



## Return to play after sports concussion in elite and non-elite athletes?

M Putukian, M Aubry and P McCrory

*Br. J. Sports Med.* 2009;43;i28-i31  
doi:10.1136/bjsem.2009.058230

---

Updated information and services can be found at:  
[http://bjsm.bmj.com/cgi/content/full/43/Suppl\\_1/i28](http://bjsm.bmj.com/cgi/content/full/43/Suppl_1/i28)

---

*These include:*

### References

This article cites 29 articles, 12 of which can be accessed free at:  
[http://bjsm.bmj.com/cgi/content/full/43/Suppl\\_1/i28#BIBL](http://bjsm.bmj.com/cgi/content/full/43/Suppl_1/i28#BIBL)

### Rapid responses

You can respond to this article at:  
[http://bjsm.bmj.com/cgi/eletter-submit/43/Suppl\\_1/i28](http://bjsm.bmj.com/cgi/eletter-submit/43/Suppl_1/i28)

### Email alerting service

Receive free email alerts when new articles cite this article - sign up in the box at the top right corner of the article

---

### Notes

---

To order reprints of this article go to:  
<http://journals.bmj.com/cgi/reprintform>

To subscribe to *British Journal of Sports Medicine* go to:  
<http://journals.bmj.com/subscriptions/>

# Return to play after sports concussion in elite and non-elite athletes?

M Putukian,<sup>1</sup> M Aubry,<sup>2</sup> P McCrory<sup>3</sup>

<sup>1</sup> Princeton University and Robert Wood Johnson University of Medicine & Dentistry, New Jersey, USA; <sup>2</sup> International Ice Hockey Federation and Hockey Canada; <sup>3</sup> Centre for Health, Exercise & Sports Medicine, University of Melbourne, Parkville, Australia

Correspondence to:  
Dr M Putukian, Princeton University, University Health Services, Washington Road, Princeton, NJ 08540, USA; [putukian@princeton.edu](mailto:putukian@princeton.edu)

Accepted 2 February 2009

## ABSTRACT

**Objective:** To examine the published literature relating to the difference in concussion management strategies between elite and non-elite athletes.

**Design:** Systematic literature review of concussion management.

**Intervention:** Pubmed, Medline, Psych Info, Cochrane Library and Sport Discus databases were reviewed using the MeSH keywords brain concussion and mild traumatic brain injury, combined with athletic injuries. Each were then refined by adding the keyword "return to play" (RTP). English language and human studies only were assessed.

**Results:** For the Medline search, using "brain concussion" as a keyword, 4319 articles were found; this was decreased to 111 when RTP was used to refine the search. When "mild traumatic brain injury" was used, 2509 articles were found; this decreased to 39 when RTP was used to refine the search. Following initial review, these articles form the basis of the discussion below.

**Conclusions:** The non-elite athlete may not have the same resources available as the elite athlete (such as the presence of trained medical staff during practice and competition, a concussion programme as part of sideline preparedness, the benefit of neuropsychological or postural testing, as well as consultants with expertise in concussion readily available) and as a result will generally be managed more conservatively. Younger athletes often have a greater incidence of concussion with longer recovery time frames; however, they are often managed with less expertise and with limited resources.

The return to play (RTP) decision after a concussion is one of the most difficult challenges facing the team physician. In part, this relates to the lack of evidence-based management guidelines to assist the decision process. In addition, there is a wide range of clinical situations with variable management resources that also influence management, ranging from a sole athletic trainer looking after a community high school through to professional sport with immediate specialist advice and investigational tools available to the team physician.

