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Introduction

Peter D. Fine, Chris Louca, and Albert Leung

This book is designed for both dental and medical professionals who either look after or who would like to be more involved in the care of both elite and recreational athletes. The role of specialist sports medicine practitioners has been well established for many years. The primary role of the sports medicine physician in competitive sport is the comprehensive health management of the elite athlete to facilitate optimal performance – the diagnosis and treatment of injuries and illnesses associated with exercise to improve athlete performance. Sports dentistry is a relatively new concept that is gaining momentum as the importance of good oral health and athletic performance become inextricably linked. For dental colleagues, this book will provide invaluable information about the recommended, evidence-based manner to provide for the dental needs of all athletes. For medical colleagues, the book will give you an insight into dental issues commonly seen with athletes and some guidance on how to deal with certain dental/orofacial emergency situations if a dentist is not immediately present. Throughout the book we shall refer to sportsmen and women of all sports as athletes, and we shall refer to professional sportsmen and women as elite athletes. This book is intended to be used as a manual by the sports medicine fraternity in order to ensure that athletes suffering from dental/orofacial trauma or tooth surface loss as result of dietary considerations and those who are in need of preventative measures, can all be treated in an appropriate, speedy, and efficient manner. We are grateful for contributions to this book from specialists in dentistry from all over the world. The book is designed to support dental/medical colleagues with the ever-increasing needs of athletes and the increasing role that dentistry/oral health has to play in athletic performance.

In this introduction, we look at the role that sports dentistry plays within sports medicine, the prevalence and incidence of dental trauma in the sporting arena, and outline the chapters that follow. With the exception of teeth that have been avulsed as a result of trauma, we shall consider dental trauma of teeth that are still in the oral cavity, and as such can be considered as cases of head injury. The relevance of head injuries will be considered in the relevant chapter from the point of view of their significance, but will not be dealt with in an exhaustive way as this is beyond the scope of this book. For more information the reader should refer to texts on concussion in sport or neurological information on the subject.

Sports and exercise medicine has been growing and gaining recognition around the world. In Britain it achieved official status in 2005, when the then Chief Medical Officer for England, Sir Liam Donaldson, promised to develop the specialty as a commitment to the

Sports Dentistry: Principles and Practice, First Edition. Edited by Peter D. Fine, Chris Louca and Albert Leung.

Companion website: www.wiley.com/go/fine/sports_dentistry

London 2012 Olympic Games. Figures from the London 2012 Olympiad show that 45% of athletes seen in the poly-clinic within the Olympic village or at any of the satellite sporting venues, were treated for musculo-skeletal injuries, whilst 30% were seen regarding dental issues. This high proportion of dental patients seen during the 2012 games indicates the significance of sports dentistry in the current age. Figures collected at recent Olympiads show a steady increase in the number of dental cases seen during the competition period: Atlanta (1996) 906; Sydney (2000) 1200; Athens (2004) 1400; Beijing (2008) 1520; and London (2012) 1800. These figures do need to be seen in context as they represent all dental patients seen during the Olympic Games, which will include a small proportion of trainers, managers, coaches, and ancillary staff. The vast majority are athletes, many of whom use the four-year cycle of the Olympic Games to get their teeth, eyes and hearing checked.

Therefore sports dentistry is not just about treating trauma to the teeth and jaws; the treatment and prevention of oral/facial athletic injuries and related oral diseases and manifestations is a significant part. Sports dentistry has evolved from a recognition that dental trauma is prevalent, particularly in contact sports, at all levels of sport, for all ages, and for both genders.

The Academy of Sports Dentistry was set up in San Antonio, Texas in 1983 as a forum for dentists, physicians, athletic trainers, coaches, dental technicians, and educators interested in exchanging ideas related to sports dentistry and the dental needs of athletes at risk of sporting injuries. Courses, seminars and symposia on sports dentistry are far more common today than in the 1980s. The role of the sports dentist is evolving continuously as new data become available. There is strong anecdotal evidence to suggest that poor oral health can have an impact on athletic performance and therefore the sports dentist has a more educational and preventative role to play than they might have done a few years ago. In Chapter 9 we will look into the implications of athletic performance and oral health. As dental professionals, we now recognise oral signs and symptoms, which can be indicators of systemic disease; recognising potential systemic problems from intra-oral signs is important for all professionals, but when dealing with elite athletes this has a particular poignancy as we are generally dealing with young, generally fit and healthy adults, the detection of eating disorders, which we will cover in Chapter 6, being one example.

