Special Article

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Practice Parameter:

The management of concussion in sports (summary statement)

Report of the Quality Standards Subcommittee

Overview. The Quality Standards Subcommittee of the American Academy of Neurology is charged with developing guidelines for neurologists for diagnostic procedures, treatment modalities, and clinical disorders. The selection of topics for which practice parameters are developed is based on the prevalence, frequency of use, economic impact, membership need, controversy, urgency, external constraints, and resources required. Based upon the quality of the evidence, the Quality Standards Subcommittee determines whether the parameter is a standard, guideline, or option.

By training and knowledge, neurologists and neurosurgeons are qualified to develop and disseminate guidelines for managing the athlete who suffers a concussion in sports. Questions addressed during neurologic or neurosurgical consultation for sports-related concussion require advice to the patient that is guided by neuroscience and the consensus of experts, rather than local lore and individual opinion. Most importantly, consultation to prevent catastrophic outcome and cumulative neurobehavioral deficits from repeated concussions can best be provided by the well-informed physician. This practice parameter is based on a background paper[1] written by James P. Kelly, MD, and Jay H. Rosenberg, MD, and on sports concussion guidelines published by the Colorado Medical Society.[2] This practice parameter for the management of concussion in sports is not intended to justify boxing as a legitimate sport, nor should it be construed to conflict with the official stance of the American Academy of Neurology, which has called for a ban on boxing.

Justification. Concussion, a common consequence of trauma to the head in contact sports, can also occur from collisions or falls in all forms of athletic activity. Close observation and assessment of the injured athlete could be critical to the prevention of catastrophic brain injury[3–5] and cumulative neuropsychological deficits.[6–8] Repeated concussions can cause cumulative brain injury in an individual injured over months or years. The problem faced by the medical community has been developing a consensus on managing athletes with these injuries.

Any sport has an inherent risk of injury. A balance must be reached between maintaining a competitive edge in a sport and ensuring participant safety. Frequently, the loss of objectivity on the part of the athlete, coaches, sports media, and spectators is an unfortunate and potentially harmful bias. In that setting, the health professional's role is to provide an objective assessment of the injured athlete and guidance about the safety of an athlete's return to competition.

Process. A MEDLINE search for the years 1966–1996 was carried out with the following key terms: *brain concussion* and *athletic injuries*. This resulted in 10,980 articles cited on MEDLINE that were then narrowed to 71 articles through the intersection of *brain concussion* and *athletic injuries*. The articles that specifically dealt with concussion and sports were retrieved. The evidence was divided into Classes I, II, and III, using the definitions found at the end of this article.

Because of the nature of this topic, no Class I studies exist. Over several years, the available evidence was evaluated and consensus was reached among the Sports Medicine Committee from the Colorado Medical Society, sports-related concussion symposia faculty, and meetings with physicians and non-physician expert groups concerned with this problem. The task undertaken by these groups was to develop the best method to prevent catastrophic outcomes of acute structural brain injury, second im-

See Appendix on page 584 for panel and subcommittee members.

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Table 1 Features of concussion frequently observed

Vacant stare (befuddled facial expression)
Delayed verbal and motor responses (slow to answer questions or follow instructions)
Confusion and inability to focus attention (easily distracted and unable to follow through with normal activities)
Disorientation (walking in the wrong direction, unaware of time, date, and place)
Slurred or incoherent speech (making disjointed or incomprehensible statements)
Gross observable incoordination (stumbling, inability to walk tandem/straight line)
Emotions out of proportion to circumstances (distraught, crying for no apparent reason)
Memory deficits (exhibited by the athlete repeatedly asking the same question that has already been answered, or inability to memorize and recall 3 of 3 words or 3 of 3 objects in 5 minutes)
Any period of loss of consciousness (paralytic coma, unresponsiveness to arousal)

Table 2 Symptoms of concussion

Early (minutes and hours):
Headache
Dizziness or vertigo
Lack of awareness of surroundings
Nausea or vomiting
Late (days to weeks):
Persistent low grade headache
Light-headedness
Poor attention and concentration
Memory dysfunction
Easy fatiguability
Irritability and low frustration tolerance
Intolerance of bright lights or difficulty focusing vision
Intolerance of loud noises, sometimes ringing in the ears
Anxiety and/or depressed mood
Sleep disturbance

pact syndrome, and cumulative brain injury due to repetitive trauma. Neurologists, neurosurgeons, sports medicine physicians, physiatrists, neuropsychologists, athletic trainers, players, and others reached the consensus presented here. Drafts of this practice parameter were reviewed by the above-mentioned groups, and a grading scale was created based on the scientific evidence as well as consensus.

