

EDITORIAL

PROTECTING THE PLAYER – THE PRIMARY OBJECTIVE OF FOOTBALL MEDICINE

Much has happened in the world of football – and the world of football medicine more specifically – since the last edition of *Medicine Matters*, which is fitting given that edition's focus on evolution. The summer of 2014 saw a magnificent FIFA World Cup, won by Germany, which featured the usual number of medical incidents that would be expected from a major tournament but also generated some wider discussions, particularly with regard to the management of concussion. This encouraged everyone involved in the game to review procedures and has ultimately resulted in significant improvements to the rules in this area. This edition will continue to look forward, focusing on issues of interest from the front line of elite football medicine – issues which doctors are confronted with on a daily basis and affect the health of the players competing in our beautiful game.

The articles in this edition focus on protecting the health and fitness of the players, for example through the design of football boots and the current hot topic of concussion, both of which directly relate to UEFA's main objective of protecting players' health on and off the pitch. Since the last edition, UEFA has introduced numerous initiatives with a view to achieving this goal, including encouraging member associations to set up national medical committees and implementing several new rules and guidelines in its competitions regarding the management of potentially serious health situations. New rules relating to head injuries and concussion have been incorporated in all UEFA competition

regulations, and formalised guidelines have been issued covering the cooling equipment that is required to protect players competing in extreme heat. In addition, a new pre-competition medical screening procedure for players is being developed and is expected to be introduced at the start of the 2016/17 season.

The theme of protecting players will also be central to the third UEFA Football Doctor Education Programme workshop, which will take place in Budapest in April 2015 and marks the end of a three-stage course for national team doctors that began in 2012. That course trains specialist football doctors to practise football medicine to the highest standards across Europe. UEFA Football Doctor Education Programme workshops also continue to be delivered at national level as part of the 'cascading' responsibilities of the doctors who attend the programme. It is to the great credit of our member associations that this process has been so well supported, and it is my hope that the initiative will be taken up by more and more associations in the future.

It should also be noted that a major improvement to UEFA's anti-doping programme – the most significant for a number of years – will be introduced at the start of the 2015/16 season. UEFA firmly believes that protecting players is a matter not only of health and fitness, but also of protecting their right to win cleanly. In the year that sees the introduction of the new 2015 World Anti-Doping Code, UEFA will become one of the first anti-doping organisations in the world to implement a steroid profiling programme as part of its annual anti-doping programme. This will give UEFA a vital new tool with which to deter and detect the misuse of steroids in football.

It is a great pleasure to present these insightful articles by members of UEFA's Medical Committee, which showcase the great work that is being carried out within Europe's medical community. ●

Dr Michel D'Hooghe
Chairman of the UEFA Medical Committee



Dr Michel D'Hooghe

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BOOTS, STUDS AND INJURIES IN FOOTBALL

By Prof. Andrea Ferretti, member of the UEFA Medical Committee

Football is the world's most popular sport. It is now estimated that more than 200 million people play some form of the game (i.e. including futsal and beach soccer) at one level or another.

Football is generally considered to be a safe sport. However, the risk of injury (especially at professional level) is substantial. It has been estimated that the overall risk is about 1,000 times greater than that of a typical high-risk industrial occupation.

Although the rules limit physical contact between players, this is an essential part of the game and can lead to some forms of trauma. However, the majority of the injuries that occur during matches and training are not contact-related. These include sprained ankles and knees, strained muscles, torn tendons and overuse injuries (stress fractures, tendinopathies, soreness following muscle overload, cartilage degeneration, etc.).

Some of the most common injuries concern the anterior cruciate ligament (ACL), typically involving a sudden overloading of the joint complex responsible for a specific action. According to literature, the majority of these injuries are not

contact-related, occurring without a player being tackled or touched by another player.