For some time the specialty of sports medicine has been well recognised in medical circles and in the sporting world. Professional and amateur sport has been aware of the impact that good medical practice, well-trained medical specialists, and appropriate medical facilities can have on the enactment, well-being, and performance of athletes. The input from sports medicine experts, physiotherapists, nutritionists, and sports psychologists in the care of athletes has been well documented for many years. No self-respecting sports club would be without their professional or voluntary medical support, including the supportive and knowledgeable parents who give their time and expertise every weekend to support their sons and daughters. All major sporting events, like the Olympic Games, football world cups, rugby world cups, motor sports, and equestrian events, are well supported by medical professionals, often with a special interest in each individual sport. There is also a long history of medical professionals representing their country at various sports, including Sir Roger Bannister (athletics), Simon Hoogewerf (athletics), and JPR Williams (rugby).

In the world of modern professional sport, the medical team works closely with conditioning coaches, technical coaches, nutritionists, and psychologists to achieve the best results for the individual athlete and/or team. A lot of amateur sport is similarly well supported, sometimes by enthusiastic medical practitioners volunteering their time and knowledge, but also by well-trained professionals. The first editor's memory of taking a group of 17-year-old rugby players to tour South Africa in the 1990s included per-

suading the other coaches that we needed a professional physiotherapist with the team to make sure any youngster who really was not fit to take the field would not do so. It ended up that the professional physiotherapist was the busiest person on the trip and she quickly became a vital member of the support team, keeping players fit and more importantly advising the coaches on which players were not fit to play. Most athletes, whether keen amateurs or professionals, will want to continue playing their sport after an injury, therefore the involvement of knowledgeable professionals to support those athletes is paramount. None more so than in the situation of concussion following a trauma to the head. Current protocols about whether players who have suffered a head injury should be allowed to return to the field of play make the presence of a suitably trained person at every sporting event essential. The days of a willing parent saying a player is fit to return to the field of play should be behind us. The importance of head injuries should not be understated and the need to recognise head injuries and remove the player from the field of play is essential for the future well-being of young sports men and women. There is anecdotal evidence of elite athletes having to retire early because of the implications of a further concussion on their general health. There are also well-reported cases of traumatic injuries to the brain being fatal or career threatening. There is well-documented evidence to suggest that an athlete who has suffered a blow to the head resulting in concussion is susceptible to a second episode of concussion, which could be fatal if they are allowed to continue playing. This is especially the case in contact sports such as rugby, boxing, and hockey. Whether repeated concussive or sub-concussive blows to the head cause permanent brain injuries is complex and controversial. Press coverage in the 1970s highlighted the case of Jeff Astle the international footballer, where the coroner ruled that his death was due to 'an industrial disease', suggesting that the repeated heading of a football during his career had resulted in neurological decline [1]. This case was at odds with another footballer from the same era, Billy MacPhail, who in 1998 lost a legal battle to claim compensation for dementia that he claimed was due to repeatedly heading an old-style leather football [2].

Concussion can be defined as a traumatic injury to the brain due to a violent blow, shaking, or spinning. A brain concussion can cause immediate and usually temporary impairment of brain function such as thinking, vision, equilibrium, and consciousness.

Although anyone can have a concussion, we will focus here purely for the purpose of example on athletes who suffer a concussion. The considerations can be generalized to the general population where there is a traumatic injury to the brain.

The signs of concussion observed by medical staff in athletes with a concussion, according to The American Medical Association (AMA), include the following:

Player might appear dazed, have a vacant facial expression, be confused about assignments; athletes might forget plays, be disorientated to the game situation or score. There can also be inappropriate emotional reaction, players can display clumsiness, be slow to answer questions, lose consciousness and display changes in typical behaviour.

Subjective symptoms reported by athletes with a concussion, according to the AMA, include the following: headache, nausea, balance problems or dizziness, double or fuzzy vision, sensitivity to light or noise, feeling slowed down, feeling "foggy " or "not sharp ", reporting changes in sleep pattern, concentration or memory problems, irritability, sadness, and feeling more emotional.

