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Imaging in sport and exercise medicine: “a sports physician’s outlook and needs”

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ABSTRACT. Sport and exercise medicine (SEM) is an exciting new medical specialty that thrives on interdisciplinary practice. The SEM physician will usually be found managing a wider, multidisciplinary team of specialists, orchestrating their various inputs to ensure that the most effective management plan is delivered to the patient. One key member of this team is the radiologist, with whom the SEM physician usually has a very close working relationship. Areas of SEM practice that commonly involve significant input from radiologists include the use of appropriate imaging to confirm an accurate diagnosis and to inform management planning (such as decisions on return to play in the elite athlete), various screening and pre-participation assessments and also technical assistance with certain procedures. This article discusses the relationship between the SEM physician and the radiologist across each of these areas, illustrating the important contribution made by imaging services to the specialty of SEM.

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Sport and exercise medicine (SEM) is a relatively new medical specialty that concerns itself with the medical care of the exercising individual. This may involve the diagnosis and management of exercise-related injury or illness or the use of therapeutic exercise in those with chronic disease. Perhaps the most important contribution to be made is in the use of exercise to prevent the significantly increased morbidity and mortality associated with inactivity.

High-performance sports medicine describes the delivery of SEM in the unusual (and often demanding and stressful) world of elite sport. Whilst the focus is always on performance enhancement, the practice of medicine in elite sport must always follow “good medical practice”, with the health of the athlete remaining the highest priority.

SEM is a truly multidisciplinary specialty. The effective management of exercising individuals requires input from many different clinicians and other specialists, no more so than in the world of elite sport. High-performance sports medicine can only be delivered effectively by a well-integrated, experienced multidisciplinary team, which can undoubtedly have a significant positive impact on performance. The multidisciplinary team would usually include doctors, therapists, strength and conditioning trainers, and sports scientists (*i.e.* nutrition, psychology, biomechanics, performance analysis etc.), in addition to a wider network of specialist support, including radiologists and surgeons. Of all the medical specialties, the sports physician’s closest working relationship is typically with a radiologist.

Sport and exercise medicine and radiology

Sports physicians have a clear interest in radiology and radiologists appear to be increasingly interested in musculoskeletal sporting injuries, as evidenced by two of the top five “hottest articles” in the latest edition of *Clinical Radiology* being related to SEM [1, 2]. So what does the sports physician need from medical imaging, and how can radiology best support our patients to ensure that they achieve their best performance? In simple terms, the role of imaging in clinical SEM may be described in four areas:

- (1) confirmation of accurate diagnosis
- (2) information to help inform management planning and decisions on return to play
- (3) screening and pre-participation assessments
- (4) technical assistance with certain procedures.

Sport-related injuries can be broadly divided into acute, traumatic injuries and chronic, overuse injuries. As in any other branch of medicine, the diagnosis is usually established after taking a thorough history and performing a careful clinical examination, but will often also include a degree of additional functional assessment. Many factors will have contributed to the injury and the clinician must understand the various demands of the sport concerned and take into account the peculiar functional stresses and injury patterns of that sport if they are to arrive at a specific diagnosis. Factors to consider include a range of internal issues (*e.g.* the athlete’s age, fitness level, biomechanics, previous injuries, current general health) and other external issues (*e.g.* training programme, environmental stressors, equipment, level of competition), all of which must be taken into consideration when formulating an effective management plan.

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The complex nature of some injuries and the need for rapid diagnosis to inform decisions on management increase the demand for accuracy and urgency in managing the elite athlete. In practice, the diagnostic process and decision-making in relation to return to play are one and the same in elite sport, and radiological support may be used to inform both decisions.

Imaging modalities

The range of pathologies and different tissues injured during sport and exercise determine the imaging modalities used. With soft-tissue injuries being common, the opportunity to image with ultrasound during functional movements (often as an extension of the clinical examination) and avoid any exposure to irradiation makes this a very useful tool. Examples include extensor carpi ulnaris tendinopathy and subluxation problems in the wrist and rectus abdominis tears in tennis players.

MRI also has a high yield in soft-tissue injuries, including documenting the extent of muscle damage (which has been shown to correlate with prognosis [3]), as well as the ability to identify intra-articular lesions such as meniscal and articular cartilage injuries. MRI is particularly useful in identifying bone stress, which occurs in a wide variety of sporting injuries. Plain radiography and CT are helpful in assessing both acute and insidious bony trauma and degenerative joint disease, such as lower limb stress fractures and ankle impingement.