Recently, our expert group (see Reference 1) performed video analysis of a series of ACL tears occurring during competitive football matches, looking at 58 cases that were captured on footage broadcast by major television companies. The most common injury mechanism for ACL tears in football players is deceleration with the body unbalanced posteriorly and the foot planted on the ground. In these circumstances, ligament loads exceed tolerable limits owing to inadequate control over the player's movement. In most cases, the injury seems to occur when the player tries to change direction.

Although valgus external rotation stress is often reported as the most common injury mechanism, more detailed analysis of the mechanism reveals that, in the case of an ACL tear, a forceful and abrupt internal rotation stress is first applied to the joint while the knee is in a valgus position. This stress leads to a sudden tearing of the ACL (which occurs in about 40 milliseconds), before the knee eventually collapses in valgus external rotation (see Figure 1).



Figure 1. Video analysis of an ACL tear showing a valgus internal rotation mechanism using Poser software (Curious Labs, Inc., Santa Cruz, California). The study was performed in conjunction with the Oslo Sports Trauma Research Center in Norway.



In fact, the injury mechanism described above, involving a combination of valgus and internal rotation stress, mimics the pivot shift test – one of the most popular tests used in the diagnosis of rotatory instability of the knee, which is commonly associated with an ACL deficiency.

Thus, most non-contact-related lower limb injuries in football occur while running, turning, pivoting, landing following a jump or shooting. In all of these situations, one foot is planted on the ground while the body turns either clockwise or anti-clockwise.

According to the website www.footballboots.co.uk, the first recorded pair of football boots were made for King Henry VIII of England in 1526. In the 19th century, when the game became increasingly popular (especially in England), the majority of players used work boots, which were very hard and heavy and not designed for running or kicking. They often had steel caps, resulting in injuries when opponents were tackled or accidentally kicked. Later on, metal tacks or studs were put on the bottom of those boots in order to obtain a better grip. In the early 1900s, the first official studded football boots were produced. They were made from black leather, they were heavy and thick, and they went right up to the ankle. The black studded boot became a kind of icon for football players (see Figure 2).



Figure 2. Studded boots worn by Silvio Piola during Italy's 4-2 victory against Hungary in the final of the 1938 FIFA World Cup. Courtesy of the Museum of Football in Florence

It was not until the 1950s that adidas introduced boots with interchangeable screw-in studs. These studs were made of rubber or plastic and meant that players could choose which studs to use with their boots depending on the weather and the condition of the pitch (see Figure 3).

More recently, thanks to new materials and manufacturing techniques, and as a result of the popularity of boots as a fashion and consumer item, boots have become even lighter, with new types of stud, more flexible soles and sometimes extravagant colours. At the same time, with various manufacturers paying professional players to wear boots, research into more appealing and more easily recognisable models is probably now considered more important than developing boots with even better biomechanical properties.

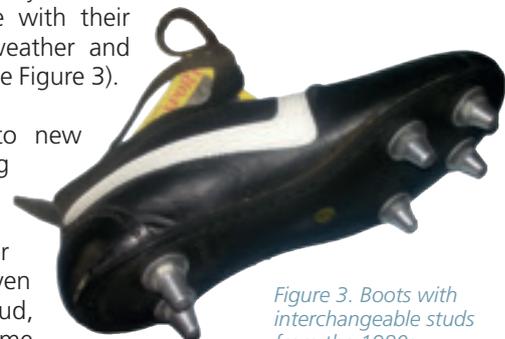


Figure 3. Boots with interchangeable studs from the 1980s. Courtesy of the Museum of Football in Florence

The goal of today's product development teams should be to adequately address questions of flexibility and stability within the confines of a lightweight boot, paying special attention to players' safety. Combining these elements with a clean, functional playing surface will result in lasting grip, increased friction between boot and ball, greater ball control, increased power and swerve, and biomechanical stability.

The various types of football boot that are available today can be classified as follows:

Firm ground – for playing on firm or moderately forgiving pitches

Firm ground studs are perhaps the most common stud type. They generally range from 10mm to 14mm on the outsole plate. Blades and round studs are equally preferred in today's market.