Concussion has been shown to have an accumulative effect in both elite athletes and amateurs [3], and certainly concussion during a game can be exacerbated by an immediate return to play and a further blow to the head. This second blow can prove to be fatal. Some sports, like Rugby Union, have a protocol in place for the gradual return of its players to the game, depending on the

The world rugby recognise and remove message incorporates 6 Rs

Recognise - Learn the signs and symptoms of a concussion so you understand when an athlete might have a suspected concussion.

Remove - If an athlete has a concussion or even a suspected concussion he or she must be removed from play immediately.

Refer - Once removed from play, the player should be referred immediately to a qualified healthcare professional who is trained in evaluating and treating concussions.

Rest - Players must rest from exercise until symptom-free and then start a graduated return to play. World rugby recommends a more conservative return to play for children and adolescents.

Recover - Full recovery from the concussion is required before return to play is authorized. This includes being symptom-free. Rest and specific treatment options are critical for the health of the injured participant.

Return - In order for safe return to play in rugby, the athlete must be symptom-free and cleared in writing by a qualified healthcare professional who is trained in evaluating and treating concussions. The athlete completes the GRTP (Graduated Return to Play) protocol.

Figure 1.1 Current IRB guidelines on dealing with concussion.

severity of the concussion. At all times the health of the player should be our prime concern. The International Rugby Board (IRB) have drawn up guidelines for dealing with concussion that are regularly reviewed in the light of new knowledge. Figure 1.1 shows the current guidelines and Table 1.1 shows the concussion rates in several sports.

It is conceivable that a dentist will be the most qualified healthcare professional attending a sporting event, especially at an amateur level, and therefore knowledge about the signs and symptoms of concussion is essential. It is of course prudent to refer any potential head injury to suitably qualified medical colleagues, who can carry out

Table 1.1 Concussion rates for various sports. Source – 4th International Concussion Conference Presentation – Dr M Turner and subsequent publications.

Sport	Concussion rates per 1000 player hours
Horse racing (amateur)	95
Horse racing (jumps)	25
Horse racing (flat)	17
Boxing (professional)	13
Australian football (professional)	4–20
Rugby union (professional)	7
Ice Hockey (NFL)	1.5???
Following Rugby Union (youth)	1–2
Rugby Union (amateur, adults)	1–1.5
Soccer (FIFA)	0.4
NFL Football (NFL)	0.2???

appropriate tests and monitor the recovery of the individual.

Apart from the immediate and mid-term effects of a traumatic brain injury, there is some evidence to suggest that following a blow to the head, there could be long-term implications from repeated episodes of concussion. During the 2015/16 rugby union season in Europe, a study led by Professor Huw Morris featured a premiership club in England who agreed to wear impact sensors to measure the force and direction of impact to the head. Professor Morris said: "The impact sensors have been providing us with data during matches and training but analysing players' blood biomarkers in conjunction with neuro-imaging and psychometric testing will greatly expand this study. This is such a complex subject, we hope this is another step forward as we look to increase our understanding. We have a duty to look after our players, and nothing is more important than their welfare". These 'patches' worn by players during training and competition were

developed to address the inconvenience of wearing a wired mouthpiece to measure impact on the head during collisions [4].

There have been attempts to monitor and measure levels of concussion, but without a baseline measurement of individual athletes it is difficult sometimes to detect relatively minor levels of concussion. Pre-season cognitive baseline testing is relatively new to youth sports. It is typically a short computerized test administered prior to the beginning of the season that measures selected brain processes and scores the test for each individual athlete; this establishes the athlete's baseline. If it is suspected that the athlete may have sustained a concussion during the season, s/he can take a re-test. The computer software will compare the baseline score to the re-test score and alert the clinician that there has been a reliable change in the score. Computerized cognitive testing can also be used during management/treatment, even when a baseline has not been established. The changes/improvements in scores over time help to determine progress toward recovery. It is important to remember that computerized cognitive baseline testing is only a tool to be used by a trained clinician. It cannot diagnose a concussion and should always be used as one component of a concussion assessment.

