

Disclaimer: this tool does not constitute, and is not intended to constitute, a standard of medical care. These recommendations are not intended to be a substitute for the clinical judgement of the treating medical staff and should be interpreted based on the individual needs of the patient and the specific facts and circumstances presented.

Football Emergency Medicine 2nd Edition update

Concussion

(Jon Patricios, Efraim Kramer)

Introductionⁱ

Concussion is a brain injury caused by a trauma-induced change in mental state that may or may not involve loss of consciousness. The acute injury may manifest with any combination of physical, cognitive, sleep and emotional symptom clusters including headache, dizziness, nausea, visual disturbance, amnesia, poor concentration, irritability, depressed affect, fatigue and drowsiness. Whereas previous definitions and classification systems emphasised loss of consciousness and amnesia as the primary manifestations of concussion, the revised definition acknowledges that this form of traumatic brain injury may, and most likely will, present with a wide spectrum of symptoms. Current models of understanding and management incorporate broader definitions, more thorough clinical evaluations, and cognitive testing. Healthcare professionals managing footballers at all levels need to understand these principles, develop a template for managing this type of injury and educate players about the risks of repetitive head trauma and concussion.

Summary of the current international concussion consensus

- Concussion represents a serious neurological injury that may present with a wide spectrum of signs and symptoms.
- Serial clinical assessments, both neurological and cognitive, remain the cornerstones of management.
- Certain categories of footballer require a more specialised and conservative approach; these include paediatric participants (aged 12 and under), those with

a history of recurrent concussion, and those with neurological and psychological co-morbidity (e.g. depression, epilepsy and attention deficit disorder).

- Football players suspected of suffering concussion should be immediately removed from play. Before returning to play, the player must be cleared by a medical professional with the appropriate expertise.

Management

The diagnosis and management of concussion in football requires a number of steps to be followed sequentially, from determining the mechanism of injury on the pitch (when possible), to on-pitch evaluation, touchline evaluation, emergency department and/or clinical evaluation, discharge and follow-up instructions, and eventually to supervised, graded return-to-play protocols. This chapter is concerned specifically with the immediate emergency diagnosis and management of concussion on the pitch and management in the acute setting. Subsequent management and discussion of return-to-play protocols may be found in other relevant texts and is beyond the scope of this emergency manual. For FIFA tournaments, it is the sole responsibility of the team doctor to make assessments and decisions concerning his/her players. FIFA supports and follows the recommendations of the Concussion in Sports Group (CISG).

What happens in the concussed footballer's brain?

Concussion is a brain injury. There are currently no easily detectable structural changes to the concussed brain, as computerised tomography (CT) and magnetic resonance imaging (MRI) radiological scans are almost always normal. Nevertheless, there is disruption to the concussed brain, which manifests itself as a range of functional disturbances. Possible mechanisms of injury include compressive forces, which may directly injure the brain at the point of contact with the cranium (coup); tensile forces that produce injury at the point opposite the injury (contrecoup) because the axons and nerves are stretched; and finally, rotational forces may result in a shearing of axons. Therefore, the direct force at the point of contact may not be solely

responsible for the severity of an injury if a high rotational component with a significant shearing effect occurs. All of the different mechanisms may result in biochemical changes relating to perfusion and the supply and use of energy at the site of injury, which is not well understood but may result from a “mismatch” between the injured brain’s increased energy requirements and diminished blood flow. Changes to the chemical flux and blood flow in the concussed brain make the latter vulnerable to further injury until full recovery has taken place.

Key issues relevant to concussion in football

Head injuries in football are most likely to result from a player’s head clashing with an opponent’s head, elbow, arm or boot, or with the ground or goalpost. Most head clashes occur in the penalty area. Rule changes forbidding high challenges with the elbow raised have resulted in a lower incidence of concussion in football.

Because football is a free-flowing game with no dedicated timeouts, doctors, coaches, referees and players need to be particularly vigilant for players who may show signs of concussion. Players suspected of having suffered a concussion after an on-pitch evaluation are required to be immediately removed from the pitch for further medical evaluation.