Hard ground – for playing on hard, unforgiving pitches

These studs are generally short and positioned in fairly uniform patterns across the outsole plate. They are very effective at providing grip where pitches are difficult to penetrate. The studs tend to be shorter and softer than the firm ground variety.

Soft ground – for playing on soft pitches

Football boots for rain-soaked or soft pitches occasionally require longer detachable studs (generally six on each boot; see Figure 4). These studs vary in length (ranging from 12mm to 19mm), depending on the condition of the pitch.

Figure 4. Boots with interchangeable studs for soft ground



Many professional players now use a mixture of soft and firm ground studs for standard pitch conditions.

Artificial turf – for playing on extremely hard or synthetic surfaces

These finely studded boots are most helpful where the pitch is even and there is no – or only sparse – natural grass (see Figure 5).



Figure 5. Studded boots for artificial turf (indoor football)

Although it has been speculated that the traction properties of football boots on natural grass and artificial turf are responsible for acute and chronic injuries, little research has been published on the importance of footwear in football. Knowledge of the effect that different types of boot and stud have on muscles, tendons and joint stress is of paramount importance for the prevention of major football injuries.

German researchers at the University of Freiburg conducted an excellent study looking at the effect that bladed and round studs mounted in commercially available football boots had on knee joint kinematics. They compared boots with eight round studs in the forefoot and four studs in the heel area with boots with nine blades in the forefoot and four blades in the heel. Using video cameras, retroreflective surface markers and surface electrodes, they found no significant differences between the two types of football boot in terms of ground reaction forces, 3D kinematics and electromyographic activity in the lower leg.

Although major manufacturers continue to release new models, they seem to be focusing solely on aesthetics, rather than players' safety and efficiency.

Indeed, we seem to be a long way from striking the right balance between the grip needed for the technical skills and the avoidance of non-contact injuries.

In some cases, very light studs positioned in areas with maximum load result in unacceptable breakage rates (see Figures 6a and 6b).



Figure 6a. Early breakage of one of the two light studs in a severely loaded area of the heel. This boot was later withdrawn from sale.

Figure 6b. The new version with four thicker studs in that area



In other cases, the unexpected, sudden failure of well-tested and reliable studs may have helped players to avoid a serious injury (see Figure 7).



Figure 7. This stud broke uneventfully during a professional match (Italian Serie A), possibly resulting in a reduced risk of injury. The player did not notice it until the boot was removed at the end of the match.

Recently, an Italian company (Camparilab in Parma) specialising in the production of carbon fibre devices and accessories protecting footballers (shin guards, face and nose masks, etc.)



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developed flexible studs that could be mounted on all commercially available types of boot. These were designed with the aim of partially absorbing loads and stresses that were transferred from the ground to the boot and the player's body (see Figure 8).



Figure 8. Flexible studs mounted on commercially available boots

This new stud features a polymeric elastomer positioned between two aluminium sections. It aims to absorb the energy that is generated when the boot strikes the ground, which would otherwise be transferred to the foot, heel and ankle, before going up the leg to the knee (see Figure 9).