The Sports Concussion Assessment Tool (SCAT) has been in use since 2005 as a reliable side-line assessment of concussion. The SCAT3 was developed at the 2012 International Summit on Concussion in Zurich; the Child-SCAT3 was released at the same time. The SCAT5 (the latest revision of SCAT3) is a standardised tool for evaluating injured athletes for concussion and can be used in athletes aged 13 years and older. It measures symptoms, orientation, memory, recall, balance, and gait. The SCAT5 can be administered by a licensed healthcare professional on the side lines or in the athletic trainer's office once an athlete has been pulled off the field because a concussion is suspected. The Child-SCAT5 is a standardized tool for evaluating children aged 5 to 12 for concussion and is designed for use by medical professionals. The Child-SCAT5 recommends that "any child suspected of having a concussion should be removed from play, and then seek medical evaluation. The child must NOT return to play or sport on the same day as the suspected concussion. The child is not to return to play or sport until he/she has successfully returned to school/learning, without worsening of symptoms. Medical clearance should be given before return to play".

Balance Error Scoring System (BESS) is included in the SCAT as part of a side-line assessment. The SCAT form (Figure 1.2), includes the Glasgow Coma Score, which was first published in 1974 as a tool to measure the severity of a brain injury [5]. On their scale, Teasdale and Jennet proposed that levels of consciousness ranged from 3-15; 3 indicating a coma and 15 a very mild level of injury.

In the following chapters we shall consider different types of dental trauma, how to deal with trauma both on the 'field of play' and in the emergency room/surgery. We shall look specifically at trauma on young athletes and the implications of damage to teeth in children and teenagers. A further chapter will look at tooth surface loss as a result of erosion and include some aspects of eating disorders, the difficulty of restoring these teeth, and the impact of acid on tooth enamel. Nutrition will be dealt with in a separate chapter, where we will look at the role of nutrition in athletes with an emphasis on their general health and how different sports demand different dietary protocols. We will consider the influences of carbohydrates, proteins, and fats on elite athletes, as well as supplements to a normal balanced diet. As our knowledge about oral health and athletes increases, we shall look at the current data available indicating the importance of good oral health and its potential to influence athletic performance. There is much anecdotal evidence to suggest a strong link between the two; we shall look at evidence to support the connection between good oral health and performance in elite athletes.

SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by

FIFA

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 professionals[1]. 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.

This tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. It should not be altered in any way, re-branded or sold for commercial gain. Any revision, translation or reproduction in a digital form requires specific approval by the Concussion in Sport Group.

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.

Echemendia RJ, *et al. Br J Sports Med* 2017;**51**:851–858. doi:10.1136/bjsports-2017-097506SCAT5

Figure 1.2 SCAT form to record levels of concussion.

The screening of athletes, particularly professional athletes, is a relatively new phenomenon. We shall investigate how to set up a screening programme, which could be applied to professional and amateur sport and which can involve the local General Dental Practitioner (GDP) attending their sports club to advise and if appropriate treat athletes. As with all screening, the idea of screening athletes is the early detection of

disease and by so doing prevent pain, loss of training and game time, and to take a more preventative approach to dental diseases. The role of the dentist within the sports medicine team will be discussed. As we shall discuss later in this chapter, there is a higher incidence of trauma due to sports injuries than in other sections of the population, particularly in contact sports, therefore treatment is sometimes required for traumatic dental injuries as well as for a relatively high level of dental caries in the athlete who perhaps has not seen a dentist on a regular basis. Therefore we have included a chapter, which will be largely appropriate for dental practitioners, about building/restoring fractured teeth both directly and indirectly. This will include the use of modern restorative techniques, using appropriate materials, and being conservative when it comes to tooth preparation.

Major dental trauma may involve the pulp (nerve and blood supply to the teeth), so we have asked one of our specialists to include a section on dealing with these issues (endodontic problems). Chapter 5 will consider how to deal with pulpal problems, from pitch-side emergency treatment to the final restoration in the dental surgery. It is important for sports medicine colleagues to be familiar with these issues, so we have included a section about recognising pulpal issues from a non-dental perspective. Of course we should consider closely the opportunities to prevent dental trauma and so we have a chapter on prevention of trauma as well as prevention of tooth surface loss as a result of acid, either in the form of food and drink or from gastric reflux.

