

## The eighth wonder of the world: the mythology of concussion management

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In sports medicine, doctors and others providing athletic care recognise and manage a spectrum of brain injury. Unlike severe brain injury, however, the management of concussion is mostly derived from anecdotal experience. In many cases current management practices have more in common with mythology than science.

### The myth of concussion definition

There is no universal agreement on the standard definition of concussion. The most widely accepted definition in sports medicine is that originally proposed by the Congress of Neurological Surgeons. It states that "concussion is a clinical syndrome characterised by the immediate and transient post-traumatic impairment of neural function...".<sup>1</sup>

The key elements of this definition state that concussion is both immediate in onset and transient. Thus a diagnosis of "delayed concussion" or "permanent concussive symptoms" has no meaning in this sense. Difficulty usually arises when a patient with continuing symptoms has been misdiagnosed as concussion, when in fact there is an unrecognised structural injury.

### The myth of loss of consciousness

Loss of consciousness is seen by some clinicians as an indispensable condition of concussion, yet the formal definition does not necessitate this particular symptom. There is neuropsychological evidence that cognitive impairment in concussion is the same whether the individual has lost consciousness or not.<sup>2</sup> Therefore the strategy of basing management decisions on the presence of loss of consciousness is not scientifically sound.

### The myth of concussion symptoms

The common symptoms of concussion have been examined in prospective studies and include headache, dizziness, blurred vision, and nausea.<sup>3,4</sup> It is worth noting that the presence of headache is not confined to concussion, with up to 20% of sporting athletes reporting exercise related headache unrelated to concussive injury. The only pathognomonic symptom in concussion is the presence of post-traumatic memory disturbance, which may be used as the basis of further clinical and neuropsychological assessment.

Table 1 Post-concussion memory assessment (adapted from ref 3)

Which ground are we at?
Which team are we playing today?
Who is your opponent at present?
Which quarter is it?
How far into the quarter is it?
Which side scored the last goal?
Which team did we play last week?
Did we win last week?

### The myth of memory assessment

After a concussive injury the athlete will typically have a variable period of post-traumatic amnesia. Many of the published concussion severity scales incorporate measures of post-traumatic or retrograde amnesia as cardinal features of injury severity, though the validity of this approach has never been tested.

The standard medical approach of assessing mental status by asking orientation items (for example, day, date, year, time, date of birth, etc) has been shown to be unreliable after concussive injury. More useful, as shown in prospective studies, are questions about recently acquired information.<sup>3,5</sup> Table 1 lists a typical question battery.

### The myth of concussion grading scales

The classification of concussion severity in sport is a contentious area. At the present time there are at least 25 different published injury grading systems, none of which has been prospectively validated.<sup>6</sup> Doctors, coaches, and athletes can easily "shop around" for an injury scale and advice about returning to play that suits their sporting needs but which may not be the best medical management for their injury.

### The myth of post-traumatic epilepsy

Concussive convulsions are an uncommon but dramatic association of minor head injury. Although often assumed to be epileptic in origin, a recent study has delineated their benign nature.<sup>7</sup> From a clinical standpoint, late seizures do not occur, anti-epileptic treatment is not indicated, and prohibition from collision sport is unwarranted.

### The myth of second impact syndrome

Diffuse cerebral oedema is a rare but recognised complication of mild brain injury in sport, which occurs in children. It has been postulated that a form of diffuse brain swelling

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may be the consequence of a repeated minor head injury, the so-called second impact syndrome.<sup>5</sup> Belief in this concept rests on the interpretation of anecdotal reports. In such cases the evidence that repeated concussion is a risk factor for this entity is not compelling.<sup>9</sup>

#### The myth of repeat concussion risk

It has become a widely held belief that having had a concussive injury, one is more prone to future concussive injury. Although suggested by retrospective studies,<sup>10</sup> recent prospective studies have not supported this concept but show that the subsequent injury rate reflects the amount of time playing the sport rather than any inherent risk.<sup>4 11</sup>

#### The myth of cumulative damage

Most of the widely cited studies of the cumulative effects of concussion have retrospectively studied motor vehicle accidents.<sup>12</sup> In former soccer players persistent cognitive deficits were noted in retrospective analysis, but significant methodological problems flaw these studies.<sup>13</sup> To date, there has been no replication of these findings by independent groups.

There have been surprisingly few prospective studies of sport related concussion. In studies of American and Australian football, neuropsychological function returned to normal within three to 10 days after injury.<sup>11 14</sup>

#### The myth of return to sport guidelines

Criteria for return to sport after a concussion remain the most controversial aspect of debate. Numerous anecdotal guidelines have been published which recommend an arbitrary period of exclusion from sport. These should be seen as loose guidelines rather than scientific fact.<sup>14 15</sup> Recent studies in sport related concussion have led to the development of simple valid neuropsychological tests to determine whether a player has returned to normal after a concussive injury.<sup>3 4 16 17</sup> Although these tests are not yet in widespread use, they may provide a simple aid for medical practitioners to measure recovery from concussion objectively.

Although mandatory exclusion after concussion is used by some sports, there are a number of inherent dangers. This idea may tempt players, trainers, and coaches to believe that medical assessment is not required after a head injury and lead to the assumption that a concussed player is medically safe to return to play as soon as an arbitrary period has passed. The guiding policy should be that until completely symptom free, concussed athletes should not resume any training or competition.

#### The myth of concussion prevention

There are a relatively few methods by which the rate of concussive brain injury may be minimised in sport. Rule changes to reduce head

injury may be appropriate where a clear cut mechanism is implicated in a particular sport. In sports where there is the potential for missile injuries (for example, baseball) or where there may be falls onto hard surfaces (for example, cycling and ice hockey) there is evidence that helmets specific for the sport are of benefit in reducing head injuries. Such benefit has not been shown for sports such as soccer, rugby, and Australian football. Other protective equipment, such as mouthguards, will reduce the rate of dental injuries, but the evidence that they reduce cerebral injuries is largely anecdotal.<sup>18</sup>

#### Conclusion

In this era of evidence based medicine the challenge for sports medicine is to develop a scientific approach to this common clinical problem. It has been 1000 years since the first clinical description of concussion by the Arabic physicians and the time has come to replace management myths and clinical anecdotes with medical science.

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