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A physiotherapy perspective of musculoskeletal imaging in sport

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ABSTRACT. This paper presents a physiotherapy perspective on the role that imaging is now playing in the diagnosis and management of musculoskeletal and sporting injuries. Although the Royal College of Radiologists and the UK Chartered Society of Physiotherapy were founded in the latter part of the nineteenth century, it is 100 years later that developments in the UK NHS have led to increased roles for non-medical healthcare professionals and allied health professionals, such as physiotherapists, in an extended clinical role. Physiotherapists, perhaps because of their knowledge of clinical and applied anatomy, have keenly taken up the opportunities offered to request and interpret imaging in its various forms; the most commonly available are plain radiography, musculoskeletal ultrasound and MRI. This has meant taking formal courses under the auspices of universities with mentorship and tutoring within the clinical setting, which are part of a continuing professional development. The ability to request several forms of imaging has enhanced physiotherapy practice and has increased the appreciation of the responsibilities which accompany this new role.

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The relationship between musculoskeletal imaging and physiotherapy practice can broadly be divided into three areas: imaging as an aid to clinical diagnosis; imaging as an aid to injury management rehabilitation and, finally, imaging as an aid to treatment accuracy, specifically ultrasound-guided injections.

Clinical diagnosis

The majority of the requests for diagnostic imaging in the sports medicine setting are for musculoskeletal problems. Imaging in its various forms is invaluable in the diagnosis of sport injuries with the caveat that the results of a physical examination should supersede the findings on an MRI scan or other diagnostic test and clinical judgement should be paramount [1]. With the advances in technology, ultrasound has been rediscovered as an important diagnostic technique for sports medicine in particular. A decrease in cost has also added to its attraction. The important role that physiotherapists play in the diagnosis and treatment of soft-tissue injury and in sports medicine has meant that ultrasound has become an important tool not only in their collaborations with radiology clinicians but also in their becoming more expert in the technique itself.

As well as its use in the physiotherapy clinic and sports medicine office, the role of ultrasound in the field of play on the pitch side during match day and ''on the road'' is now becoming more apparent, although it is still not widely used in professional sports [2]. There is still some debate as to its limited role in the assessment of injuries and contribution to diagnosis during match day, but its contribution to match day procedures such as local anaesthetic injections will be potentially valuable [3]. A recent collaborative study between emergency medicine physicians and physiotherapists indicated that ultrasound may also be valuable in small sports medicine clinics and on match day, when the other imaging techniques are not available. Here, ultrasound has been found to be viable in helping to rule in or rule out fractures following ankle or foot sprains [4].

However, it is an important consideration that using ultrasound on the pitch side immediately after musculoskeletal injury and requesting MRI in the acute setting may not actually change the management of the injury and the well-known ice–compression–elevation protocol [5].

Diagnostic ultrasound is also known for its capability in categorising soft-tissue injury. In Achilles tendinopathy, scientists and physiotherapists have been able to provide a wealth of information on tendon integrity [6–8].

Cook and Purdam [9] proposed a continuum of tendon pathology comprising three stages: reactive tendinopathy, tendon failed healing and degenerative tendinopathy. The three-stage model had distinctive features clinically as well as on imaging, primarily with ultrasound. For example, for the first stage of reactive tendinopathy, the tendon is swollen in a fusiform manner; the diameter is increased on both MRI and ultrasound scans. Because the three stages of Achilles tendinopathy have differing physiotherapy rehabilitation protocols, there is an important role in imaging to categorise musculoskeletal injury and direct physiotherapy treatment.

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The technique of ultrasound tissue characterisation has provided evidence of clear advantages over conventional ultrasound. This allows the imager to see significant differences between symptomatic and asymptomatic tendons, providing the physiotherapist treating the condition with a quantitative method for the monitoring and evaluation of existing and new treatment protocols for tendinopathy [10]. The relationship between the various greyscale ultrasound categories, Doppler flow and pain has also been investigated. There was a greater probability of tendon pain in hypoechoic tendons (59%) and diffusely thickened tendons (43%) than in normal tendons (24%). Doppler flow was common among tendons containing a hypoechoic region (42%), uncommon among diffusely thickened tendons (6%) and absent among normal tendons. The current findings suggest that greyscale ultrasound imaging demonstrates stages of tendinopathy. There is a greater risk of pain and neovascularity among tendons containing a hypoechoic region. However, diffusely thickened patellar tendons may also be painful, usually in the absence of Doppler flow. This information may assist in interpreting ultrasound scans among people with pain in the region of the patellar tendon [11].

Ultrasound is also used to discriminate between types of low back pain, thus adding to the diagnostic accuracy, and helps to direct the appropriate physiotherapy in this difficult condition. Ultrasonography may be used as a non-invasive method to detect or measure activity of specific muscles during isometric contractions. It can be used to detect low levels of muscle activity but cannot discriminate between moderate and strong contractions. Ultrasound measures could reliably detect changes in electromyography of as little as 4% maximal voluntary contraction (MVC) (in biceps muscle thickness), 5% MVC (in brachialis muscle thickness) or 9% MVC (in tibialis anterior pennation angle) [12]. This is particularly pertinent in physiotherapy as the importance of subgrouping injury and pathology in order to focus treatment more precisely is now being seen as an important area of assessment. Real-time ultrasound provides a viable tool for measurement of muscle activity, particularly for deep or small muscles, provided that the relationship between activity and the measured parameters is known.

