation (or automated external defibrillator pad placement) when necessary.

When to Remove the Shoulder Pads. Spinal immobilization must be maintained while the helmet is removed; therefore, during helmet removal, the shoulder pads must be removed simultaneously.⁸² The helmet/shoulder pad unit should be thought of as an all-or-none scenario with regard to spinal immobilization. Studies have shown excess movement in the cervical spine when helmet or shoulder pads are removed alone.^{82,92-94}

In the athlete with a potential cervical spine injury, controversy has arisen over whether the helmet, shoulder pads, or both should be removed before transport from the field to an emergency facility. Concerns regarding the removal of equipment include

1. The ability to maintain neutral spinal alignment
2. The ability to secure rigid fixation of the athlete to the board
3. A guarantee of access to the airway and to the chest for resuscitation efforts⁹⁴

Possible situations in which removal of shoulder pads would be necessary before transport to an emergency facility may include, but are not limited to, the following situations:

1. The helmet is removed
2. Multiple injuries require full access to shoulder area
3. Ill-fitting shoulder pads caused the inability to maintain spinal immobilization

The helmet and shoulder pads elevate an athlete's trunk in the supine position. Should either be removed or if only one is present, appropriate spinal alignment must be maintained. With removal of only the face mask, and not the entire helmet, the spine is able to remain in the existing position. If the helmet is removed, the athlete's head will hyperextend, particularly if the player is wearing shoulder pads.^{82,92-98} Research with fluoroscopy and kinetic magnetic resonance imaging shows that unless the shoulder pads are removed simultaneously, it is not possible to maintain in-line neutral stabilization.^{82,90-94,96-98} Therefore, removal of the helmet and shoulder pads, if required only as a last resort, must be coordinated to avoid cervical hyperextension. Head/shoulder stabilization must be

maintained during any manipulation of equipment. The Inter-Association Task Force recommends that neither the football helmet nor the shoulder pads be removed before transportation.^{1,77-80} Furthermore, the simultaneous removal of the helmet and shoulder pads is best done in a controlled atmosphere, such as the emergency department, with many trained hands.^{51,82,94}

How to Remove the Shoulder Pads. The Inter-Association Task Force recommends that shoulder pads be removed only in conjunction with the athlete's helmet and only when removal is warranted (see *When to Remove the Shoulder Pads*). Whenever the decision is made to remove the shoulder pads, it is favorable to follow the following steps:

1. Cut jersey and all other shirts from neck to waist and from the midline to the end of each arm sleeve.
2. Cut all straps used to secure the shoulder pads to the torso. Attempts to unbuckle or unsnap any fasteners should be avoided due to the potential for unnecessary movement.
3. Cut all straps used to secure the shoulder pads (and extenders) to the arms.
4. Cut laces or straps over the sternum. A consistent manufactured characteristic of shoulder pads is the mechanism to attach the two halves of the shoulder pad unit on the anterior aspect. This lace or strap system allows for quick and efficient access to the anterior portion of the chest.
5. Cut and/or remove any and all accessories such as neck rolls or collars, so they can be removed simultaneously with the shoulder pads. The shoulder pads can now be released with full access to chest, face, neck, and arms. The posterior portion of the shoulder pads helps to maintain spinal alignment when the helmet and shoulder pads are in place.
6. A primary responder maintains cervical stabilization in a cephalad direction by placing his or her forearms on the athlete's chest while holding the maxilla and occiput. This is a skilled position that requires personnel who are practiced in this technique.
7. With responders at each side of the patient, their hands are placed directly against the skin in the thoracic region of the back.
8. Additional support is placed at strategic locations down the body as deemed appropriate in consideration of the size of the patient.
9. While the patient is lifted, the individual who was in charge of head/shoulder stabilization should remove the helmet and then immediately remove the shoulder pads by spreading apart the front panels and pulling them around the head.
10. All shirts, jerseys, neck rolls, extenders, and so on should be removed at this time.
11. The patient is lowered.

Shoulder pads have consistent design characteristics that allow removal procedures to be relatively uniform. It is highly recommended these procedures be practiced with all necessary rescue and medical

The Inter-Association Task Force recommends that shoulder pads be removed only in conjunction with the athlete's helmet and only when removal is warranted.

personnel using the equipment commonly worn by the athletes.^{1,79,99} It is also suggested that all equipment be properly maintained. It is the integrity of the shoulder pads and helmet working together that provide spinal

immobilization and safe removal of equipment when it is necessary to do so.⁹³ Poorly maintained or modified equipment may hamper the safe removal process, which may lead to an increase in the severity of the initial injury.

Immobilization and Transportation

For initial stabilization of an injured athlete, see *On-the-Field Management and Immediate Care*.

Manual stabilization of the head, neck, and shoulders should be performed as the patient is being assessed. In most cases, the football helmet and shoulder pads should not be removed during evaluation, immobilization, and transportation, but when the helmet must be removed, the shoulder pads should be removed as well (see *Equipment Management*).

When a determination is made that transportation to an emergency receiving facility is imminent, the athlete will have to be secured to an appropriate immobilization device (see *Immobilization Equipment*). Controversy has arisen over whether the athlete whose spine is found in a less than anatomically correct position should be repositioned. In the past, when an athlete could actively reposition his or her head into a neutral position without encountering resistance or pain, they were encouraged to do so. Recently, a more cautious approach has been observed since it is assumed that an unstable spinal injury can be converted to an injury with more severe damage if the athlete is mishandled.¹⁰⁰

The Inter-Association Task Force recommends only that stabilization of the head and spine be maintained. In most cases, this means that the head and spine are repositioned into a neutral position so in-line stabilization can be accomplished with appropriate immobilization devices.¹⁰¹⁻¹⁰³ However, in some instances, it may be best for the athlete's head and neck to be immobilized in the position in which they are found. The appropriateness of repositioning the head into a spine-neutral position should be assessed on an individual basis. Techniques for spinal immobilization and the determination of whether in-line stabilization is required for transportation should be left to local protocols or the clinical judgment, expertise, and training of the individuals on-site.

