

# Current Issues in Managing Sports-Related Concussion

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**T**HE ISSUE OF DETERMINING THE readiness of athletes to return to action following a head injury has received recognition as a major public health issue.<sup>1</sup> Concern over the health of the athlete with a concussion has prompted the development of parameters to guide management and return-to-play issues. These guidelines, however, have been controversial within the sports medicine community.<sup>2</sup> The controversy appears to result from a lack of scientific foundation, and thus an arbitrary delineation of concussion grades and return-to-play criteria. This article critically examines concussion management guidelines and makes recommendations for the development of practical strategies. Two actual concussion cases illustrate these issues.

## Definition and Identification

There is no universally accepted definition of concussion. One of the most popular working definitions is "a trauma-induced alteration in mental status that may or may not be accompanied by a loss of consciousness."<sup>3</sup> Signs and symptoms of concussion are presented in TABLE 1. While there is wide variability in the expression of these signs and symptoms following concussion, virtually any change in the athlete's behavior may signal a disruption in neurological functioning and should be taken seriously. Computed tomography and magnetic resonance imaging can reveal more severe brain injury, but they typically do not detect subtle pathology that occurs following concussion.

## Better Strategies Are Needed

As outlined by the American Academy of Neurology,<sup>3</sup> there are 3 important

considerations in management of the athlete with a concussion. First, immediate neurologic emergencies must be identified. Second, prevention of catastrophic outcome from second impact syndrome (which results from a second concussive insult closely following the first) should be prevented. At least 17 deaths possibly related to second impact syndrome have been reported.<sup>4</sup> All victims returned to play before symptoms related to an initial concussion had resolved. Finally, cumulative and chronic brain injury from repeated concussions should be avoided. The cumulative effects of repeated concussions have been implicated recently in cognitive impairments among college football players,<sup>5</sup> as well as poorer neuropsychological functioning in amateur soccer players.<sup>6</sup>

## Return-to-Play Guidelines

At least 14 return-to-play scales have been published since 1973. TABLE 2 and TABLE 3 depict 3 of the most widely used. The Cantu guidelines<sup>7</sup> evolved to provide basic guidance for the on-field management of concussion. Cantu based his criteria on his clinical experience as a neurosurgeon, as well as on a review of existing literature on mild head injury. Cantu was clear in emphasizing that the final decision regarding return to play should be a clinical judgment, and that deviation from these recommendations may be entirely appropriate depending on the individual case.

The Colorado Guidelines<sup>8</sup> were published by members of the Colorado Medical Society following the death of a Colorado football player from an on-field injury. These more rigorous criteria mandate emergency transport and close follow-up for athletes who are unconscious for any length of time (grade 3 concussion). Athletes sustaining a

grade 1 concussion are allowed to return to competition if their symptoms clear within 20 minutes of injury.

The Colorado Guidelines were amended<sup>9</sup> by a panel of experts assembled by the American Academy of Neurology. These criteria allow return to play following a grade 1 concussion if the athlete is asymptomatic after 15 minutes of careful sideline observation. Transport to a hospital for observation is recommended if there is a prolonged period of unconsciousness.

These grading systems have promoted the use of uniform terminology and increased awareness of concussion signs and symptoms. There have been ongoing concerns, however, regarding the lack of scientific method in constructing the management guidelines (eg, there are no data to support the 15-minute distinction for return to play following a grade 1 concussion). Further, they assume a standard use for all groups and playing levels, and do not account for individual variability in symptom presentation, or for differing vulnerabilities to neurological injury at different ages. Current grading systems also weigh loss of consciousness much more than other markers of concussion. The following cases illustrate the inherent limitations of these guidelines.

## Case 1

A 19-year-old running back makes helmet-to-helmet contact with a linebacker. After an approximately 5-second loss of consciousness, he walks off the field under his own power. He reports no related symptoms and passes

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a cursory mental status examination immediately following the injury and at 5-, 10-, and 15-minute intervals. The Colorado guidelines would recommend that this individual, who suffered a grade 3 concussion, be transported to a hospital and prohibited from practicing or playing until he has been asymptomatic for 2 weeks. The American Academy of Neurology guidelines would disallow return to play for 1 week and recommend careful observation. The Cantu guidelines would classify this incident as a grade 2 concussion and the athlete would return to participation 2

weeks later, if he remained asymptomatic at rest and exertion for 1 week.