In the shoulder, evidence-based clinical guidelines from the Chartered Society of Physiotherapy have underlined the importance of plain radiography, ultrasound and MRI in helping to establish a diagnosis in shoulder impingement. Once again, ultrasound has a prominent place in diagnostics for physiotherapists owing to its safety, convenience and comparatively low cost. Its ability to diagnose full-tear rotator cuff tears is probably reliable and as convincing as MRI [13]. An important proviso for shoulder ultrasound examination has been the following of a standardised imaging protocol [14].

Injury management

Physiotherapists have recognised that imaging not only helps with diagnosis but also can monitor injury progress and direct rehabilitation [15]. Monitoring injury can range from measuring the changing size of a haematoma to using Doppler ultrasound to assess the stages of inflammation in tendinopathy. Researchers using ultrasound in patellofemoral pain syndrome, a common musculoskeletal problem in sports medicine, have been able to quantify quadriceps muscle atrophy and direct physiotherapy and rehabilitation accordingly [16]. They found that quadriceps atrophy is not as common an accompaniment to patellofemoral pain as previously thought. It has also been used successfully to visualise muscle contraction and activity in real time, in the measurement of muscle thickness and cross-sectional area in research studies. Ultrasound is advocated as a clinical biofeedback tool in the rehabilitation of transverse abdominis function following episodes of low back pain [17]. For physiotherapists, real-time visualisation of the transverse abdominis has been a regular rationale for ultrasound technique [17–19]. Its usefulness to differentiate between different types of muscle contractions, or timing of muscle activation, is perceived as an important part of rehabilitation [19, 20]. Monitoring muscle activity in low back pain by ultrasound supports the theory that certain forms of physiotherapy would be more applicable to those with low back pain with poor abdominal muscle recruitment.

The tendo-Achilles visualisation of neovascularisation, as achieved by both colour Doppler and power Doppler ultrasound, gives important new information for the clinician to both detect and directly influence the area of interest in tendinopathy [21].

Several studies demonstrate both short-term and long-term changes in the imaging appearance of tendons. Nearly half of normal yet painful patellar tendons became abnormal (mainly as a result of reactive tendinopathy) in the presence of ongoing high tendon load over a season of volleyball. A single tendon became hypoechoic, indicating transition through a reactive tendinopathy to tendon dysrepair/degenerative tendinopathy. Longitudinal imaging studies have consistently demonstrated that between 10% and 30% of tendons reported as abnormal at baseline become normal at follow-up [6–8]. This supports the viability of a transition from reactive change back to normal tendon and the usefulness of diagnostic ultrasound in monitoring injury recovery.

However, the clinician should be cautious for several reasons. First, both ultrasound and MRI commonly result in false-positive and false-negative diagnoses. As always, careful clinical correlation with imaging findings is essential. Also, with either MRI or ultrasound imaging tendon abnormalities persist even when patients have done well with physiotherapy and made good functional recovery. Thus, imaging appearance should not be used to guide whether or not a player is fit to return to sport after Achilles tendinopathy [22]. However, should future studies closely control the treatment protocol prescribed for various pathologies, it would add strength to any finding of an association between imaging appearance and clinical outcome. This illustrates that, particularly in sports medicine, a close collaboration between radiology assessment and physiotherapy assessment should exist for a successful return to sport.

Ultrasound-guided injections

Diagnostic musculoskeletal ultrasound has become an increasingly important adjunct to clinical examination for physiotherapists, but the technique is now being used increasingly for procedures such as intra- and periarticular injections. This is now a relevant issue for physiotherapists as many working in an extended scope role in the NHS are now performing injections. It has been documented that 14–71% of injections carried out ''blind''—without image guidance—miss their target [23–27]. What we do not know is whether this makes a difference in clinical efficacy. It is perhaps because of these concerns and the improved technology that ultrasound is an increasingly popular technique to ensure accuracy of soft-tissue injection in sports medicine for medical staff and physiotherapists [28]. Eustace et al [24] report improved outcomes in shoulder pain in accurately placed subacromial and glenohumeral injections. Nevertheless, some have suggested that ultrasound guidance does not make a difference in long-term efficacy [29, 30]. The results of one study indicate that local corticosteroid injection with guided ultrasound is no more effective than systemic corticosteroid injection for short-term improvement in rotator cuff disease [31]. Harmon and O'Connor [32] argue that injections may not need accurate ultrasound-guided placement, particularly with corticosteroid, which may diffuse through the tissue planes to affect the target tissue despite inaccuracy.

London 2012

The 30th Olympiad in London, UK, will provide an idealistic situation of the role and availability of imaging in sports medicine and the diagnosis, management and treatment of musculoskeletal injury. Services available in the Olympic village will be MRI, ultrasound, CT and plain radiography. These will all be reported by a musculoskeletal consultant radiologist and it is highly likely, judging from past experience, that the combination of clinical examination, imaging assessment and instigation of treatment for Olympic athletes will all be performed rapidly after presentation to the Olympic Polyclinic.

In summary, imaging plays an essential role in the diagnosis and monitoring of sports injuries. However, the information it provides should always be married with clinical examination. From physiotherapists' perspective, the ability to request various forms of imaging has transformed their role in the assessment and management of sport injuries.

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