There should be no interference from players or team management in a doctor’s or trainer’s decision to remove a suspected concussed player from the field. Players diagnosed with suspected concussion should be permanently removed from the game or training session and not return to play and undergo a formal medical assessment. Before returning to play, a player must be cleared by a medical professional with the appropriate expertise.

Diagnosis and assessment

The most obvious practical sign of concussion is the mechanism of injury that causes the concussive injury (e.g. did the player receive an elbow to the head?).

The mechanism of injury may place the team doctor or other on-duty healthcare provider(s) on alert for concussion in the player concerned, which may lead to an on-pitch response as indicated by the referee if there is a medical problem. If there is no obvious medical problem, removal from play may be needed, with continued observation and monitoring of the player on the touchline as the match progresses and/or further appropriate neurological evaluation at either half-time or after full time in the team's dressing room. This is important because signs and symptoms of acute concussion may not always be evident immediately post-injury, but delayed onset of symptoms may develop.

If the referee summons the team doctor or other on-duty healthcare provider(s) onto the pitch to attend to an injured player for an assessment of suspected concussion, the three-minute concussion rule may be requested from the referee, whereby the medical team has three minutes with the injured player to assess whether an acute concussion is present or suspected and thereby remove the player from the pitch and from further play, or whether the player may return to play. If an adequate assessment for concussion cannot be undertaken in the three minutes provided, then – when possible – the player should be safely removed from the pitch to the touchline for further evaluation. Medical staff trained in concussion assessments should provide the assessment.

If, at any stage of the concussion assessment, the medical team cannot make a definite decision regarding whether concussion is present or not and a doubt exists, it is recommended that “when in doubt, sit the player out” and he or she should be removed from play.

If concussion is suspected, a number of practical steps should be undertaken on the pitch by the team doctor or healthcare provider:

- Assess the player's level of consciousness in order to ascertain if airway, breathing or circulatory resuscitative interventions are immediately required.

- Assess if neck stabilisation and immobilisation is required by ascertaining the presence of neck pain or tenderness, neck muscle spasms, abnormal alignment, peripheral paresthesia/paralysis or sensory loss.
- Determine the most appropriate and safest manner of transferring the player from the pitch and whether long-board spinal stabilisation is required.
- Establish concussion by determining the presence of any neurological signs or symptoms post-injury. This is undertaken by asking the injured player specific questions that have been clinically validated to demonstrate a decrease in brain function if any of them are answered incorrectly, and thus warrant removal of the player from the pitch.

These standard Maddocks questions are:

- What venue are we at today?
- Which team are we playing?
- What half is it now?
- How far into the half are we?
- Who scored last in this match?
- What team did you play last week/game?
- Did your team win its last game?

If the injured player cannot easily, quickly and correctly answer all of these questions, then concussion should be suspected, and the player should be removed appropriately from the pitch and managed accordingly. He or she may not return to the match.

If there are no signs or symptoms that are evident immediately, continued monitoring may still be required from the touchline while the player remains in the match. Typical signs that may develop in a concussed player on the pitch include confusion about on-pitch calls, repeatedly being out of position, deterioration in play, or self-reported complaints of headache, nausea, dizziness or blurred vision.

Importantly, a player does not have to lose consciousness to be diagnosed with concussion. Fewer than 10% of concussions are associated with loss of consciousness.

Use can be made of the Pocket Concussion Recognition Tool 5 (PCRT5) that was developed for pitch and touchline use. Never be embarrassed to use the PCRT on an injured player in view of others, as it was made for this specific purpose.

CONCUSSION RECOGNITION TOOL 5[®]

To help identify concussion in children, adolescents and adults



RECOGNISE & REMOVE

Head impacts can be associated with serious and potentially fatal brain injuries. The Concussion Recognition Tool 5 (CRT5) is to be used for the identification of suspected concussion. It is not designed to diagnose concussion.

STEP 1: RED FLAGS – CALL AN AMBULANCE

If there is concern after an injury including whether ANY of the following signs are observed or complaints are reported then the player should be safely and immediately removed from play/game/activity. If no licensed healthcare professional is available, call an ambulance for urgent medical assessment:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/ burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

Remember:

- In all cases, the basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Assessment for a spinal cord injury is critical.
- Do not attempt to move the player (other than required for airway support) unless trained to do so.
- Do not remove a helmet or any other equipment unless trained to do so safely.