The Inter-Association Task Force recognizes that it may not be possible to apply a rigid cervical collar when the helmet and shoulder pads are left in place or when spinal immobilization is being accomplished in a position other than neutral. Other methods of padding, such as towels or blanket rolls, must then be used to secure the head to the spine board.²⁸ It has also been suggested that a cervical vacuum splint is an effective immobilizer in the athlete wearing protective equipment.¹⁰⁴ If the athlete's spine is being immobilized in a neutral (in-line) position, every attempt should be made to apply a rigid cervical collar.^{14,105-110} When the athlete is anchored to the spine board, the body should be secured using standard techniques.^{8,111-117} The application of a spine board should always include straps to secure the pelvis, shoulders, legs, and, last, the head.¹¹⁸ After removal of the face mask, with the chin strap left in place, the helmeted head is secured to the board with adhesive tape or straps. At least two straps should be used to secure the torso, pelvis, and legs. The straps must be applied snugly so the athlete does not move if rolled onto his or her side due to vomiting. Any gaps must be filled in with towels or rigid foam.^{9,42,80,119} Once the athlete is completely stabilized, the person at the head relinquishes his or her control, and the athlete is transported to an emergency medical facility.¹⁰⁰ The Inter-Association Task Force recommends some form of acceleration/deceleration, or "trauma strapping", to prevent axial loading in the ambulance during braking. It is also a common practice and a local protocol in some districts to load the stretcher in the ambulance with the athlete's head at the rear to avoid axial loading during ambulance braking.

Patients with spinal injuries often have a component of head injury that can lead to vomiting. Athletes who are vomiting or bleeding from the oral cavity must be kept prone or placed on their side to prevent aspiration of blood or vomitus into the airway.⁹ However, this can be performed after the athlete is immobilized (see above). Furthermore, proper equipment, such as a suction apparatus, should be readily available (see *The Emergency Plan*). These procedures should be identified and practiced often to ensure a smooth transfer to a spine board when an emergency occurs.

TRANSFER OF THE ATHLETE

To transfer a *supine athlete*, the Inter-Association Task Force recommends using a six-plus--person lift along with a scoop stretcher to lift the athlete onto a rigid long spine board rather than a log roll technique.⁸⁰ A six-plus--person lift is recommended due to the size of many athletes and the interference by protective equipment. To transfer a *prone athlete*, the Inter-Association Task Force recommends log rolling the athlete directly onto a rigid long spine board. Movement of the athlete from the prone to the supine position should be done with a minimum of four persons, with one designated to maintain stabilization of the head and neck. All movement should be carefully coordinated to avoid shifting the head, neck, and torso.⁸

Log Roll of a Prone Athlete. Due to the urgency of establishing an airway in the athlete, assessment must be made very quickly and efficiently. If a prone athlete is not breathing, a log roll should be performed immediately. Unless the immobilization device is readily available, the athlete must be log rolled into a supine position on the playing surface and then moved (lifted) a second time onto the long back board. Obviously, with each movement the chances of a secondary injury increase. If the athlete is conscious and stable, the log roll should be delayed until the backboard is available.

To immobilize the prone athlete, the rescuer at the head (rescuer 1) should maintain the athlete's head/neck complex in the position in which it was found until it is completely splinted on the full body splint. When possible, the athlete should be treated with a rigid cervical collar to ensure the immobilization of all segmental levels.^{78,109,120} Next, position the immobilization device by the injured athlete on the side of rescuer 1's lower hand. When the athlete is wearing protective equipment, the athlete's arms should be maintained at his or her side (with palm inward). Rescuers 2 and 3 will then roll the athlete onto his or her arm, which should be kept to the side during the log roll maneuver. An injury that involves the arm calls for the athlete to be log rolled to the opposite side, which may be difficult in the presence of shoulder pads. Shoulder pads are not easy

to remove, especially if worn with a neck collar; thus, they should be only removed in the most extenuating of circumstances.

Rescuer 1 is in charge and will give every command to move the athlete. Rescuer 1 must continue to maintain the position of the head/neck complex until the athlete is completely immobilized. Rescuers 2 and 3 position themselves adjacent to the athlete. On the opposite side of the athlete, rescuer 4 positions himself or herself and the splinting device. Rescuer 2 is positioned at the chest area, and rescuer 3 is positioned at thigh level. Rescuer 3 is expected to control both legs during the log roll maneuver. To roll the athlete, rescuer 1 gives the command "prepare to roll, roll." The other rescuers should then roll the athlete onto his or her side, toward the rescuers. By rolling the athlete onto his or her arm, the head, shoulders, and pelvis are kept in anatomical alignment. Rescuer 4 places the splinting device against the athlete's back at a 30-degree angle. While positions are maintained, rescuer 1 gives the command "prepare to lower, lower," and the athlete is lowered onto the splint.⁹⁹

Six-Plus--Person Lift. Heavy persons, including many athletes, can be handled more efficiently with a six-plus--person lift; this is also preferred for suspected spine injuries. The Inter-Association Task Force recommends that the six-plus--person lift be used along with a scoop stretcher whenever possible. In the athletic arena, there are usually a sufficient number of certified athletic trainers, physicians, and EMS personnel on hand to effectively administer the six-plus--person lift.

For the six-plus--person lift, rescuer 1 immobilizes the neck. The rescuer's hands are placed on the athlete's shoulders (under the shoulder pads) with the thumbs pointed away from the athlete's face. The athlete's head will then be resting between the rescuer's forearms.

The other six rescuers position themselves along the athlete's sides: one on each side of the chest, pelvis, and legs. The hands are slid under the athlete and equipment, if any, to provide a firm, coordinated lift. To lift, rescuer 1 gives the command "prepare to lift, lift." The assistants lift the athlete 4 to 6 inches off the ground. It is imperative to maintain a coordinated lift

and to prevent any movement of the spine. One of the rescuers at the thigh level must control the legs with his or her arms toward the feet so the splint can be slid into place from the foot end. After the splint is in place, while positions are maintained, rescuer 1 gives the command “prepare to lower, lower,” and the athlete is lowered onto the splint.