Finally, we will look at the requirements for setting up suitable dental facilities at sporting events. These will range from the local sports club perhaps needing mouth guards to be made for its athletes and a phone number to contact in the case of a traumatic dental injury of a player, through to the provision of dental treatment at a major sporting event like an Olympic Games. The latter will involve recruiting suitable personnel, designing adequate facilities, and estimating the likely workload that will occur prior to and during the period of competition.

1.1 The Prevalence/ Incidence of Dental Trauma During Sport

There have been many studies carried out during the last 30–40 years indicating the prevalence of dental trauma in the sporting arena [6–9]. To put dental trauma related to sports in perspective, a study by Huang et al., indicated that sport and leisure were responsible for 30.8% of all dental trauma [10]. What we think is important is that we recognise trauma to the teeth and mouth, and the fact that trauma suffered in the orofacial area should be considered a head injury and appropriate precautions should be taken to deal with that. The history of sports dentistry is littered with anecdotal evidence of players having a tooth avulsed (knocked out completely) and the coach sending the player back onto the field of play before anything could be done to repair the damage. In fact an avulsion is quite a rare occurrence [11], but when it does happen it requires quick and effective treatment by whomever is available and appropriately trained to deal with the dental emergency. The importance of adequately accessing head injuries in sport has been a major concern in recent years and should be something that dentists attending a sporting event in a professional capacity, watching their children play sport, or perhaps where they are the only medically qualified person in attendance need to be proficient at. The current guidelines laid down by the Rugby Football Union in England are essential for all levels of sport (See Figure 1.1).

A study by Hendrick et al. highlighted the prevalence of orofacial injuries in female hockey players [9]. Of the respondents, 68% reported having received a facial injury, 11% had fractured facial bones, 19% had dental trauma, 10% reported loosened teeth, 5%

avulsed at least one tooth and 3% had fractured a tooth. In Ice Hockey, Hayrinen-Immonen reported that 29% of all injuries sustained during a match were dental [12]. Ice Hockey is a particularly violent sport where professional players see the loss of front teeth following a trauma as a badge of honour. Obviously the sports that are most likely to result in trauma to the orofacial region are contact sports. In rugby at the non-elite level, Blignaut et al. showed that 30.5% of all injuries were dental [7]; Muller-Bola et al. indicated that 29.6% of injuries in their sample were to the lower half of the face [13]. We will consider the work of Blignaut more fully in Chapter 7 when we look at various methods of prevention of dental injuries. A study looking at the aetiology of paediatric trauma reported that between 1.2 and 30% of all facial traumas were due to sporting trauma [8].

Since the recent success of British cyclists at Olympic and world events, there has been a boom in the number of recreational cyclists. Equally we see a larger proportion of facial injuries with cyclists and 3384 cases of hard dental tissues and 2061 cases of soft tissue injuries were reviewed by Haug et al. [8]. Table 1.2 shows the results for hard tissue injuries and Table 1.3, soft tissue injuries.

Amongst 2061 soft tissue injuries in 1697 patients, 51.9% were lacerations, 22.6% were abrasions, 13.8% were contusions, and 11.7% were hematomas (See Table 1.3).

Table 1.2 Showing the number and percentage of dental traumas due to cycling.

	Number	%
Crown fractures	975	28.8
Root fractures	45	1.3
Luxation injuries	1904	56.3
Losses of teeth	244	7.2
Contusions	68	2.0
Intrusions	148	4.4
Total	3384	100

Table 1.3 Soft tissue injuries

Soft Tissue Injury	n	%
Lacerations	1069	51.9
Excoriations	466	22.6
Contusions	285	13.8
Hematomas	241	11.7
Total	2061	100

Soccer is played across the world and is particularly common throughout schools in many countries around the world. In Norway it was found that from a total of 7319 soccer players between 1979 and 1983, 17.4 % received dental trauma [14]. Studies comparing indoor [15] with outdoor [16] soccer injury rates indicate that indoor soccer players were six times more likely to encounter injuries than outdoor soccer players with similar hours of playing time. Higher injury rates in indoor soccer may be attributable to many factors, including the playing surface, and collisions between players and the walls bordering the field of play. Differences between artificial turf and natural grass playing surfaces account for variable injury rates among adult soccer players playing outdoors [17].