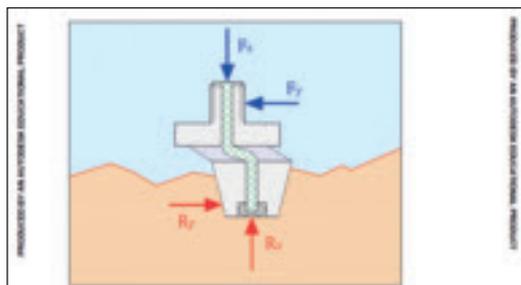
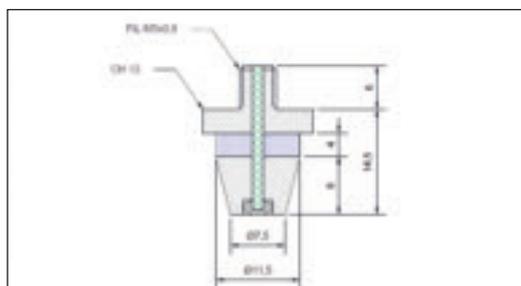
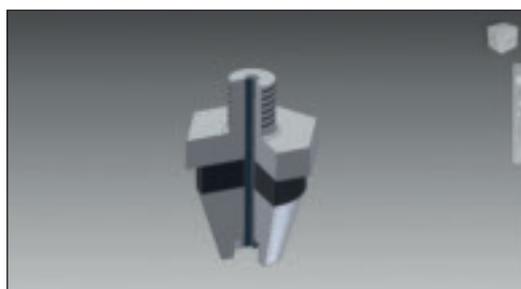


Figure 9. Plans for the flexible studs. Courtesy of Carlo Mapelli (reference no. 9)



These studs were evaluated by a group of researchers (led by Carlo Mapelli) at the Polytechnic University of Milan using a specially modified testing machine. Boots equipped with flexible

studs were tested and compared with commercially available boots with aluminium studs (see Figures 10 and 11).

The results of this preliminary series of tests indicate that the new flexible studs have the potential to absorb up to 25% of the load that conventional studs normally transmit to the sole and the rest of the body (see Figures 12 and 13).



Figure 10. Test simulating loads caused by running. Courtesy of Carlo Mapelli



Figure 11. Flexible studs changing shape during test. Courtesy of Carlo Mapelli

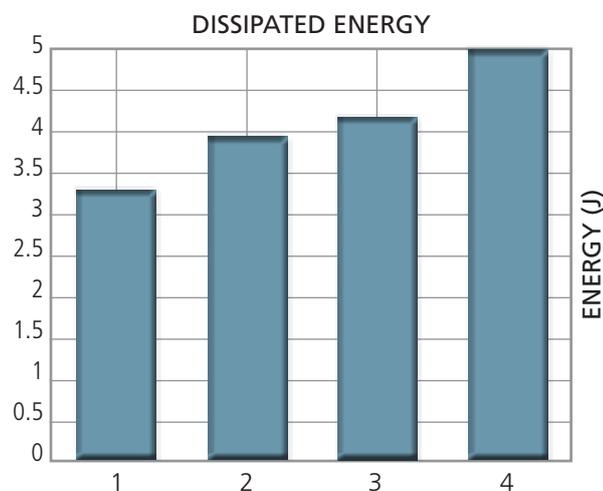


Figure 12. Dissipation of energy by different types of stud. Number 1 is aluminium, while numbers 2 to 4 are flexible studs with elastomers of varying degrees of hardness. Courtesy of Carlo Mapelli

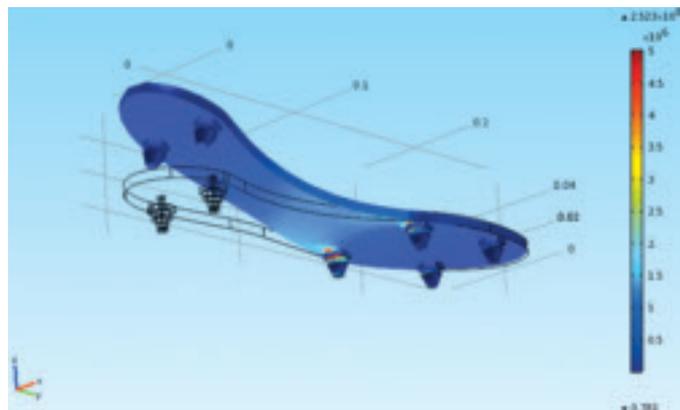
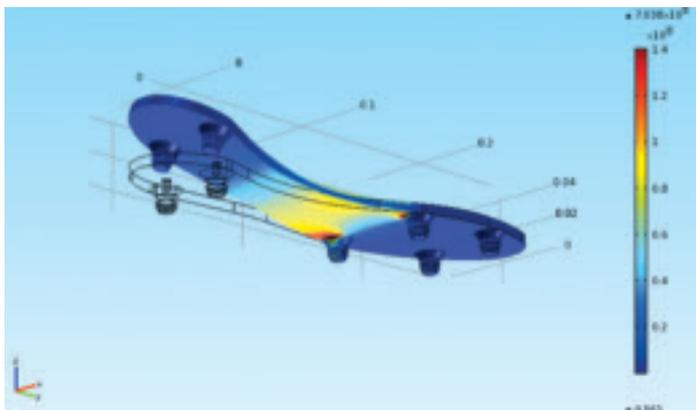