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If there are no Red Flags, identification of possible concussion should proceed to the following steps:

STEP 2: OBSERVABLE SIGNS

Visual clues that suggest possible concussion include:

- Lying motionless on the playing surface
- Slow to get up after a direct or indirect hit to the head
- Disorientation or confusion, or an inability to respond appropriately to questions
- Blank or vacant look
- Balance, gait difficulties, motor incoordination, stumbling, slow laboured movements
- Facial injury after head trauma

STEP 3: SYMPTOMS

- Headache
- "Pressure in head"
- Balance problems
- Nausea or vomiting
- Drowsiness
- Dizziness
- Blurred vision
- Sensitivity to light
- Sensitivity to noise
- Fatigue or low energy
- "Don't feel right"
- More emotional
- More irritable
- Sadness
- Nervous or anxious
- Neck Pain
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down
- Feeling like "in a fog"

STEP 4: MEMORY ASSESSMENT

(IN ATHLETES OLDER THAN 12 YEARS)

Failure to answer any of these questions (modified appropriately for each sport) correctly may suggest a concussion:

- "What venue are we at today?"
- "Which half is it now?"
- "Who scored last in this game?"
- "What team did you play last week/game?"
- "Did your team win the last game?"

Athletes with suspected concussion should:

- Not be left alone initially (at least for the first 1-2 hours).
- Not drink alcohol.
- Not use recreational/ prescription drugs.
- Not be sent home by themselves. They need to be with a responsible adult.
- Not drive a motor vehicle until cleared to do so by a healthcare professional.

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ANY ATHLETE WITH A SUSPECTED CONCUSSION SHOULD BE IMMEDIATELY REMOVED FROM PRACTICE OR PLAY AND SHOULD NOT RETURN TO ACTIVITY UNTIL ASSESSED MEDICALLY, EVEN IF THE SYMPTOMS RESOLVE

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Touchline assessment

Once a player has been removed from the pitch, a touchline assessment provides a good opportunity to adequately assess the player's neurological status and provides the first quantitative assessment of the injury, serving as the baseline measure of what should be a series of clinical evaluations to come.

Neurological evaluation of the injured player on the touchline should use the specially developed Sports Concussion Assessment Tool™ (version 5, SCAT5).

This touchline concussion neurological assessment tool, which may also be used in concussion education, has two main functions, namely:

- Indications for emergency management
 - - Glasgow Coma score of less than 15
 - - Deteriorating mental status
 - - Potential spinal injury
 - - Progressive, worsening symptoms or new neurological signs
- Baseline clinical neurological and cognitive assessment

Once again, never be embarrassed to use the SCAT5 on an injured player in the presence of others, as it was made for this specific purpose. The SCAT5 card also has a paediatric version, the Child SCAT5 developed for children 12 years and younger.

Use of the PCRT5 and SCAT5 will identify those players who have clinically recognisable concussion, those that may have more extensive damage and those at possible risk.

Any clinical evidence of concussion or suspicion of concussion should result in removal of the player from the pitch with constant observation and serial neurological evaluation. No return to play may occur that day and medical staff can determine if

referral to the nearest, most appropriate emergency department for a full neurological examination and/or radiological investigation is deemed necessary. It is the team doctor's responsibility to ensure that such procedures are in place.

In addition, it is essential to acknowledge that, at any stage, a player may develop worsening signs and symptoms of an intracerebral haemorrhage or brain ischaemia. Should this critical situation occur, the player should be adequately and appropriately resuscitated, stabilised, spinally immobilised and efficiently transferred to the nearest, most appropriate trauma and emergency department for full emergency and neurosurgical evaluation and management.

These signs include:

1. Worsening headaches
2. Severe neck pain
3. Decreasing or altered level of consciousness
4. Inability to recognise familiar people or places
5. Increasing confusion or irritability
6. Obvious unusual behavioural change
7. Repeated vomiting
8. Slurred speech
9. Focal neurological signs
10. Weakness/numbness in limbs
11. Any seizure-type activity

Any player with suspected concussion who has continued neurological signs or symptoms, especially if these are deteriorating or not improving or are developing post-match where no medical doctor is available, should be transferred by emergency services to the emergency department for a fully comprehensive neurological

examination, radiological investigation or admission for neurological observation, whichever is appropriate.