**Case 2**

A 25-year-old hockey player receives an elbow to the face. Initially, he experiences a 1- to 2-minute period of confusion without loss of consciousness. He denies headache, nausea, and dizziness, and passes a brief mental status evaluation. After 30 minutes the athlete reports nausea, dizziness, and “not feeling right.” He also performs poorly on the memory component of a mental status evaluation. By the Colorado and American Academy of Neurology guidelines, this athlete experienced a grade 1 concussion and return to play would have been allowed after 20 and 15 minutes, respectively. Under the Cantu

guidelines, a grade 1 concussion would probably be diagnosed and immediate return to play is likely. Clearly, however, his later developing signs and symptoms suggest a more severe injury.

**Clinical Management of Concussion: Current Status and the Need for Further Research**

These 2 cases represent relatively common scenarios that face the sports medicine physician. In both cases, the application of current concussion guidelines would lead to less than optimum management of the injured athlete. In case 1, the benching of the player for 1 to 2 weeks is probably too conservative, while the hasty return of

**Table 1.** Frequently Observed Signs of Concussion

Signs observed by medical staff	
	Player appears dazed
	Player has vacant facial expression
	Confusion about assignment
	Athlete forgets plays
	Disorientation to game, score, opposing team
	Inappropriate emotional reaction (laughing, crying)
	Player displays incoordination or clumsiness
	Player is slow to answer questions
	Loss of consciousness (even for seconds)
	Any change in typical behavior or personality
Symptoms reported by athlete	
	Headache
	Nausea
	Balance problems or dizziness
	Double or fuzzy vision
	Sensitivity to light or noise
	Feeling slowed down
	Feeling “foggy” or “not sharp”
	Change in sleep pattern
	Concentration or memory problems
	Irritability
	Sadness
	Feeling more emotional

**Table 2.** Diagnostic Grading Scales for Sports-Related Concussion

Guideline	Severity of Grade		
	1	2	3
Cantu <sup>7</sup>	(1) No loss of consciousness (2) Posttraumatic amnesia lasts less than 30 min	(1) Loss of consciousness lasts less than 5 min OR (2) Posttraumatic amnesia lasts longer than 30 min	(1) Loss of consciousness lasts longer than 5 min OR (2) Posttraumatic amnesia lasts longer than 24 h
Colorado <sup>8</sup>	(1) Confusion without amnesia (2) No loss of consciousness	(1) Confusion with amnesia (2) No loss of consciousness	(1) Loss of consciousness (of any duration)
Practice Parameter American Academy of Neurology <sup>9</sup>	(1) Transient confusion (2) No loss of consciousness (3) Concussion symptom or mental status change resolves in less than 15 min	(1) Transient confusion (2) No loss of consciousness (3) Concussion symptoms or mental status change lasts longer than 15 min	(1) Loss of consciousness (brief or prolonged)

**Table 3.** Clinical/Management Recommendations for Grading Scales

Guideline	Severity of Grade		
	1	2	3
Cantu <sup>7</sup>	Athlete may return to play that day in select situations if normal clinical examination at rest and exertion. If symptomatic, athlete may return to play in 7d.	Athlete may return to play in 2 wk if asymptomatic at rest and exertion for 7 d.	Athlete may return to play in 1 mo if asymptomatic at rest and exertion for 7 d.
Colorado <sup>8</sup>	Remove athlete from contest and evaluate immediately and every 5 min. Permit athlete to return if amnesia or symptoms do not appear for 20 min.	Remove athlete from contest and disallow athlete to return. Examine athlete the next day. Permit athlete to return to practice after 1 wk if asymptomatic.	Transport athlete to hospital. Perform neurological examination and observe overnight. Permit athlete to return to play after 2 wk if asymptomatic.
Practice Parameter American Academy of Neurology <sup>9</sup>	Examine athlete immediately for mental status changes. Return to contest if no symptoms or mental status changes at 15 min.	Remove athlete from game and disallow to return. Examine athlete on site for symptoms/mental status changes. Athlete can return in 1 wk if asymptomatic.	Remove athlete from game and transport to hospital. Perform neurological examination and observe overnight. Permit athlete to return to play if asymptomatic after 1 wk (if loss of consciousness was brief) or 2 wk (if loss of consciousness was prolonged).