The recommendation that neuropsychological testing be the cornerstone of concussion management<sup>1</sup> and the advent of reliable and low cost web-based neuropsychological test platforms has brought objective testing within reach of most athletes, regardless of level of competition.<sup>2-5</sup> This in turn has brought pressure on all team physicians and those involved in athletic care of athletes to provide "best practice" management of their concussive injury, which includes access to such tools. The knowledge of how, and more importantly, when to use such tools, requires a thorough

clinical understanding of the condition and its potential complications.<sup>4</sup>

The non-elite athlete may not have the same resources available as the elite athlete, such as the presence of trained medical staff during practice and competition, a concussion programme as part of sideline preparedness, and the benefit of neuropsychological or postural testing, as well as consultants with expertise in concussion readily available. This in turn impacts on the completeness of their management and their ability to return to play in a timely manner. This paper will review the areas of controversy regarding RTP after a concussion in the elite versus non-elite athlete.

## METHODS

A search of the PubMed, Medline, Psych Info, the Cochrane Library and Sport Discus databases was performed using the MeSH keywords brain concussion and mild traumatic brain injury, combined with the term athletic injuries. The search was limited to English language publications and human studies. Each was then refined by adding the keyword "return to play". The main sports medicine journals were also searched for additional papers regarding RTP after concussion in the athlete. The references of these papers were also examined; all papers related to the RTP question were reviewed.

## RESULTS

For the search, using "concussion" as a keyword, 4319 articles were found; this was decreased to 111 when RTP was used to refine the search. When "mild traumatic brain injury" was used, 2509 articles were found; this decreased to 39 when RTP was used to refine the search. Many of these articles were common to both searches. The title and abstract of the articles were then reviewed by one author (MP), and were discarded if they were not applicable to the question. These articles form the basis of the discussion below.

## DISCUSSION

### What is the difference between the elite and non-elite athlete?

There has been some controversy about the need to differentiate RTP in the elite versus non-elite athlete setting, with a more rapid RTP considered reasonable in this "elite" setting. Although it may seem easy to define elite as the professional, Olympic or national team level athlete—the athletes at the highest level of competition for their sport—one might argue that a university/college athlete who has been granted a scholarship to play their sport is also an "elite" athlete.

The expectation for the elite level athlete is that they are being allowed to participate as soon as possible, unless their timeline does not demand it (end of season, concomitant injury, etc). In addition, the elite athlete may have resources available to them, such as an emergency action plan, sideline preparedness that includes a concussion protocol, trained medical providers (eg, certified athletic trainers, physiotherapists team physicians), and the availability of neuropsychological (NP) testing and postural stability testing, that allow for a more sophisticated approach to the athlete with concussion.

Sports medicine professionals that take care of athletes have as their ultimate goal to return athletes to play as soon as possible, without putting them at undue risk for further or re-injury. However with such resources and investigative tools, it is possible that the "elite" athlete can RTP more quickly, whereas without these resources, the RTP decision will likely be more conservative and cautious.

An additional concern is that non-elite, particularly junior, competitions may have higher rates of concussion than that reported at the professional level, which makes the need for expert care more relevant in non-elite sport than in professional sport.<sup>5-8</sup>

In distinguishing elite versus non-elite athlete management, it is more important to consider the level of medical care provided to that athlete. Do they have a certified athletic trainer/physiotherapist available to them or is there a physician either on the sideline or immediately available? Is a specialist consultation available urgently? What kind of training do these health care providers have? Is additional testing readily available to athletes?

#### **What is the minimum standard of care for concussed athletes?**

The Vienna<sup>1</sup> and Prague<sup>9</sup> concussion agreement statements, as well as the US Team Physician Consensus Statement<sup>10</sup> and US National Athletic Trainers Association Position Statement,<sup>11 12</sup> have been reviewed in detail elsewhere<sup>13</sup> and form the basis for conceptually understanding the skill set and knowledge base for team physicians managing concussed athletes.

One of the concepts endorsed by the new Zurich Concussion Consensus document<sup>14</sup> is that all athletes, regardless of level of participation, should be managed using the same treatment and return to play paradigm. It was felt to be a more useful construct whereby the available resources and expertise in concussion evaluation were of critical importance in determining management, than a simple separation between elite and non-elite athlete care.