Video replay analysis

The advent of video replay technology in football has resulted in additional medical data becoming available to the medical team who are on site, near the injured player, making a clinical assessment for a potential concussion injury. During the FIFA World Cup™, video replays are available at all times to the medical team on site and can provide additional clinical information to supplement what may already be clinically evident from the initial pitchside assessment.

Any signs of concussion that can be immediately gleaned from the video replay may only be evident very briefly and may not still be clinically present in the injured player by the time that the medical team is summoned onto the pitch by the referee. These signs include:

1. **Mechanism of injury** – the mechanism of injury observed indicates a high risk of concussion/head injury;
2. **Loss of consciousness**/lying motionless for a long period – the player's body goes limp and the player does not protect (i.e. brace) themselves when falling. The player lies motionless on the ground for a longer period than expected, or shows a lack of visible responsiveness to verbal stimuli. This is an indicator of concussion even if the player exhibited such behaviour for just one second;
3. **Slow in getting up onto their feet** – the player takes longer than usual to return to their feet (e.g. remains on the ground, gets to their knees or haunches, and pauses before standing);
4. **Loss of function of limb(s)** – “floppy position” – player does not use one or more limbs for a variable period of time;

5. **Blank stare** – the player is not visually focused on the team doctor when spoken to and/or appears to be looking off into the distance;

6. **Limb posturing** – tonic posturing of upper limbs;

7. **Seizure-like activity** – tonic/clonic seizure activity;

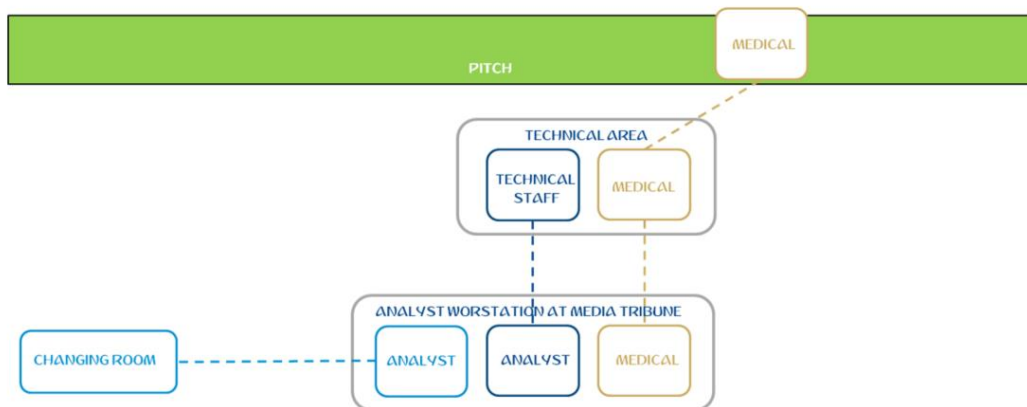
8. **Grabbing/shaking of the head** – the player holds their head in the palm of their hand or hands, or rubs or shakes their head in a manner that appears to demonstrate that they are experiencing discomfort;

9. **Unsteady gait** – unable to stand steadily unaided or walk normally. Upon standing and walking, the player has unsteadiness, wobbly legs, balance problems, stumbles or falls over, or cannot walk straight independently;

10. **Grabbing and holding the neck** – player admits to pain/discomfort in the neck;

11. **Abnormal/aggressive/confused behaviour** noticed in the player anytime post-injury, even if the player is allowed to return to play initially.

Communication Flow



The recommended video replay protocol should include the following steps:

1. Each team appoints a medically qualified member whose sole function during matches is to act as a medical analyst. Teams may appoint more than one person for appropriate training and skills acquisition to ensure adequate capacity.
2. The team medical analyst will be located in the media tribune area or other designated area, as per the decision of the Technology department on site.
3. The medical analyst should commence action replay analysis immediately after every relevant injury witnessed on the pitch, with the intention of providing the team doctor with additional clinical information within the three-minute concussion time, if practicable.
4. The video replay information that flows between the medical analyst and team doctor is undertaken via radio.