Figure 13a. Load transmitted to the sole by traditional (i.e. aluminium) studs. Courtesy of Carlo Mapelli

Figure 13b. Load transmitted to the sole by flexible studs. Courtesy of Carlo Mapelli

Although the results obtained by the Italian researchers need to be confirmed by further studies evaluating flexible studs' resistance to cyclic loading and torsional stresses, the preliminary results seem to be encouraging, and the researchers' attempts to break new ground in the development of football boots could potentially contribute to the prevention of football injuries.

In conclusion, we speculate that studs and boots could represent a key factor in both the performance and the safety of footballers. In

addition to providing proper grip to keep the player well balanced in all circumstances requiring good traction, boots should be flexible enough to absorb excessive loads and stresses, which might otherwise result in a risk of major injuries to the player. It is very important that doctors and researchers encourage companies involved in the manufacture and sale of boots and studs to continue to address this issue with the aim of making the best sport in the world even safer. ●

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THE UEFA ELITE CLUB INJURY STUDY MEETING – A UNIQUE FORUM FOR ELITE CLUB DOCTORS

On 22 January the most recent edition of a unique elite football medicine forum, the UEFA Elite Club Injury Study doctors' meeting, took place at UEFA headquarters in Nyon, Switzerland. This forum is used to discuss the findings and outcomes of the UEFA Elite Club Injury Study – a crucial source of information on injuries specific to football.

This was the first such meeting to be held at UEFA since the first get-together some 13 years ago. In the intervening years, clubs participating in the Elite Club Injury Study have taken turns to host the meeting and welcome doctors from other clubs involved in the study. The next meeting will be hosted by FC Barcelona in June.

Prof. Jan Ekstrand, first vice-chairman of the UEFA Medical Committee and the man behind the injury study

The Elite Club Injury Study provides clubs, associations and the scientific community with important data that helps them in their efforts to treat and prevent player injuries, while sharing best practice examples with participating clubs. The study was launched in 2001 and is coordinated by the vice-chairman of the UEFA Medical Committee, Professor Jan Ekstrand. The doctors' meeting helps to bring leading football medicine practitioners together in a unique discussion forum, where ideas and experiences can be shared, and friendships established. The doctors are presented with a range of lectures, scientific presentations and open forums which help to expand further on the results of the study, published twice annually in an anonymised report (each club sees its own data in comparison with anonymous data from the other clubs).

By and for the clubs

The January meeting was attended by 24 team doctors from 23 elite European clubs, who participated in discussions on key medical issues such as concussion, training loads in relation to injury, and the importance of good communication between the medical team and coach education staff. Members of the UEFA Medical Committee and administration were also in attendance to ensure that the organisation could contribute to discussions and gauge the opinions of the clubs' medical staff on various issues that affect UEFA's competitions and its player safety regulations.

Prof. Ekstrand is the founder and director of the study, and he continues to manage the study on UEFA's behalf. *"There have been tremendous developments in football medicine in the last 15 years, and football is really leading the way in injury science and research. We couldn't do this without the support of the clubs, some of which have been involved in the study since the very start, and of course, the study is a key part of UEFA's drive to develop elite football performance in a way that is safe and healthy for players,"* he says.