Use of imaging

The use of imaging as a valuable diagnostic tool is growing in many medical specialties, but especially within SEM. Indeed, diagnostic ultrasound has recently been described as the "sports physician's stethoscope" as more and more practitioners have adopted its use in their clinical practice. The ability to image tissues with ultrasound as a direct extension of one's clinical examination can both improve the accuracy of diagnosis and greatly enhance the patient's understanding of their injury. Moving the diagnostic scanning process from the radiology department to the outpatient clinic does bring with it concerns about safety and clinical governance. There has been much debate about the levels of competency of sports physicians using this very user-sensitive imaging modality and various initiatives to define training requirements and standards of practice for non-radiologists [4]. Provided sports physicians are trained and maintain their skills to an agreed standard, there is no doubt that they are very well placed to scan and interpret sports injuries, given their extensive knowledge and understanding of functional musculoskeletal anatomy and patterns and mechanisms of injury, as well as having the distinct advantage of knowing the full history and clinical examination findings.

The interest in imaging comes not just from the clinicians but also from their patients, who have become increasingly knowledgeable about medical technology and treatment options. Elite athletes are a peculiar group of individuals who have a heightened awareness and understanding of their body's physical and physiological

function and who, as a result, will often want to become more involved in the management of their injury. Whilst this is to be encouraged (as it undoubtedly improves compliance with treatment and so outcome), it risks the development of a customer-driven approach to management in which the athlete leads decisions on when and what to image. It is not uncommon for athletes to demand that they have a particular form of scan before they can be convinced of their fitness to train or compete. In the competition setting, the sports physician must be mindful of the impact that imaging can have on an athlete's confidence. A minor abnormality detected on imaging that may not have a significant effect on physical performance can have a serious negative impact on the athlete's psychological state if revealed just before competition. Equally, a negative scan can help to reinforce the athlete's confidence in their ability to perform to their best.

This focus on imaging can extend further to include coaching staff and managers, who are increasingly involved in injury management. Indeed, team managers will often be quoted as saying that "we are waiting for the player to have a scan", rather than "we are waiting for the player to be assessed by our medical team". Such comments may, however, eventually become obsolete as clinical assessment and imaging merge and are delivered closer to the field of play. One example of this trend is the use of portable ultrasound at the pitch side. This has been used to assess injuries and guide injections during Australian rules football matches [5], and was trialled during the 2010 Vancouver Olympic Winter Games to help inform decisions on return to play.

Medical assessments

Most pre-participation medical assessments do not involve radiological investigation. Two notable exceptions in sport are cardiac screening and pre-signing medicals in professional sport.

Cardiac screening

Sudden cardiac death in sport is fortunately rare, but is a tragedy that appears to strike apparently healthy, exercising individuals and is usually caused by an undetected, often asymptomatic, cardiac anomaly [6, 7]. Cardiac screening of apparently healthy young athletes is controversial, but aims to reduce the incidence of sudden cardiac deaths caused by preventable cardiomyopathies and conduction anomalies [8]. The International Olympic Committee (IOC) supports cardiac screening, and its recommendations [9] include echocardiography for individuals with risk factors on history, clinical examination or routine electrocardiogram. Some sporting organisations routinely screen elite junior players with echocardiography. The charity Cardiac Risk in the Young [10] has further information on cardiac screening in the UK.

Pre-signed medical assessments

Pre-signing medical assessments are common in professional sport. The contribution of imaging to such an

assessment is to quantify and document any structural deficits and damage from previous injuries, as these may be used to negotiate the terms of a contract.

The IOC has developed a periodic health examination that aims to monitor the health of athletes throughout their sporting career. Whilst there is no specific imaging input, this may well be used to monitor ongoing pathology.

Ultrasound

The use of ultrasound to guide intra-articular and intralesional therapeutic injections is now common practice in many specialties and has been shown to both increase the accuracy of needle placement [11] and improve clinical outcome [12]. There is much debate about who is best placed to perform guided injections in the treatment of sports injuries. Rapidly advancing technologies and increasing expectations mean that the radiologist (who may have the greater technical ability and experience of the procedure) is perhaps best placed to perform the injection. Coupled with this are concerns about current specialist medical training, which may compromise the young SEM physician's ability to develop the skills required to deliver this form of treatment without imaging support. The SEM physician does, however, have the distinct advantage of knowing the athletes, their sport and its functional demands, and the underlying pathology. In the world of high-performance sport, there is much to recommend continuity of care from the clinic to the field of play.

Further issues surrounding the use of guided injection treatments include the need to be cognisant with current antidoping regulations and the World Anti-Doping Agency code [13]. Regulations are reviewed annually and may change with respect to the use of newer, emerging treatments, such as platelet-rich plasma.

Conclusion

The future of imaging in SEM is an exciting prospect. As technology develops, the ability to better understand the relationship between structure and function during athletic activity will improve. The use of dynamic MRI scanning and 640-slice dynamic CT imaging are beginning to reveal more about how the musculoskeletal system moves and should help us to better understand some of the demands of sporting activity and the abnormal functional movement patterns that result from

injury. By working closely together, SEM physicians and radiologists can significantly improve the clinical management of sporting injuries and thus enhance the performance and health of all exercising individuals.

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