Definitions. Concussion is a trauma-induced alteration in mental status that may or may not involve loss of consciousness. Confusion and amnesia are the hallmarks of concussion. The confusional episode and amnesia may occur immediately after the blow to the head[9] or several minutes later.[10] Close observation and assessment of the athlete over some period of time is necessary to determine whether evolving neuropathologic change associated with concussion will lead to a confusional state or to the development of memory dysfunction. A history of recent head trauma outside the sports setting, such as a motor vehicle accident, should be considered in the evaluation of an athlete with concussion. Frequently observed features of concussion are listed in table 1. Symptoms that the athlete may experience can be divided into "early" and "late" categories, although times may vary case by case. Symptoms are listed in table 2.

The usefulness of a grading scale has been well established in sports medicine to determine the severity of a concussion.[11] This practice parameter presents the following grading scale arrived at by a consensus of experts who reviewed all existing scales, including the recommendations in the Colorado Medical Society Guidelines.[2]

Grade 1:

1. Transient confusion
2. No loss of consciousness
3. Concussion symptoms or mental status abnormalities on examination **resolve in *less* than 15 minutes**.

Grade 1 concussion is the most common yet the most difficult form to recognize. The athlete is *not* rendered unconscious and suffers only momentary confusion (e.g., inattention, poor concentration, inability to process information or sequence tasks) or mental status alterations. Players commonly refer to this state as having been "dinged" or having their "bell rung."

Grade 2:

1. Transient confusion
2. No loss of consciousness
3. Concussion symptoms or mental status abnormalities on examination **last *more* than 15 minutes**

With Grade 2 concussion, the athlete is not rendered unconscious but experiences symptoms or exhibits signs of concussion or mental status abnormalities on examination that last longer than 15 minutes (e.g., poor concentration or post-traumatic amnesia). Any persistent Grade 2 symptoms (greater than 1 hour) warrant medical observation.

Grade 3:

1. Any loss of consciousness, either brief (seconds) or prolonged (minutes).

Grade 3 concussion is usually easy to recognize—the athlete is unconscious for any period of time.

Refer to table 1 for details about behavioral features of concussion. A sideline evaluation to assess the status of the athlete suspected of having a concussion appears in table 3. This evaluation should be performed by individuals properly

Table 3 Sideline evaluation

Mental status testing	
Orientation	Time, place, person, and situation (circumstances of injury)
Concentration	Digits backward (e.g., 3-1-7, 4-6-8-2, 5-3-0-7-4); Months of the year in reverse order
Memory	Names of teams in prior contest; Recall of 3 words and 3 objects at 0 and 5 minutes; Recent newsworthy events; Details of the contest (plays, moves, strategies, etc.)
External provocative tests	40-yard sprint; 5 push ups; 5 sit ups; 5 knee bends; (any appearance of associated symptoms is abnormal, e.g., headaches, dizziness, nausea, unsteadiness, photophobia, blurred or double vision, emotional lability, or mental status changes)
Neurologic tests	
Pupils	Symmetry and reaction
Coordination	Finger-nose-finger, tandem gait
Sensation	Finger-nose (eyes closed) and Romberg

trained in the administration of the examination. Timing of initial management and return to play are outlined in tables 4 and 5.

Recommendations. Based on the literature review and expert consensus, the following recommendations for return to competition after concussion should be considered practice **options**.

Grade 1. If the injured athlete's condition fits the description of a Grade 1 injury as described previously:

1. Remove from contest.
2. Examine immediately and at 5 minute intervals for the development of mental status abnormalities or post-concussive symptoms at rest and with exertion.
3. May return to contest if mental status abnormalities or post-concussive symptoms clear within 15 minutes.
4. A second Grade 1 concussion in the same contest eliminates the player from competition that day, with the player returning only if asymptomatic for one week at rest and with exercise.

Grade 2. If the injured athlete's condition fits the description of a Grade 2 injury as described previously:

1. Remove from contest and disallow return that day.
2. Examine on-site frequently for signs of evolving intracranial pathology.
3. A trained person should reexamine the athlete the following day.
4. A physician should perform a neurologic examination to clear the athlete for return to play after 1 full asymptomatic week at rest and with exertion.
5. CT or MRI scanning is recommended in all instances where headache or other associated symptoms worsen or persist longer than one week.
6. Following a second Grade 2 concussion, return to play should be deferred until the athlete has had at least two weeks symptom-free at rest and with exertion.
7. Terminating the season for that player is mandated by any abnormality on CT or MRI scan consistent with brain swelling, contusion, or other intracranial pathology.