In the case of larger athletes, as many as 10 individuals should participate in the lift, with one on each side of the chest and pelvis, two at the legs, one at the head, and one with the splint. The Inter-Association Task Force does not recommend the use of fewer than four-plus--persons to lift athletes suspected of having a spinal injury, even smaller athletes and children, in part due to the weight of the athlete while wearing protective equipment.

IMMOBILIZATION EQUIPMENT

Any injured athlete who may have a cervical spine injury should be immobilized on a suitable full-body splint. The equipment used for splinting athletes with head or neck injuries will depend on the appliances that are available, as well as the training and knowledge of EMS personnel.

Certified athletic trainers should know how to use the equipment that is available and should be familiar with the equipment EMS providers will bring to the scene. EMS providers should take the lead in the immobilization of an athlete for transportation because they are far more practiced in immobilization techniques and will be responsible for the athlete during transportation. However, team physicians and certified athletic trainers are more familiar with athletic protective equipment and should therefore direct and assist the EMS providers in the immobilization process of the athlete with protective equipment. Certified athletic trainers and team physicians should familiarize themselves and rehearse the handling of such equipment on a regular basis because of their infrequent use of such equipment.

Equipment for spinal immobilization includes the Miller full-body splint, the standard rigid spine board, the vacuum mattress, and the scoop stretcher.

Miller Full-Body Splint. To use the Miller full-body splint, move the splint next to the athlete. Open the harness, and fold all straps onto themselves to prevent entanglement of the Velcro. Lift or log roll the athlete onto the Miller full-body splint. Align the athlete’s shoulders with the shoulder pins on the Miller full-body splint. Place the chest straps loosely over the athlete’s chest. Place the shoulder strap onto the chest strap. Thread the chest strap through the pins on the Miller full-body splint. Adjust the chest strap, and then adjust the shoulder straps. Do not overtighten either of the straps. Adjust the torso and the leg and ankle straps to secure the athlete to the Miller full-body splint.

If the athlete is wearing a protective helmet, tape the helmet directly to the Miller full-body splint headpiece. Apply the chin strap snugly but loose enough to allow the mouth to open.

Rigid Spine Board. Once the athlete has been placed on the board (by six-plus--person lift or log roll), apply blankets, rolled towels, or commercial head immobilizers, and strap the athlete into position. At least two straps should be used to secure the torso, pelvis, and legs. The Inter-Association Task Force recommends some form of acceleration/deceleration, or “trauma strapping”. With the helmet and shoulder pads in place, towels or other padding is usually sufficient to fill the voids. Finally, the helmet should be secured to the backboard with adhesive tape. When completed, the athlete with protective equipment is said to be immobilized.

Vacuum Mattress. The vacuum mattress is one of the newest methods of immobilization. Unlike the rigid spine board, the vacuum splints consist of Styrofoam beads encapsulated in a vacuum nylon covering. When air is released, the splint provides support to the axial spine or total body. The splint includes wooden slats posteriorly for head-to-toe stability.

To prepare the splint for use, remove from the case at the beginning of each practice or game. Create a semirigid splint through partial removal of air. In the event of an injury, the semirigid splint can be moved into place as needed.

When an injury occurs that necessitates total body immobilization, those who are providing care must decide how to move the athlete onto the splint. Always protect the athlete with a suspected spinal injury. Athletes in awkward positions may be moved onto the rigid spine board or vacuum splint with a scoop stretcher. When the vacuum mattress is used, release the buckles on the mattress before moving the athlete onto the splint. The person at the head maintains firm support, or pressure, to the head. Pressure includes gentle, in-line traction. When preparing the athlete for the vacuum mattress, use standard commands of “prepare to lift, lift” or “prepare to roll, roll.” Once the athlete is positioned onto the mattress, continue stabilization of the head and neck. Open the valves at the head and foot ends to allow air to enter the mattress. Bunch the beads around the head and into the body to mold the splint. At this point, screw the valve at the head to the locked position. Continue the application of pressure so the beads form around the head and helmet. The person at the head works with the second rescuer to accomplish this molding around the head/helmet. Reattach the straps by connecting color-coded buckles. Take care not to twist the straps, which could create uncomfortable pressure points for the athlete. Move the excess strap down the body from head to toe. As tightened, attach the pump to the foot end and release air from the splint. As the splint becomes rigid, recheck the straps in a head-to-toe direction to remove any excess slack from the belt. Apply adhesive tape across the head area to secure the helmet to the splint. Screw all valves to the locked position.

Scoop Stretcher. The scoop stretcher, or split litter, is adjusted to the correct length and then separated, inserted, and fastened according to its design. The patient is lifted 4 to 6 inches off the ground while a rigid long board is slid underneath. The split litter should not be picked up from the head and foot ends or used to carry the patient before it has been placed on a long board because it can sag without center support. The scoop stretcher can be left in place or removed before the athlete is secured to the long board, but keep in mind that these devices are usually made of aluminum and x-rays do not penetrate easily. The Inter-Association Task Force recommends using a scoop stretcher along with the six-plus--person lift to

facilitate the transfer of the supine athlete onto a long spine board for definitive immobilization.

ADVANCED TRANSPORTATION AND CARE

Team physicians, certified athletic trainers, and EMS personnel who are caring for an athlete with a potential spinal injury should be familiar with local trauma networks and protocols. If the patient is hemodynamically stable, transport should be directed to a designated hospital with special capabilities for spinal injury. Critical patients may need to be stabilized at the closest appropriate hospital before transfer to a more definitive care facility. In remote areas where the distance to a trauma center is very long, the physician may elect to accompany the athlete to the hospital and participate in the treatment.

Any athlete who is suspected of having a spinal injury is to be transported by trained professionals in an ambulance. Transportation in a private vehicle is never to be attempted. In certain settings, air transportation may be preferred to ground transportation. A trauma center should be the first-choice destination for spine-injured athletes. Trauma center designation levels and capabilities will vary by state, so it is important to be familiar with the facilities available in your area.