The critical elements of concussion management are physical and cognitive rest until symptoms resolve and then a graded programme of exertion prior to medical clearance and return to play. The majority of injuries will recover spontaneously over several days. In these situations, it is expected that an athlete will proceed rapidly through a stepwise return to play strategy.<sup>9</sup> In such cases, apart from limiting playing or training while symptomatic, no further intervention is required during the period of recovery and the athlete typically resumes sport without further problem.

Common to all management, regardless of level of performance, is a basic understanding of the injury and the supervision of a graded RTP rehabilitation programme that allows the athlete to safely resume their sport. The minimum elements of management that a team physician must possess include:

- ▶ The ability to recognise (or suspect the diagnosis where non-medical staff are present) concussion and institute appropriate first aid and triage of the patient.
- ▶ The ability to medically assess a concussion injury urgently (or triage a patient to an appropriate facility where urgent medical assessment can occur).
- ▶ The development (and practise) of a game-day medical plan specific to concussion injuries and have medical supplies on-site for rescue, immobilisation and transportation. Depending on the situation, it may also be appropriate to have emergency medical personnel either on-site or accessible.
- ▶ The team physician should have a thorough knowledge of concussion, the role and use of additional investigations, understand the potential sequelae of concussive injuries and be competent to perform a more detailed assessment of neurological function, including cognitive assessment. In addition, the team physician should coordinate the care and follow-up of the athlete.
- ▶ The team physician should be responsible for overseeing the return to play stepwise rehabilitation once the patient is asymptomatic at rest and with exertion, and be responsible for the medical clearance prior to return to play.

At the professional (or elite) level of sport, what differs is not necessarily the core medical knowledge but rather the immediate access to additional multidisciplinary resources such as specialists (eg, neurologist, neurosurgeon, neuropsychologist, etc) expertise, and the availability of additional investigations (eg, baseline and post-injury NP testing) that can be performed at short notice. While the basic principles of management may remain unchanged, the additional resources make a more rapid assessment of recovery possible, which in turn may appear to accelerate RTP strategies as athletes can be moved through the RTP stepwise strategy without undue delay.

#### **How does evaluation of the concussed elite athlete differ from that of the non-elite athlete?**

For the elite athlete, trained healthcare providers with expertise in evaluating and managing head injuries are often on-site for both practice and competition. For the non-elite athlete, there may not be a healthcare professional trained in evaluating and managing concussion available. In this latter situation, the athlete, coach, teammates, and/or parent need to be educated regarding the importance of head injury, and particularly in removing an athlete with a possible concussion as soon as it is considered, with referral to a healthcare provider for evaluation and assessment before RTP is considered.

For many of these athletes, their initial concussion evaluation occurs either in a hospital emergency room or in their family physician's office. In such situations, the history of what occurred is often vague and difficult to delineate, especially if the athlete had a significant injury with memory dysfunction. In addition, the availability of physicians with expertise regarding concussion may be limited.

In the elite situation, because of the additional resources, an early assessment potentially allows determination of the prognosis and severity of injury, which then allows for rehabilitation planning commencing from the game day itself. In addition, in the elite setting, the providers often know the athlete well, and thus are in a better situation to determine whether the athlete is behaving normally or not, being alert to subtle changes.

## What is already known on this topic

- ▶ There is a stepwise process or protocol in return to play guidelines for all athletes; treatment should not differ for the elite and non-elite athlete.
- ▶ All athletes should have no symptoms (with exercise), have a normal neurological examination including a normal balance examination, and a normal cognitive examination before a return to play.

## What this study adds

The stepwise process or protocol for return to play guidelines can be accelerated in elite athletes because of the access to specialised medical care, neuropsychological assessment and other tools which may not be at the disposal of the non-elite athlete.