Flanders and Bhat reported that male and female soccer players were more likely to sustain an orofacial injury than football players [18]. This is probably due to the mandatory need for face shields and helmets to be worn in football. (It is worth emphasising here the difference in terminology: in the USA, football refers to american football and soccer refers to what Europeans call football.) They also reported a higher incidence of sporting trauma in basketball, lacrosse, and handball.

Whenever a major sporting event is held it is seen by elite athletes as an opportunity to have a dental examination. Studies undertaken at the London 2012 Olympic Games reported that 9% of elite athletes attending the games had never seen a dentist and 46.5% had not seen a dentist for over a year [19]. We will consider this aspect further in Chapter 8.

The London 2012 Olympic Games also proved to be an interesting opportunity to study elite athletes' oral health and previous history (we will deal with this in Chapter 9).

Whenever a major sporting event is held it is seen as an opportunity for sports medicine specialists to learn more about injuries and how to deal with them. Similarly recent sporting events have proved to be ideal to investigate the prevalence of dental trauma. One such study was conducted during the Pan American Games [20]. This proved to be a good opportunity to compare different sports at the same time; what was surprising was that 49.6% of athletes reported a history of dental trauma and 63.3% of injuries were during sports of which the most prevalent were: wrestling 83.3%, boxing 73.7%, basketball 70.6%, and karate 60%.

1.2 Dealing with Trauma to Teeth

In Chapter 4, we will consider how to repair fractured teeth using conventional dental restorative techniques, but we shall be particularly conscious of the need to be conservative in our approaches. We have not looked at the replacement of teeth that are either lost or damaged beyond repair as the prosthodontic replacement of missing/damaged teeth is beyond the scope of this book. As sports dentists we are occasionally faced with a situation where we have to replace a missing tooth. Several options are available to us, including the use of resin-retained bridges, conventional fixed-bridge work, removable prosthodontic work, and implants. The dentist needs to consider the type of restoration needed by the athlete and take into account the likelihood of further trauma, aesthetics, the oral health status of the athlete, and their willingness to undergo restorative dental treatment. Treatment might be divided into immediate, interim, and definitive phases, which might include the use of any combination of the above treatment options. In the case of an elite athlete taking part in a contact sport, the definitive treatment of placing an implant may have to be delayed until the individual has ceased playing and an interim measure of a resin-retained bridge be used for aesthetic, phonetic, and functional reasons.

The use of various restorative measures will need to be considered in conjunction with a well-constructed mouth guard. This will be considered in Chapter 7.

1.3 The Role of Saliva in Tooth Surface Loss

We have not included a separate chapter in the book on saliva, but we do consider the role of hydration with athletes in some detail in Chapters 7 and 8. It is worth mentioning that saliva has a major role to play in hydration, and so the testing of a patient's saliva is important, particularly when planning restorative treatment and instigating preventative measures. The important aspects to consider are: the buffering capacity of saliva, saliva flow rates, level of hydration as indicated by saliva volume, the consistency of saliva as this can be an issue if saliva is too viscous and does not naturally wash the dentition, the quantity of saliva being reduced due to medication, i.e. systemic bronchodilators, cardiac anti-arrhythmics, expectorants, and tranquillisers. There are numerous saliva testing kits on the market, which can be used either in the surgery or at the sports venue (during screening) to advise athletes about the need for hydration and to test their salivary function.

In addition, the presence or absence of saliva has an important role to play in the immune response of saliva. Especially during endurance exercise, elite athletes who have a reduced saliva presence show a decrease in IgA levels, but it is unclear whether this is associated with an increase in upper respiratory tract infections [21]. Psychological stress has also been shown to decrease salivary IgA levels [22], but the relevance of

this observation to immune fitness following fatiguing exercise is unclear.