Methylprednisolone. Methylprednisolone is used in cases of spinal cord injury, but it must be administered as soon as possible and over 24 hours. The dosage of this medication is 30 mg/kg body weight administered over 1 hour. The subsequent dosage is 5.6mg/kg body weight, administered over the next 23 hours. The first dose of intravenous methylprednisolone should be administered within 4 hours of the injury to be most effective. Therefore, team physicians in rural areas or those who travel substantial distances may elect to carry methylprednisolone or to ensure that the emergency receiving facilities and/or EMS providers have the medication on hand. Many local EMS providers are able to begin this treatment while transporting the patient.

Injuries and Possible Mechanisms

Injuries can be classified as direct or indirect.^{27,121} Direct injuries occur as a result of sports participation and include closed head injuries and cervical spine trauma as a result of contact/collision. Indirect injuries can include heart attack, heat illness, or other preexisting medical conditions. Direct injuries are more common in contact/collision sports such as football, hockey, and rugby.^{12,13,48,122,123}

All of the anatomic components of the cervical spine are subject to traumatic injury, including soft tissues, bone and joint structures, and neurological elements.^{124,125} Within each category, these tissues are variably susceptible to both compressive and tensile overload, which will result in specific injury patterns and clinical presentations.^{36,126} Not all spinal injuries are catastrophic, although many of the same signs and symptoms can appear in catastrophic and noncatastrophic injuries. Therefore, an understanding of all of the possible injuries to the spine is warranted.

SOFT TISSUE INJURIES

Soft tissue injuries to the cervical spine, including muscle, ligament, and tendon injuries, probably occur most frequently.²⁹ *Muscle contusions* can result from direct impact in the neck region or can occur indirectly via forces transmitted through protective equipment (i.e., the shoulder pads and helmet). *Tensile* overload to the musculotendinous unit occurs most commonly and is often associated with tackling in football. This is particularly true with a blind-side tackle when the player is not prepared for the collision, which can result in a forceful eccentric muscle contraction that places the musculotendinous unit at risk. This risk is often increased when muscle fatigue is present.

Acute muscular spasm often develops secondary to an underlying spinal injury, so a spinal injury should be considered whenever an initial assessment reveals spasm, tenderness or loss of active range of motion.^{127,128}

Ligamentous injuries typically result from tensile overload with varying degrees of disruption. The innervation of the ligamentous structures in the cervical spine includes receptors that respond to slow tonic input, which is important in postural control,

rather than ballistic movement.¹²⁹ Thus, ligaments are susceptible to sudden loads. Ligament injury may lead to instability patterns specific for the segmental location of the particular ligament and may be associated with neurological impairment. Instability must be considered in any player with neurological symptoms, especially if the symptoms are persistent.

SKELETAL INJURIES

The spatial and geometric orientation of the cervical *zygapophyseal joints* (also known as facet joints, or z-joints) allows a high degree of mobility of the cervical spine, which places all anatomic structures at risk for injury. The z-joints are loaded when the head and neck are moved into the posterior and posterolateral quadrants. Acute compressive overload or chronic repetitive loading of these structures may result in synovitis of the z-joint and, depending on the force, may have an impact on injury and microfracture of the articular cartilage and subchondral bone of the facet processes. Tensile overload injuries lead to a spectrum of capsular damage, from strain to complete disruption. Greater degrees of capsular incompetence contribute to segmental hypermobilities and instabilities. Whether resulting in hypomobility or hypermobility, z-joint injury at one segmental level may lead to a cascading effect of segmental motion abnormalities elsewhere in the cervical spine.

Fractures of the cervical spine can occur when a player's head unexpectedly strikes another object and the force of impact exceeds the compressive or tensile limit of the bony structure.¹³⁰⁻¹³² Both the anterior column (i.e., vertebral body) and the posterior column (i.e., pedicle, lamina, or facet) structures are at risk.^{133,134} Fractures can be associated with instability, which must always be considered if neurological sequelae develop, but can also exist without neurological symptoms or signs. It is important to note that some fractures, particularly in the posterior column, can be difficult, if not impossible, to identify on plain radiography and require some type of advanced imaging technique.^{135,136}

Acute cervical fracture-dislocations occur most commonly as the result of an axial load to the top of the helmet with the neck slightly flexed, the so-called

segmented column.^{131,137-140} The straightened spine buckles in the center in an accordion-type mechanism, which produces a fracture dislocation or a transitory subluxation.^{141,142} It is for this reason that spearing is illegal in football. However, inadvertent contact with another player, or even the ground, also can produce this injury.^{85,138,143,144} Catastrophic injuries almost universally result from the axial load mechanism, of which an understanding is important for injury prevention. Other injuries that can occur from axial loading include the following^{137,145,146}:

- Flexion rotation fracture dislocation of the midcervical spine
- Jefferson fracture of the ring of C1
- An anterior subluxation injury that involves a rupture of the posterior longitudinal ligament and ligamentum flavum
- Bilateral and unilateral facet dislocation
- Cervical disc herniation
- Vertebral body fracture
- Intervertebral facet fracture
- A rupture of the atlantoaxial ligament

A variety of other mechanisms can also result in fracture-dislocation or in dislocation without fracture (i.e., unilateral or bilateral facet dislocation), including forceful rotation with flexion or extension.^{147,148} These types of injuries usually result in an intervertebral disc injury, as well as a disc rupture or herniation.¹²⁴ Less severe disc injury also can occur, due to excessive torque to the cervical spine and excessive shear force across the annulus fibrosus, leading to annular tears and possibly disc herniations.