## Does the return to play progression differ for elite versus non-elite athletes?

The Vienna Statement suggested that the RTP progression should follow a series of steps, each of which takes a minimum of 24 hours to complete.<sup>1</sup> These steps include a period of rest, aerobic exercise, sport specific drills, practice, contact practice and full play. In the Prague Statement, consideration was made for the professional athlete where progression could occur more quickly if specialised physicians were available, providing that clinical recovery had occurred and that other testing supported normalisation of cognitive function.<sup>9</sup>

Many collegiate and professional team physicians, however, do not follow these recommendations, and instead base their RTP on a symptom-free interval, followed by a rapid RTP.<sup>15–16</sup> A rapid RTP might be considered in an athlete with a brief duration of symptoms, complete resolution of symptoms, normal cognitive function, no recent injury, and no recurrence of symptoms with exertion. This management approach is supported by published guidelines, such as by the American Academy of Neurology,<sup>17</sup> as well as the US Team Physician Consensus Statement<sup>10</sup> and the US National Athletic Trainers Association Position Statement.<sup>11–12</sup> Whether this is appropriate or safe is a contentious question that has not been fully answered in the published literature.

There is evidence that some professional American football players are able to RTP more quickly, with even same day RTP supported by National Football League studies without a risk of recurrence or sequelae.<sup>16</sup> However, it has been shown that at the collegiate level, athletes allowed to RTP on the same day show NP deficits post-injury that may not be evident on the sidelines and are more likely to have delayed onset of symptoms.<sup>18–19</sup>

What appears significant is the disparity in normalisation of cognitive function between high school athletes and their older counterparts. Where high schoolers can often take on average 30 days to return to their baseline level of cognitive function,<sup>20–22</sup> college athletes take 7–10 days<sup>18–23–27</sup> and professional athletes take 3–5 days.<sup>28–29</sup> These studies show that age is an important determinant for the RTP decision and hence RTP paradigms need to be more conservative in younger athletes. Athletes younger than 18 should be treated in the paediatric category and hence a longer period of recovery should be prescribed. In general terms, the young elite athlete should be treated more

conservatively, even though the resources may be the same as for an older professional athlete

## Conclusion

This issue highlights the current management dichotomy that exists whereby non-elite athletes, who are mostly younger than elite athletes, have both a higher incidence of concussion and a much longer recovery timeframe, yet have less management resources available to them than their professional counterparts and are often managed by physicians without specific expertise in this field. The reliance on parents, coaches and other non-medical staff to assist in their treatment reinforces the need for public education programmes to raise awareness of safe management principles.

Having additional resources at the elite level may assist in the rapid diagnosis and management planning for a professional athlete following a concussion; however, the current rapid RTP paradigms that exist (eg, same day RTP) remain contentious, and evidence for this being safe in the short and long term is limited.