Pharmacological intervention

The mainstay of the treatment for concussion is removal from the exercise environment plus physical and cognitive rest. Headaches should be managed with only mild analgesics, e.g. paracetamol/acetaminophen. Non-steroidal anti-inflammatory analgesics should not be prescribed unless intra-cranial bleeds have been excluded radiologically.

Conclusion

Current concussion management emphasises a structured clinical protocol incorporating a thorough history and serial clinical assessments. Adopting policies and protocols in the management of players of all levels is in the best clinical interest of players and helps militate against the possible medico-legal consequences of poorly managed head injuries. Key to the on-pitch management of concussion in football is vigilance, early detection, immediate removal and ongoing evaluation.

Player discharge home following concussion – information handout

Player information – important reminders for the first 48 hours

You are being discharged home after being medically assessed following the concussion you received while playing football.

- Always make sure that you are in the presence of a responsible adult for 24- 48 hours.
- Record and monitor any symptoms of concussion, including nausea, dizziness, fatigue, sleep disturbances, memory lapses, mood swings, poor concentration or any other feeling that concerns you.
- Complete rest and sleep will help recovery.

DO NOT:

- Drive or use machinery for the first 48 hours or if you have symptoms
- Consume any alcohol for the first 48 hours
- Take any amount of painkillers other than that prescribed on the box and always follow the doctor's orders
- Place yourself in an environment of loud noise and excessive light for the first 48 hours
- Study, watch TV or work with your mobile phone for the first 48 hours
- Work at your computer for the first 48 hours
- Exercise until you have received permission from your treating doctor

Contact the emergency ambulance service or go to your nearest emergency department immediately if:

- Any of the symptoms get worse or you feel worse
- Your headache becomes worse and does not respond to mild painkillers
- You have a seizure (fit)
- You experience excessive irritability
- You experience visual disturbances
- You experience balance problems
- You or anyone else is concerned about your condition

Decisions regarding returning to sport will be made taking into consideration your individual circumstances including your medical history, previous head injuries and current symptoms.

You must receive clearance from a doctor before returning to sport.

SCAT5

SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP
FOR USE BY MEDICAL PROFESSIONALS ONLY

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FIFA®



FEI

Patient details

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date of Injury: _____ Time: _____

WHAT IS THE SCAT5?

The SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals¹. The SCAT5 cannot be performed correctly in less than 10 minutes.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The SCAT5 is to be used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT5.

Preseason SCAT5 baseline testing can be useful for interpreting post-injury test scores, but is not required for that purpose. Detailed instructions for use of the SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

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Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be **REMOVED FROM PLAY**, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If an athlete is suspected of having a concussion and medical personnel are not immediately available, the athlete should be referred to a medical facility for urgent assessment.
- Athletes with suspected concussion should not drink alcohol, use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The SCAT5 should **NOT** be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a concussion even if their SCAT5 is "normal".

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

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IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The Maddocks questions and cervical spine exam are critical steps of the immediate assessment; however, these do not need to be done serially.

STEP 1: RED FLAGS

RED FLAGS:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

STEP 2: OBSERVABLE SIGNS

Witnessed Observed on Video

	Y	N
Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS²

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Mark Y for correct answer / N for incorrect

	Y	N
What venue are we at today?	Y	N
Which half is it now?	Y	N
Who scored last in this match?	Y	N
What team did you play last week / game?	Y	N
Did your team win the last game?	Y	N

Note: Appropriate sport-specific questions may be substituted.