Predisposing Conditions. Numerous injuries can be acquired from head contact. Predisposing conditions can make certain players more vulnerable even though they are unaware of this predisposition. The most common abnormality is congenital stenosis, in which the spinal canal is too small for the spinal cord. Klippel-Feil syndrome is a congenital abnormality that involves the fusion of different segments of the neck to produce compensatory hypermobility in other areas. Most players and physicians are not aware of congenital abnormalities until some symptoms develop. These findings can be a major factor in

determining potential risk and in decisions concerning continued play after an injury.¹⁴⁹⁻¹⁵⁴

Spinal stenosis, whether congenital or acquired, means the player is more likely

- To have an episode of transient quadriplegia^{153,154}
- To have “stingers”^{146,154}
- To require surgery after a cervical disc herniation^{152,153}
- To run the risk of potential paralysis without a fracture-dislocations^{152,156,157}
- To develop paralysis and a greater degree of paralysis after a fracture-dislocation^{154,156,157}

NEUROLOGICAL INJURIES

From a mechanical basis, the neurological contents of the spinal canal can be compromised by bone or disc fragment, malalignment, or instability.^{131,155,157,158}

Vascular insult also may contribute to various neurological syndromes. The three main neurological elements at risk are the spinal cord, nerve root/spinal nerve complex, and brachial plexus. Catastrophic injury that results in transient or permanent quadriplegia is rare, with an incidence of approximately 0.6 to 1.5 per 100,000 participants in high school and college, respectively, during the 19-year period of 1977 to 1995.^{6,7}

As previously described, *central spinal canal compromise* is associated with fracture-dislocation and other instability patterns. The spinal cord is deformable and can accommodate some change in the length of the spinal canal without injury. However, the presence of spinal stenosis, developmental or acquired, decreases the chances for full neurological recovery if an athlete develops quadriplegia due to cervical spine trauma.¹⁶⁰⁻¹⁶² Spinal cord injury may be neurapraxic (a reversible concussive event) with motor and sensory function returning within approximately 24 hours.¹⁶³

The most typical pattern of incomplete spinal cord injury is the central cord syndrome.¹⁶⁴ Due to the lamination of the corticospinal tracts located toward the center of the spinal cord, the upper extremities are most susceptible to impairment with swelling or contusion to the cord. A variety of incomplete spinal cord injuries can develop due to a combination of mechanical and vascular effects on the spinal cord.

Burners and Stingers. The more common neurological injury is the “*stinger*,” or “*burner*.”¹⁶⁵ The stinger is a peripheral nerve injury, not a spinal cord injury. It is characterized by burning dysesthesias that usually begin in the shoulder and radiate unilaterally into the arm and hand. Weakness, numbness, or both are occasionally associated in a C5-6 nerve root distribution. Recovery from an initial stinger usually occurs in minutes, but the symptoms and signs (most commonly numbness or weakness) can persist for several days to a few weeks, particularly if it is a recurrent condition.

Stingers typically result from one of two mechanisms of injury, which can vary depending on the skill and physical maturity of the athlete. A *compressive mechanism* develops when the head and neck are forcibly moved into a posterolateral direction toward the symptomatic upper limb.¹⁶⁶ The other mechanism, a *tensile mechanism*, occurs when the involved arm and neck are forced in opposite directions. With either pathomechanism (tension or compression), the cervical spine nerve is probably at greater risk than the brachial plexus.^{124,145} Thus, stingers are more appropriately considered a cervical radiculopathy than a brachial plexopathy, although a brachial plexopathy can occur from a direct blow to the upper thorax or from tension. Cervical radiculopathy also can occur due to a cervical disc herniation, cervical foraminal stenosis, and instability.

Burners and stingers typically produce loss of function and pain only for a limited period of time.¹⁶⁷⁻¹⁷⁰ Often the player will flex and laterally bend his or her head and neck away from the involved arm. As the pain decreases, the player will gradually demonstrate improved range of motion. There can be a great deal of posterior cervical tenderness with the stinger because the posterior primary ramus of the nerve innervates the skin in that area and comes directly off the dorsal ganglion.

The symptoms of a stinger should be distinguished from those of a spinal cord injury to initiate an appropriate treatment relative to the severity of the injury.¹²⁷ The key clinical distinction between spinal cord injury and a stinger is that the spinal cord injury results in multiple limb involvement (i.e., two to four),

whereas the stinger always results in unilateral upper extremity impairment. The determination of whether an injury is related to the spinal cord or is a stinger should be made with great caution due to the importance of initial management of the injury.¹⁷¹ Unlike the consequences of a spinal cord injury, players with burners and stingers often are headed off the field when their symptoms are discovered.^{167,168}

Transient quadriplegia is a temporary paralysis that is characterized by a loss of motor or sensory function, or both. It is current neurosurgical thinking that a common mechanism of transient quadriplegia is a contusion of the spinal cord that produces a temporary restriction of blood flow to a portion of the cervical spinal cord. The extent of neurological deficit and how long it lasts are critical and determine prognosis. The mechanism of injury may be varied and complex.^{163,172} The most significant factor is the initial head-first contact. If subsequent neck flexion follows, the spinal cord becomes taut and is stretched over the floor of the spinal canal, producing a transitory plastic deformation of the cord. This produces a collapse of blood vessels and an interruption of blood supply to the cord. Neck extension after head contact produces the opposite effect, or slackening of the cord. Further extension narrows the central spinal canal, and the posterior disc, osteophytes, and ligamentum flavum protrude into the spinal canal and compress the spinal cord. In addition, the intervertebral foramen diameter narrows and becomes smaller in extension as the two articular facets slide into a small relative subluxation. Conversely, flexion produces a larger central canal diameter through removal of the relative infolding of ligamentum flavum and posterior disc bulging from the canal. Extension and flexion can produce a pincer effect between the posterior edge of one vertebral body and the lamina of another. This is a relative subluxation between two vertebral segments that squeezes the spinal cord producing a contusion and localized deformation of the cord. Transient quadriplegia is, by definition, a temporary condition, a neurapraxia, but the player initially presents with paralysis and must be managed accordingly.¹⁷³

Return-to-Play Criteria

There is not a simple algorithm that determines return to play after a cervical spine injury.¹⁷⁴

Medical factors are paramount, although a variety of nonmedical factors (e.g., age of the athlete, level of competition, psychosocial issues) can influence return-to-play decisions.¹⁷⁵⁻¹⁸⁰ Although the decision to return to play can be complex, some medical sequelae of certain cervical spine injuries do represent absolute contraindications to return to contact or collision sports. These include neck injuries resulting in permanent central nervous system (i.e., spinal cord) dysfunction, permanent and significant

peripheral nerve (i.e., nerve root) dysfunction, and injuries resulting in a spinal fusion at the C4 level or above. Some other conditions, which include anatomic abnormalities such as spinal stenosis, represent relative contraindications to return to play, even in the clinical setting of “full” recovery.^{156,181} The Inter-Association Task Force recommends that any athlete who sustains a cervical spinal injury be evaluated individually and completely by a licensed, well-trained sports medicine physician who is then responsible for making the final return-to-play decision.¹⁸²⁻¹⁹¹

Prevention

Many believe that prevention is the most important aspect of this topic. Over the years, many strategies have been used to reduce spine injuries, including rules changes,^{55,142,192-198} changes in equipment and equipment standards,^{193,198-200} and conditioning and strengthening programs.^{192,201,202} However, the heart and soul of the preventive program should be teaching the proper technique. The majority of catastrophic spine injuries are a result of the axial loading mechanism.