**Table 4.** Return-to-Play Options: Clinical Areas of Agreement and Disagreement\*

Status of Signs and Symptoms	Loss of Consciousness Status		
	Absent	Brief	Prolonged
Absent	Return to play that day and observe for evolving signs/symptoms	Further research is necessary	Do not return to play that day; hospital evaluation may be necessary
Brief	Further research is necessary	Further research is necessary	Do not return to play that day; hospital evaluation may be necessary
Prolonged	Further research is necessary	Do not return to play that day; hospital evaluation may be necessary	Do not return to play that day; hospital evaluation may be necessary

\*Not to be construed as clinical guidelines.

the athlete in case 2 may place him at increased neurologic risk.

It is our opinion that concussion management guidelines have not yet evolved to the extent that they can be used to make reliable return-to-play decisions. Because current guidelines are not evidenced-based, concussion is difficult to categorize. Further, response to injury is highly individualized. The best that can be said at present is that general agreement for acute management of injury appears to have been attained for several categories of concussion as shown in TABLE 4. This table should not be construed as another set of guidelines and is presented only to summarize the current status of the field and highlight the need for further research. The definition of brief and prolonged loss of consciousness and signs and symptoms of concussion will also require continued study. Nevertheless, it seems reasonable to define brief loss of consciousness in terms of seconds and prolonged loss of consciousness in terms of minutes. Brief signs and symptoms may be defined as lasting minutes and prolonged as lasting hours.

Research designed to address these issues has been initiated with animal models,<sup>10</sup> as well as descriptive studies with athletes.<sup>11</sup> Further, current large-scale neuropsychological studies at the high school,<sup>12</sup> college,<sup>5</sup> and professional level<sup>13</sup> may help establish management directives that are anchored to empirical markers of recovery from concussion. These studies aim to delineate the acute recovery curves associated with specific signs and symptoms of concussion. Scientific data are needed to in-

vestigate the relative importance of variables such as duration of confusion, amnesia, loss of consciousness, or symptoms such as headache, dizziness, or postural instability. Loss of consciousness has historically been the primary indicator of concussion severity but recent research has questioned the validity of this assumption.<sup>14</sup> Future research may hinge on the relative importance of these variables or their combinations. Until these evidenced-based directives are attained, management of the athlete following concussive injury should be individualized and based on clinical judgment and experience.

A recent roundtable of experts<sup>15</sup> has emphasized the following: (1) physicians should carefully assess every athlete with a concussion; (2) no athlete should be allowed to return to play while still exhibiting either signs or symptoms of concussion; and (3) regular ongoing and repeated examination of the athlete should be conducted following injury. This ongoing evaluation should involve a thorough assessment of the athlete's symptoms and a sideline mental status examination to measure basic cognitive processes. It should be emphasized, however, that brief sideline assessment of the athlete provides only a gross characterization of his/her level of cognitive function, and that return to play should not be based solely on these results.

More formal neuropsychological evaluation can delineate the subtle cognitive changes associated with concussion,<sup>5,6,13</sup> and is most effective if completed within 24 hours of injury. This should involve the careful assessment of specific cognitive functions such as

attention, memory, and information processing speed, instead of just administering sideline mental status tests, which do not adequately assess these domains. Follow-up evaluations are routinely completed to document the recovery process. The most effective use of the neuropsychological evaluation includes a baseline assessment of the athlete's preinjury level of cognitive functioning. This allows for direct comparison to postconcussion test results and takes into account the variability in test performance that exists across athletes.

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