Clubs are clearly a key part of the study and it could not be done without their contribution, and without them getting something useful in return. According to the head of Juventus' medical department, Fabrizio Tencone: *"The [studies] are currently the most important on injuries in football in the world, and they allow us to improve our knowledge and information every year. This information has allowed us to scientifically understand concepts which we thought were true, but we didn't know for sure – the number of injuries, what parts of a player's body*





are affected the most by injuries, or where the worst injuries occur. And then the correlation between serious injuries and a less successful end to a season. So it's interesting not only for the doctor, but also for the coaching staff and the owners of the teams and clubs."

Understanding all the factors

The main aim of the study is to help reduce injury frequency and severity in training and matches, in particular injuries that result in players being unable to participate fully in training or matches. Consequently, the study helps to increase footballers' safety and physical well-being. Over 14 seasons the study has recorded some 10,000 injuries, and a total of 41 clubs from 16 different countries have taken part, including the 2014/15 participants.

"When we first began the study, some clubs were reluctant to get involved, for reasons of confidentiality, and some saw the delivery of data as extra work," says Prof. Ekstrand. "Now, all the clubs that are invited want to participate. They see the usefulness of the study because they get a lot of information back."

Since 2001, the scope and content of the study has developed constantly. *"The most important [development] for the injury study is that there are obviously more factors involved in avoiding injuries at elite level than we in medicine had thought of before,"* Prof. Ekstrand adds.



Dr Michel D'Hooghe at the workshop

"We started [14 years ago] by looking at muscle injuries, counting knee ligament injuries and so on. Now there are the mental factors, the well-being of the players, internal communication between the different parts of a club – the medical team and coaching staff, for example – plus coaching/training methods and the load on players."

The latest Elite Club Injury Study doctors' meeting was one of the most successful to date and showcased the clubs, UEFA and European football as a whole as some of the leading proponents of injury science in world sport. ●



Doctors from 23 different clubs travelled to Nyon for this latest get-together

DIAGNOSTIC APPROACH TO HEAD INJURIES IN FOOTBALLERS

By Dr Ioannis Economides, member of the UEFA Medical Committee

Football is a contact sport. The forces that occur during a match, the speed of the game and stress relating to the result of the match all cause increases in both arterial blood pressure and heart rate. A head injury may cause a variety of symptoms, such as bleeding from a skin laceration trauma, a nose bleed, bleeding from the ear, diplopia (double vision), concussion or loss of consciousness.

Concussion is a complex pathophysiological process affecting the brain which is induced by traumatic biomechanical forces. Concussion can be caused either by a direct blow to the head or by a blow to the neck or another part of the body which results in an 'impulsive' force being transmitted to the head.

An assessment of the various tackle mechanisms has identified that a deliberate or accidental clash of heads has the highest probability of causing an injury to one or both players (Fuller et al., 2004). This often occurs when players jump to challenge for the ball in the penalty area following a cross or a corner, or in the centre of the pitch following a clearance by a goalkeeper

or a defender. In the penalty area, a clash of heads is more likely to involve face-to-face contact, while a clash of heads in the middle of the pitch is more likely to involve contact between the face and the back of the head. The second most common cause of head/neck injuries involves contact between the arm or hand of one player and the head of another.

Skin lacerations can be sutured immediately – even on the pitch. In the case of a simple nose bleed which is not accompanied by nasal pyramid deviation, the nasal cavity should be well cleaned of mucous discharge and bloody secretions and an anterior tamponade should be put in place (either a gauze or a MeroCel). The player can return to the pitch if he/she does not have symptoms such as dizziness, tinnitus or vertigo. However, if the player has a nasal pyramid deviation, that should be reduced by the physician in the stadium or transferred to a hospital for further treatment. In the event of bleeding from the ear due to trauma, there may well be a fracture to the temporal bone, so the player has to be withdrawn from play and sent to the nearest hospital for a CT scan. Likewise, in



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the event of persistent diplopia, the player must be withdrawn and sent to the nearest hospital for more detailed evaluation. The same applies if the player shows symptoms of concussion or any loss of consciousness.