1.4 The Role of Education

In common with all dental patients, it is important to emphasise the significant role that education plays in sports dentistry. We need to be able to educate our athletes from an early age about the potential problems of dental diseases and what preventative measures can be put in place. When dealing with a primarily young cohort (16–30 years), it is essential to install good habits in terms of diet, oral hygiene, and a preventative strategy. One of the problems particularly relevant to elite athletes is their availability to visit the dentist. Track and field athletes during the season are travelling the world entering various competitions and therefore are extremely difficult to tie down for a dental appointment. Sports dentists need to be aware of this and be flexible in their appointment systems to accommodate an athlete who may only be in the country for a couple of days and needs to have a dental issue resolved. This will often involve just getting the elite athlete out of pain and rearranging a suitable time for a follow-up appointment. Once free of pain, it is common for these elite athletes to forget or cancel appointments, as they are no longer uncomfortable. It is important to educate the athlete that they need further treatment before the situation deteriorates further, something which is challenging for an elite athlete who needs to catch a flight the next day to compete.

As sports dentists, we can have a positive effect on educating elite athletes during a screening session and should take every opportunity to re-iterate the preventative message whenever possible. Chapter 10 will look at screening, but suffice to say screening of soccer and rugby players in the UK is becoming more common during pre-season assessments and training; an ideal time to educate and spread the word.

1.5 The Role of Sports Dentistry

So what role can dentistry play in the world of sports medicine? The simple answer is many roles. The fundamental idea behind this book is to discuss those aspects of dentistry that have an impact on athletes from all sports and all grades of sport, and to consider how we as sports dentists can support our medical colleagues. As sports dentists we enable our colleagues in general dental and medical practices to feel confident to take an active role in the health and care of sports people and advise other health professionals on those specific areas of dental care that are particularly relevant to athletes.

The role of the sports dentist is continually evolving; initially we dealt with oro-dental trauma, then our skills spread to include emergency treatment of orofacial trauma, then prevention of injuries and most recently looking at the impact of oral health on the performance of elite athletes [19]. This book is designed to be useful to dental practitioners with a special interest in sports dentistry, as well as medical professionals who, whilst having seen dental trauma, are generally unaware of first aid measures that can make a significant difference to the long-term dental treatment of athletes. In this book we will investigate how to recognise dental trauma as a result of a sporting injury, we will consider the prevention of dental trauma, but if it should occur, how to restore those traumatised teeth, we will look at dietary advice for athletes, particularly with dental caries and tooth surface loss in mind, and consider how we can work with club doctors, physiotherapists and nutritionists.

The contents of this book form the basis of a 12-day sports dentistry programme at University College London Eastman Dental Institute that prepares general dental practitioners for dealing with athletes at all levels of sport. The programme covers all aspects of sports dentistry, including the particular problems encountered by Paralympic athletes, the role of the sports dentist with

respect to banned substances that may be taken by athletes they look after, the repair of tissues following injury, i.e. muscle and bone, dealing with soft tissue injuries and the psychological implications of injuries on athletes. Teaching is a combination of seminar-based sessions and hands-on, skills-based training. Not all these issues will be dealt with in great detail in this book, but the common concerns of athletes and elite athletes in terms of sporting trauma, its prevention, dietary implications, the repair of damaged teeth, and differences between treating adults and children will be highlighted.

The London 2012 Olympic Games proved to be an inspiring and interesting opportunity to study elite athletes' oral health and previous history (see Chapter 9). The role of sports dentists in the future has been changed by the experience of those researchers at London 2012, who opened the minds of dental and medical sports practitioners as to the potentially significant role that dentists can play in elite and general sport. The interest shown worldwide in studies that emanated from those researchers has resulted in a revolution in sports dentistry and a realisation that future elite athletes need to consider their oral health along with their nutrition, cardiac physiology, fitness routines, and psychological well-being.

Elite athletes do need special consideration when it comes to dental matters and the role of prevention is paramount not just in trauma cases, but in preventing dental diseases and tooth surface loss. We need to consider dietary factors as well as the overall well-being of the athletes; screening of athletes is a very valuable way of tackling dental disease amongst a population that seems to be more prone to the ravages of dental caries, periodontal disease, and tooth erosion.

If this book inspires you to discover more about sports dentistry, please feel free to contact the editors for information on current courses/programmes. We are also happy to attend individual sporting venues, events, and clubs to advise you on how you may incorporate some of the information in this book and help your athletes achieve their ultimate goals, prevent trauma and tooth surface loss, and develop a strategy for athletes to encompass good oral health measures.

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