**Competing interests:** None.

## REFERENCES

1. **Aubry M**, Cantu R, Dvorak J, *et al*. Summary and agreement statement of the First International Conference on Concussion in Sport, Vienna 2001. Recommendations for the improvement of safety and health of athletes who may suffer concussive injuries. *Br J Sports Med* 2002;**36**:6–10.
2. **Collie A**, Maruff P. Computerised neuropsychological testing. *Br J Sports Med* 2003;**37**:2–3.
3. **Moser RS**, Iverson GL, Echemendia RJ, *et al*. Neuropsychological evaluation in the diagnosis and management of sports-related concussion. *Arch Clin Neuropsychol* 2007;**22**:909–16.
4. **Grindel S**, Lovell M, Collins M. The assessment of sport-related concussion: the evidence behind neuropsychological testing and management. *Clin J Sport Med* 2001;**11**:134–44.
5. **Emery CA**, Meeuwisse WH. Injury rates, risk factors, and mechanisms of injury in minor hockey. *Am J Sports Med* 2006;**34**:1960–9.
6. **Williamson IJ**, Goodman D. Converging evidence for the under-reporting of concussions in youth ice hockey. *Br J Sports Med* 2006;**40**:128–32.
7. **Braham R**, Finch CF, McCrory P. The incidence of head/neck/orofacial injuries in non-elite Australian football. *J Sci Med Sport* 2004;**7**:451–3.
8. **Orchard J**, Wood T, Seward H, *et al*. Comparison of injuries in elite senior and junior Australian football. *J Sci Med Sport* 1998;**1**:83–8.
9. **McCrory P**, Johnston K, Meeuwisse W, *et al*. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. *Br J Sports Med* 2005;**39**:196–204.
10. **Herring S**, Bergfeld J, Boland A, *et al*. Concussion (mild traumatic brain injury) and the team physician: a consensus statement. *Med Sci Sports Exerc* 2006;**38**:395–9.
11. **Guskiewicz KM**, Bruce SL, Cantu RC, *et al*. Recommendations on management of sport-related concussion: summary of the National Athletic Trainers' Association position statement. *Neurosurgery* 2004;**55**:891–6.
12. **Guskiewicz KM**, Bruce SL, Cantu RC, *et al*. National Athletic Trainers' Association Position Statement: Management of Sport-Related Concussion. *J Athl Train* 2004;**39**:280–97.
13. **Cantu RC**, Aubry M, Dvorak J, *et al*. Overview of concussion consensus statements since 2000. *Neurosurg Focus* 2006;**21**(4):E3.
14. **McCrory P**, Meeuwisse W, Johnston K, *et al*. Consensus Statement on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2008. *Br J Sports Med* 2009;**43**:176–184.
15. **Pellman EJ**, Powell JW, Viano DC, *et al*. Concussion in professional football: epidemiological features of game injuries and review of the literature—part 3. *Neurosurgery* 2004;**54**:81–96.
16. **Pellman EJ**, Viano DC, Casson IR, *et al*. Concussion in professional football: players returning to the same game—part 7. *Neurosurgery* 2005;**56**:79–92.
17. **Kelly J**, Rosenberg J. Diagnosis and management of concussion in sports. *Neurology* 1997;**48**:575–80.
18. **Guskiewicz KM**, McCreary M, Marshall SW, *et al*. Cumulative effects associated with recurrent concussion in collegiate football players: the NCAA Concussion Study. *JAMA* 2003;**290**:2549–55.
19. **Lovell M**, Collins M, Bradley J. Return to play following sports-related concussion. *Clin Sports Med* 2004;**23**:421–41.
20. **Collins M**, Field M, Lovell M, *et al*. Relationship between postconcussion headache and neuropsychological test performance in high school athletes. *Am J Sports Med* 2003;**31**:168–73.
21. **Collins MW**, Lovell MR, Iverson GL, *et al*. Cumulative effects of concussion in high school athletes. *Neurosurgery* 2002;**51**:1175–81.

22. **McCrea M**, Hammeke T, Olsen G, *et al*. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med* 2004;**14**:13–7.
23. **Collins M**, Grindel S, Lovell M, *et al*. Relationship between concussion and neuropsychological performance in college football players. *JAMA* 1999;**282**:964–70.
24. **Echemendia R**, Julian L. Mild traumatic brain injury in sports: neuropsychology's contribution to a developing field. *Neuropsychol Rev* 2001;**11**:69–99.
25. **Echemendia R**, Putukian M, Mackin R, *et al*. Neuropsychological test performance prior to and following sports-related mild traumatic brain injury. *Clin J Sport Med* 2001;**11**:23–31.
26. **Guskiewicz K**, Ross SE, Marshall SW. Postural stability and neuropsychological deficits after concussion in collegiate athletes. *J Athl Train* 2001;**36**:263–73.
27. **McCrea M**, Guskiewicz KM, Marshall SW, *et al*. Acute effects and recovery time following concussion in collegiate football players. *JAMA* 2003;**290**:2556–63.
28. **Pellman EJ**, Lovell MR, Viano DC, *et al*. Concussion in professional football: recovery of NFL and high school athletes assessed by computerized neuropsychological testing—part 12. *Neurosurgery* 2006;**58**:263–74.
29. **Pellman EJ**, Lovell MR, Viano DC, *et al*. Concussion in professional football: neuropsychological testing—part 6. *Neurosurgery* 2004;**55**:1290–305.