Tackling Techniques. Proper tackling techniques are the key. Although some players have hit their head into their teammate after missing the tackle they were attempting, many simply lower their head in an attempt to deliver a blow to their opponents. Smaller players occasionally develop a head tackling technique to be successful against larger players. This is also evident by the fact that fracture dislocations with paralysis occur in a higher incidence in defensive backs.

Proper instruction in blocking and tackling techniques has, and can continue to, significantly decrease the incidence of axial loading injuries to the cervical spine through purposeful head contact.²⁰³ Although hard tackling and hard blocking are a part of football and

other sports, a certain number of these injuries may be unavoidable. A proper preventative approach educates players about the potential risk for catastrophic injury when tackling an opponent with a lowered head and teaches athletes alternate ways to be effective on the playing field.^{76,199}

The Inter-Association Task Force recommends that players, parents, and coaches all participate in educational programs. These educational programs in youth leagues and other developmental programs should emphasize a “see what you hit” approach to blocking and tackling. Educational programs at all levels should remind players, parents, and coaches about the dangers of moving an injured player. Everyone should be cognizant of the dangers of moving a player with a suspected spinal injury and must be instructed and reminded not to move any player who shows signs of a severe injury. Educational programs should also include a picture of the potential for catastrophe.^{199,200} The Inter-Association Task Force recommends that educational programs be held at regular intervals.

Having an emergency plan in place is also an important part of the prevention program.

The Emergency Plan

Although professional organizations, including NATA, have specific documents detailing the components of an emergency plan, the Inter-Association Task Force believes that a comprehensive document regarding the care of the spine-injured athlete should contain at least basic information regarding an emergency plan.

OVERVIEW

A quick review established procedures with all parties involved should take place before every contest due to the possibility of a personnel change in any component of the athletic healthcare delivery system. This review may include the determination of who should be on the field (team physician, certified athletic trainer, etc.), who will be responsible for completing the initial evaluation, when EMS personnel are to be summoned, and what special equipment should be brought onto the field. A review that is specific to the activity being covered should occur as often as possible and

A review that is specific to the activity being covered should occur as often as possible and especially before every competition.

especially before every competition. For example, exact procedures for back boarding an equipment-laden football player will differ from that for the soccer player with no

heavy equipment. Follow-up plans, such as determining who accompanies the athlete to the hospital, who notifies a family member, and who completes all appropriate documentation, should be discussed and agreed on by all responsible parties before the start of the sports season.

Essential to the smooth operation of any emergency situation is proper planning; all athletic healthcare providers must work together as a team, and a well-conceived plan must be followed. This plan is frequently called an emergency plan.²⁰⁴ Although it is not the purpose of this paper to discuss the emergency plan, it is important to emphasize that following an organized plan is critical to the emergency

management of an athlete with a suspected head or cervical spine injury. Furthermore, the emergency plan should address equipment issues specific to the management and packaging of suspected head or cervical spine injuries.

The emergency plan should be thought of as a blueprint for handling emergencies. It should contain the roles and responsibilities of each member of the sports medicine team, and it should include steps to properly activate the EMS system.²⁰⁵ A good emergency plan is easily understood and establishes accountability.²⁰⁴

Emergency plans should be comprehensive and practical, yet flexible enough to adapt to any emergency situation. The emergency plan must be established, approved, revised, and rehearsed on a regular basis.²⁰⁴ Emergency plans must be written documents that are distributed to key personnel and approved by administrators.²⁰⁵⁻²⁰⁷

Each emergency plan can vary but should include information on education, emergency equipment, personnel, and communication and a rehearsal schedule.²⁰⁵

EDUCATION

It is likely that each member of the prehospital emergency care team will have a different type or level of education, have different levels of knowledge, and possess different skills.²⁰⁸ These differences should be considered a positive circumstance. Individually, each member brings strengths to the team. Collectively, these differences become complementary to one another.

EMERGENCY EQUIPMENT AND SUPPLIES

Each member of the emergency team should be knowledgeable and practiced in the function and operation of emergency equipment.⁵⁰ It would be helpful for each member of the sports medicine team to be multi-skilled and cross-trained in the use of all emergency equipment. For example, it is common for certified athletic trainers to know how to remove a football helmet face mask, whereas physicians and

emergency medical technicians may not have this skill.²⁰⁸ Likewise, emergency medical technicians are more familiar with the operation of automated external defibrillators and are more practiced in packaging an individual for transportation (athlete or not) than are certified athletic trainers.²⁰⁸

In addition, many certified athletic trainers do not have ready access to the types of emergency care equipment to which EMS providers have access, particularly in the high school setting.²⁰⁸

Access to and familiarity with the equipment is only part of being prepared. Having sufficiently practiced with the equipment is the other part. It has been suggested that practice with the tools required for face mask removal of the catastrophically injured football player is essential.^{51-53,55,59,60,71,73}

Equipment must be properly maintained and readily accessible.^{50,205,206} Each member of the sports medicine team should be aware of the location of all emergency equipment and know how to use it. More importantly, each member should be practiced and skilled in its use. However, each state may have specific guidelines regarding the use of emergency equipment and who is legally authorized to use the equipment.²⁰⁵ The Inter-Association Task Force advise individuals to become aware of the regulations in their particular state.

EMERGENCY PERSONNEL

When an athlete sustains an on-the-field cervical spine injury, potentially devastating and even life-threatening consequences can occur. These serious injuries are complex and happen in a difficult environment, significantly challenging the medical team. Well-rehearsed preparation and cooperation among all of the personnel involved in the prehospital care of the cervical spine injured athlete are essential to ensure the best chance for recovery.