Grade 3. If the injured athlete's condition fits the description of a Grade 3 injury as described previously:

1. Transport the athlete from the field to the nearest emergency department by ambulance if still unconscious or if worrisome signs are detected (with cervical spine immobilization, if indicated).
2. A thorough neurologic evaluation should be performed emergently, including appropriate neuroimaging procedures when indicated.
3. Hospital admission is indicated if any signs of pathology are detected, or if the mental status of the athlete remains abnormal.
4. If findings are normal at the time of the initial medical evaluation, the athlete may be sent home. Explicit written instructions will help the family or responsible party observe the athlete over a period of time.
5. Neurologic status should be assessed daily thereafter until all symptoms have stabilized or resolved.
6. Prolonged unconsciousness, persistent mental status alterations, worsening post-concussion symptoms, or abnormalities on neurologic examination require urgent neurosurgical evaluation or transfer to a trauma center.
7. After a brief (seconds) Grade 3 concussion, the athlete should be withheld from play until asymptomatic for 1 week at rest and with exertion.
8. After a prolonged (minutes) Grade 3 concussion, the athlete should be withheld from play for 2 weeks at rest and with exertion.
9. Following a second Grade 3 concussion, the athlete should be withheld from play for a minimum of 1 asymptomatic month.

The evaluating physician may elect to extend that period beyond 1 month, depending on clinical evaluation and other circumstances.

10. CT or MRI scanning is recommended for athletes whose headache or other associated symptoms worsen or persist longer than 1 week.
11. Any abnormality on CT or MRI consistent with brain swelling, contusion, or other intracranial pathology should result in termination of the season for that athlete and return to play in the future should be seriously discouraged in discussions with the athlete.

Recommendations for future research:

1. Development of a valid, standardized, systematic sideline evaluation designed for the immediate assessment of concussion in athletes.
2. Development of a standardized, neuropsychological test battery designed to detect impairment associated with concussion.
3. Multicenter prospective studies documenting baseline physical, neurologic, and neuropsychological data in athletes and changes in these measurements following concussion.
4. Multicenter prospective studies to determine the physical, neurologic, and neuropsychological outcomes of multiple concussions.

Table 4 *Initial management following first event*

Grade	On-site evaluation	Neurologic evaluation	Same day return to play
Grade 1	Yes	Not required, but may be pursued depending on clinical evaluation	Yes, if normal sideline assessment while at rest and with exertion, including detailed mental status examination
Grade 2	Yes	Yes	No
Grade 3	Yes	Yes	No

Table 5 *When to return to play after removal from contest*

Grade of concussion	Time until return to play*
Multiple Grade 1 concussion	1 week
Grade 2 concussion	1 week
Multiple Grade 2 concussions	2 weeks
Grade 3—brief loss of consciousness (seconds)	1 week
Grade 3—prolonged loss of consciousness (minutes)	2 weeks
Multiple Grade 3 concussions	1 month or longer, based on clinical decision of evaluating physician

* Only after being asymptomatic with normal neurologic assessment at rest and with exercise.

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Reviewers of this practice parameter:
American Association of Neurological Surgeons; American College of Emergency Physicians; American Academy of Pediatrics; American Academy of Family Physicians; National Athletic Trainers Association; and American Academy of Neurology Member Reviewer Network.

Definitions for classification of evidence:

Class I:
Evidence provided by one or more well-designed randomized controlled clinical trials.

Class II:
Evidence provided by one or more well-designed clinical studies.

Class III:
Evidence provided by expert opinion, nonrandomized historical controls, or case reports.

Definitions for strength of recommendations:

Standards:
Generally accepted principles for patient management that reflect a high degree of certainty based on Class I evidence; or, when circumstances preclude randomized clinical trials, overwhelming evidence of Class II studies that directly address the question.

Guidelines:

Recommendations for patient management that identify a particular strategy or strategies that reflect moderate clinical certainty based on Class II evidence or consensus of Class III evidence.

Options:

Other strategies for patient management for which there is unclear clinical certainty based on inconclusive or conflicting evidence or opinion.

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