Name: _____
 DOB: _____
 Address: _____
 ID number: _____
 Examiner: _____
 Date: _____

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)³

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best verbal response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best motor response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion / Withdrawal to pain	4	4	4
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

References

1. Cantu RC. Second-impact syndrome. *Clin Sports Med* 1998;17: 37-44.
2. Colvin AC, Mullen J, Lovell MR, et al. The role of concussion history and gender in recovery from soccer-related concussion. *The Am J Sports Med* 2009;37:1699-1704
3. Giza GC and Houda DA. The Neurometabolic Cascade of Concussion. *J Athl Train* 2001;31(3); 228-235.
4. Gioia G and Collins M. Acute Concussion Evaluation (ACE). Heads Up: Brain Injury In Your Practice: Tool Kit. Center for Disease Control, available at; www.cdc.gov/ncipc/pub-res/tbi_toolkit/tbi/ACE, modified June 2007.
5. Guskiewicz KM, Bruce SL, Cantu RC, et al. National Athletic Trainers' Association Position Statement on the Management of Sports-related Concussion. *J Athl Train* 2004;39; 278-295
6. Harmon KG. American Medical Society for Sports Medicine Position Statement: Concussion in Sport. *Br J Sports Med* 2013;47: 13-26.
7. Herring SA, Bergfield JA, Boland A, et al. ACSM Team Physician Consensus Statement: Concussion (Mild Traumatic Brain Injury) and the Team Physician. *Med Sci Sport Ex* 2006;2; 395-399
8. Johnston K. Concussion (Mild Traumatic Brain Injury) and the Team Physician: A Consensus Statement – 2011 Update. *Med Sci Sport Exerc* 2011; 43(12): 2412-2422.
9. McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport – the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med* 2017;**51**:838-847.
10. Kohler R and Patricios J. Ethically we can no longer sit on the fence. *SA J Sport Med* 2007;19: 1-2.
11. Kolodziej MA, Koblitz S, Nimsky C et al. Mechanisms and Consequences of Head Injuries in Soccer. A Study of 451 Patients. *Neurosurg Focus*. 2011;31(5):e1

12. Kutcher JS and Eckner JT. At-risk populations in sports-related concussion. *Curr Sports Med Rep*. 2010;9:16-20.
13. Maddocks DL, Dicker GD, Saling MM. The assessment of orientation following concussion in athletes. *Clin J Sport Med* 1995;5: 32-35.
14. Maher M, Hutchison M, Cusimano M et al. Concussions and heading in soccer: A review of the evidence of incidence, mechanisms, biomarkers and neurocognitive outcomes. *Brain Injury* 2014, Vol. 28, No. 3 , 271-285
15. Makdissi M, Davis G, Jordan B et al. Revisiting the modifiers: how should the evaluation and management of acute concussions differ in specific groups? *Br J Sports Med* 2013;10: 1-9.
16. McCrea M, Kelly JP, Kluge J, et al. Standardized assessment of concussion in football players. *Neurology* 1997;48: 586-588.
17. McCrea M, Kelly JP, Randolph C, et al. Standardized assessment of concussion (SAC): on-site mental status evaluation of the athlete. *J Head Trauma Rehabil* 1998; 13: 27-35.
18. McCrory P, Collie A, Anderson V, et al. Can we manage sport-related concussion in children the same as in adults? *Br J Sports Med* 2004;38: 516-519.
19. 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.
20. 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: i76-i84.
21. McCrory P. Should we treat concussion pharmacologically? *Br J Sports Med* 2002; 36: 3-5.
22. McCrory PR. Were you knocked out? A team physician's approach to initial concussion management. *Med Sci Sports Exerc* 1997; 29: S207-S212.
23. McCrory PR, Meeuwisse W, Aubry M et al. 4th Consensus Statement on Concussion in Sport. *Br J Sports Med* 2013; 47:250-258.
24. Patricios JS. The Masters' Voices to Mandela's Melody: A South African

- Template for Complete Concussion Care. Br J Sports Med 2009; 43: i91-i105.
25. Preiss-Farzanegan SJ, Chapman B, Wong TM, et al. The relationship between gender and post-concussion symptoms after sport-related mild traumatic brain injury. PM & R 2009 Mar;1(3):245-253.
26. Scott Delaney J, Puni V and Rouah F. Mechanisms of injury for concussions in university football, ice hockey, and soccer: a pilot study. Clin J Sport Med. 2006 Mar;16 (2):162-5.

NOTES

ⁱ Certain specific examples of concussion management in competition are based on FIFA's specific guidelines to be followed at the FIFA World Cup™. FIFA members, professional leagues and amateur leagues are encouraged to develop concussion management guidelines suitable for their own members, competitions, players and teams.