Certified athletic trainers, physicians, emergency medical technicians, paramedics, and all other participants must be comprehensively trained and completely clear regarding their duties and responsibilities. This is best achieved through the repeated practice of all aspects of on-the-field triage, initial treatment, and transport of the injured athlete

until every component is automatic. Remember there must also be a plan in place for both practice and event situations.

It is the opinion of the task force that no one discipline should have entitlement to supervision or performance of any particular aspect of the rescue.

Responsibilities for care may vary among different medical teams based on individual qualifications, skills, and availability. It is the opinion of the task force that no one discipline should have

entitlement to supervision or performance of any particular aspect of the rescue. By working together, the knowledge and experience of individual team members can best be used to provide care for the athlete in this critical situation.

Certified athletic trainers play a critical role in the emergency management of athletic injuries.²⁰⁷ The certified athletic trainer should take responsibility for better communication among all emergency personnel, which includes educating other professionals about the training and the roles and responsibilities of certified athletic trainers.²⁰⁸ It is also advisable to get to know other members of the emergency care team on a personal basis and to establish a good working relationship at the athletic contest.²⁰⁹ Each healthcare provider has individual expertise and deserves the respect of the other.²⁰⁹

Each member of the emergency team has his or her role in the emergency plan.²¹⁰ For example, it is not the responsibility of the certified athletic trainer or the team physician to transport injured athletes, and emergency medical technicians are generally more practiced at securing an individual to a spine board. In each case, the roles and responsibilities of the team members may change, based on the situation and the participants. The most qualified individual should always be in charge but should also respect the qualifications and expertise of his or her coworkers.²⁰⁸

COMMUNICATION

A physical means of communication must be available, including the use of telephones and radios.⁹⁹ This is necessary to activate the EMS system or to communicate with team physicians, parents, and so on. However, communication is a much broader topic and includes interaction between individuals.

Many individuals are unaware of the qualifications of certified athletic trainers in providing emergency care.¹⁹⁶⁻¹⁹⁹ Furthermore, because of the changes in the educational process for certified athletic trainers, there can be great variability in knowledge and qualifications among certified athletic trainers.^{208,211} Communication is the key to identifying who is present at the game and their roles and responsibilities.^{208,209,212,213} It is important to establish this communication before the game starts and before an emergency situation arises.^{210,212,213}

The lack of communication and role delineation has made for difficult and embarrassing situations for athletic healthcare providers, particularly with regard to differences in protocol on helmet removal in potential cervical spine injuries.^{205,208,210,214,215} The best way to avoid this type of conflict in an emergency situation is to discuss the protocols and roles of each member of the medical team before the event and to familiarize the team members with the emergency plan.²⁰⁶ Emergency plans should be detailed and should be reviewed and practiced. Forming a written emergency plan together with local EMS providers may also help to modify existing EMS protocols.

REHEARSAL SCHEDULE

To avoid potential conflicts, a meeting should be scheduled before a problem arises.^{212,214} All providers of prehospital care, such as emergency medical technicians and EMS medical directors, should meet with team physicians, certified athletic trainers, coaches, and concerned parents to agree on an emergency plan.^{204,208} Planning should take place before the start of the sports season and should be approved through all appropriate administrative channels.²⁰⁴

Certified athletic trainers should meet with coaches and game officials to review basic safety issues regarding spine injuries. Within the first few days of practice, certified athletic trainers should also meet with athletes to review the dangers of moving an injured player (see Table 3 for the guidelines of the National Football League).

Certified athletic trainers should conduct a meeting with the team's emergency care providers, including student athletic trainers, and with EMS personnel and

All aspects of emergency spine care should be agreed on in concept and then practiced to perfection before the need for implementation on the field.

medical directors to discuss all aspects of the emergency plan, including the protocol for spine-injured athletes.²¹⁰ All aspects of emergency spine care should be agreed on in concept and

then practiced to perfection before the need for implementation on the field.⁷⁶ Formal rehearsal, such as mock emergency drills, should be conducted with all members of the emergency care team.

The Inter-Association Task Force recommends that the education, practice, and rehearsal of the protocol for managing a spine-injured athlete be scheduled at regular intervals and followed.

Summary and Conclusions

Injuries to the spine are relatively rare in athletics. However, when they do occur, they must be treated promptly and correctly. Certified athletic trainers and other providers of prehospital care must know which procedures to use in these situations. They must have the necessary equipment readily available and be proficient in its use. The regular practice of immobilization of athletes with potential cervical spine injuries is a must for individuals who expect to perform these important tasks in an actual emergency.

Care of the injured athlete should follow a carefully designed protocol. The athlete's airway, breathing, and circulation; neurological status; and level of consciousness should be assessed, and the EMS system should be activated.

Because unconscious individuals are unable to speak, they are unable to tell the rescuer whether they have a spinal injury. Therefore, all unconscious athletes in a situation that may have included a collision or a fall and conscious athletes with any sign or symptoms that suggest cervical spine trauma must be treated as if they have a cervical spine injury.

Any athlete suspected of having a head or spinal injury should not be moved unless absolutely essential to maintain airway, breathing, and circulation. If the athlete must be moved to maintain airway, breathing, and circulation, the athlete should be placed in a supine position while spinal immobilization is maintained.

In the conscious athlete, a possible cervical spine injury must be identified early. Athletes who display spasm, tenderness or loss of active range of motion should be suspected of having significant cervical spine trauma and should be treated accordingly. Cervical spine injuries are usually orthopedic in nature and may or may not have immediately observable neurological sequelae.

Athletes with no neurological signs or symptoms and no findings that suggest trauma to the cervical spine can be safely moved to a more suitable site for further evaluation. However, if there is any question as to medical status, it is best to err on the side of safety and to treat the injury as if it were a significant cervical spine injury.

When it becomes necessary to transport the athlete, the head and trunk should be moved as a unit. It takes many

people to correctly move an injured athlete, with one rescuer responsible for stabilizing the athlete's head and cervical spine; as a general rule, this should be the most qualified and experienced person on the scene. It is imperative that this rescuer maintains cervical stabilization throughout the procedure. The rescuer who is stabilizing the head must continue to keep it stabilized until the athlete is completely immobilized with an appropriate device.