Concussion results in functional changes to the way that the brain works, but no structural damage can be seen using standard imaging tests such as a CT scan. It is well known that concussion follows a blow to the skull or an action that generates abrupt acceleration and deceleration of the brain within the skull. The acceleration/deceleration forces may lead to linear and/or rotational movement of the brain, whereby brain tissue is compressed inside the skull, increasing the risk of neurocognitive and neurobehavioural deficits (Barth et al., 2001).

The most common symptoms include headaches, dizziness, confusion, nausea, memory problems, 'mental foginess', fatigue, balance problems, attention and concentration problems, feeling 'dinged', stunned or dazed, seeing stars or flashing lights, and ringing in the ears. There may also be delayed symptoms such as sleepiness, sleep disturbance, 'nervousness' and a subjective feeling of slowness or fatigue (Erlanger et al., 2003; Iverson et al., 2004).

According to the Centers for Disease Control and Prevention (CDC) in the United States, symptoms observed by coaching staff that may be a sign of concussion include the following:

- Appears dazed or stunned
- Is confused about his/her role or position
- Forgets an instruction
- Is unsure of the game, score or opponent
- Moves clumsily
- Answers questions slowly
- Loses consciousness (even briefly)
- Shows mood, behaviour or personality changes
- Cannot recall events prior to the incident
- Cannot recall events after the incident

The following symptoms are reported by players:

- Headache or 'pressure' in head
- Nausea or vomiting
- Balance problems or dizziness
- Double or blurred vision
- Sensitivity to light
- Sensitivity to noise
- Feeling sluggish, hazy, foggy or groggy
- Concentration or memory problems
- Confusion
- 'Does not feel right' or 'feels down'



The following physical signs may be observed when examining a player:

- Slow to answer questions or follow instructions
- Poor concentration or easily distracted
- Loss of consciousness
- Poor coordination or balance
- Decreased playing ability
- Nausea and vomiting
- Slurred speech

It is essential that the team physician or a paramedic undertakes a physical examination on the pitch and conducts a thorough neuropsychological evaluation (e.g. attention and memory function tests), looking for weakness, paralysis or changes in sensation in the body. To maximise the clinical utility of such neuropsychological assessments, baseline tests are recommended. Examples include:

- Which team are we playing today?
- Who are you marking?
- Which team did we play last week?
- Did we win last week?
- Which half is it?
- Which side scored the last goal?

Balance and coordination should be evaluated. Vision and hearing could also be checked. The head will be examined, looking for signs of



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Head injuries must be treated with particular caution

injury, including potential skull or facial bone fractures. (For example, a clear liquid discharge from the nose may be a sign of a skull base fracture.) The neck may also be evaluated, since neck injuries can be associated with head traumas.

The Sport Concussion Assessment Tool (SCAT) was developed as part of the summary and agreement statement of the second International Conference on Concussion in Sport, which took place in 2004 in Prague (McCroory et al., 2005). This tool represents a standardised method of evaluating people who have suffered a concussion while playing sport.

There are no clear rules or guidelines when deciding whether a player should return to the pitch. The team physician or paramedic has to deal with each suspected concussion on a case by case basis. If the player shows any symptoms or signs of concussion, he/she should not be allowed to return to the match in question. More generally, players should never return to the pitch while displaying any symptoms, hence the maxim: 'If in doubt, sit them out.'

In conclusion, where a player has the above symptomatology, the physician should immediately withdraw that player from the game and send him/her to the nearest hospital for more detailed evaluation and surveillance. ●

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