Injuries to the head and neck are difficult to evaluate and treat in the athletic environment. To adequately prepare for these and other critical injuries to athletes, an emergency plan should be developed. Providers of emergency care must make sure to have the proper equipment readily available and that it is in good working order.

The sports medicine team must be prepared for any emergency; preparation includes education and training, maintenance of appropriate emergency equipment and supplies, utilization of appropriate personnel (including certified athletic trainers), and the formation and implementation of an emergency plan.

Emergency plans should be comprehensive and practical, yet flexible enough to adapt to any emergency situation. The emergency plan must be established, approved, revised, and rehearsed on a regular basis. Each emergency plan may vary but should include information on education, emergency equipment, personnel, and communication and a rehearsal schedule. The emergency plan should also address equipment issues, which are particularly important in managing and packaging persons with suspected head or cervical spine injuries. Each member of the emergency team should be knowledgeable and practiced in the function and operation of emergency equipment. It would be helpful for each member of the sports medicine team to be multi-skilled and cross-trained in the use of all emergency equipment. For example, it has been suggested that practice with tools required for face mask removal of the catastrophically injured football player is essential.

Emergency medical personnel must take extreme caution when evaluating and treating an athlete with a suspected head or spinal injury. The proper management of head and neck injuries can prevent further damage from occurring.

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Table 1

GUIDELINES FOR APPROPRIATE CARE OF THE SPINE-INJURED ATHLETE

General Guidelines

- Any athlete suspected of having a spinal injury should not be moved and should be managed as though a spinal injury exists.
- The athlete's airway, breathing, circulation, neurological status and level of consciousness should be assessed.
- The athlete should not be moved unless absolutely essential to maintain airway, breathing and circulation.
- If the athlete must be moved to maintain airway, breathing and circulation, the athlete should be placed in a supine position while maintaining spinal immobilization.
- When moving a suspected spine-injured athlete, the head and trunk should be moved as a unit. One accepted technique is to manually splint the head to the trunk.
- The Emergency Medical Services system should be activated.

Face Mask Removal

- The face mask should be removed prior to transportation, regardless of current respiratory status.
- Those involved in the prehospital care of injured football players should have the tools for face mask removal readily available.

Football Helmet Removal

The athletic helmet and chin strap should only be removed:

- if the helmet and chin strap do not hold the head securely, such that immobilization of the helmet does not also immobilize the head;
- if the design of the helmet and chin strap is such that, even after removal of the face mask, the airway cannot be controlled nor ventilation provided;

- if the face mask cannot be removed after a reasonable period of time;
- if the helmet prevents immobilization for transportation in an appropriate position.

Helmet Removal

Spinal immobilization must be maintained while removing the helmet.

- Helmet removal should be frequently practiced under proper supervision.
- Specific guidelines for helmet removal need to be developed.
- In most circumstances, it may be helpful to remove cheek padding and/or deflate air padding prior to helmet removal.

Equipment

Appropriate spinal alignment must be maintained.

- There needs to be a realization that the helmet and shoulder pads elevate an athlete's trunk when in the supine position.
- Should either the helmet or shoulder pads be removed – or if only one of these is present – appropriate spinal alignment must be maintained.
- The front of the shoulder pads can be opened to allow access for CPR and defibrillation.

Additional Guidelines

- This task force encourages the development of a local emergency care plan regarding the prehospital care of an athlete with a suspected spinal injury. This plan should include communication with the institution's administration and those directly involved with the assessment and transportation of the injured athlete.
- All providers of prehospital care should practice and be competent in all of the skills identified in these guidelines before they are needed in an emergency situation.

These guidelines were developed as a consensus statement by the Inter-Association Task Force of Appropriate Care of the Spine-Injured Athlete:

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Table 2

RECOMMENDATIONS FOR APPROPRIATE CARE OF THE SPINE-INJURED ATHLETE

- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete commends the current and ongoing commitment of helmet and face guard manufacturers for integrating safety in the development of their products.
- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete encourages manufacturers to continue to support research promoting helmet and face guard safety.
- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete recommends that manufacturers provide information to purchasers on the best methods for the emergency removal of the face guard.
- The Inter-Association Task Force for Appropriate Care of

the Spine-Injured Athlete recommends that NOCSAE develop equipment standards that would allow for the emergency removal of helmets and face guards.

- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete recommends that helmets and face guards that meet current NOCSAE standards be worn by all football, lacrosse, baseball, and softball players.
- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete recommends that football helmet face guards be attached by loop straps and not bolted on, in order to facilitate appropriate emergency management by medical personnel (from the May 1998 meeting in Indianapolis, Indiana).
- The Inter-Association Task Force for Appropriate Care of the Spine-Injured Athlete recommends that loop straps be made of material that is easily cut, and that the producers of loop straps provide appropriate tools to cut/remove the loop straps that they manufacture (from the May 1998 meeting in Indianapolis, Indiana).

These guidelines were developed as a consensus statement by the Inter-Association Task Force of Appropriate Care of the Spine-Injured Athlete:

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Table 3

NATIONAL FOOTBALL LEAGUE GUIDELINES⁴¹

The guides set forth by the NFL for game officials to use during serious on-field injuries include:

- Players and coaches must go to and remain in the bench area. Direct all players and coaches accordingly. Always ensure adequate lines of vision between the medical staff and all available emergency personnel.
- Attempt to keep players a significant distance away from the seriously injured player(s).
- Do not allow a player to roll an injured athlete over.
- Do not allow players to assist a teammate who is lying on the field; i.e. removing the helmet or chin strap or attempting to assist breathing by elevating the waist.

- Do not allow players to pull an injured teammate or opponent from a pile-up.
- Once the medical staff begins to work on an injured player, all members of the officiating crew should control the total playing field environment and team personnel and allow the medical staff to perform services without interruption or interference.
- Players and coaches should be appropriately controlled to avoid dictating medical services to the certified athletic trainers or team physicians or taking up their time to perform such service.

Note: Officials should have a reasonable knowledge of the location of emergency personnel and equipment at all stadiums.

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