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Qualifications: MA VetMB MRCVS

Year of Qualification: 2002
Main interests: My main area is equine orthopaedic disease with an emphasis on diagnostic imaging. I have a special interest in computed tomographic and magnetic resonance imaging and the early detection of stress injuries in racehorses.

I graduated from the University of Cambridge Veterinary School in 2002. I completed an equine internship in Canada and spent time in first opinion equine practice before joining RosSDales in 2005. I am one of four senior orthopaedic clinicians at RosSDales Equine Diagnostic Centre, where we are proud to be recognised as world leaders in equine diagnostic imaging techniques. I currently head the imaging facility at the Diagnostic Centre and I am particularly interested in further developing our advanced imaging techniques (MRI and CT), a subject on which I publish regularly. I have lectured extensively at international and national scientific meetings and conferences. Additionally, I act as a consultant and provide image reading services to a number of other veterinary practices wishing to improve their own imaging skills and facilities. I have a number of collaborative equine clinical research projects in progress and hope to achieve my Fellowship of the Royal College of Veterinary Surgeons in due course.

MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) describes the method of imaging the horse by stimulating the molecules in the tissue to 'resonate' when a magnetic field is applied to them.

The most common application is to investigate causes of foot pain in horses when a specific diagnosis is required to aid prognosis and enable more appropriate treatment/management. MRI first became available to equine patients in the mid 1990s, but, until 2004, a general anaesthetic was required to carry out the scan. More recently, an MRI scanner has been developed that enables us to scan horses standing, under mild sedation – removing the risk of general anaesthesia. Every year, around 300 horses undergo an MRI scan at RosSDales. The foot, fetlock, upper cannon and knee are commonly investigated using this method.

How MRI works

When the area (i.e. tissue) we are interested in is placed into a strong magnetic field and a short pulse of radio waves is applied, the tissues 'resonate' and a weak 'signal' echoes back from the tissue. The echo varies depending on the type of tissue present in the anatomic site being imaged. This depends on the amount of hydrogen ions (water molecules) present in the tissue. Ligament, bone and tendon have a characteristic signal on MR images. The images appear as black and white 'slices' through the tissues. Abnormal signal can be the result of a number of disease processes within the tissue, such as inflammation or degeneration.

Advantages of MRI over other imaging techniques

MRI allows us to see what's going on in the tissue right now! Radiography and ultrasonography rely on damage to tissues causing a STRUCTURAL change, whereas



A horse, under mild sedation, positioned in the MRI scanner for imaging of its lower forelimb

MRI can tell us about the BIOCHEMICAL CHANGES long before there is structural damage. This allows us to detect injuries earlier than with other imaging techniques. The foot is a complex anatomic area that had been

difficult to assess fully until the introduction of MRI. X-rays give us information about the bones within the foot and the hoof capsule impedes the use of ultrasound. Using MRI we can now image the bone AND soft tissues

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of the foot in detail, both of which are frequently implicated in foot lameness. This is particularly true of what is commonly called 'Navicular Syndrome' (NS). A number of different structures can be implicated in NS, including the deep digital flexor tendon, the impar ligament and the suspensory ('T') ligament of the navicular bone, which carry different prognoses and may require individual therapies. However, horses often present to the lameness clinician in a similar way, irrespective of the specific structures involved.

An added benefit is that unlike radiography and scintigraphy (bone scanning), MRI does not involve the use of ionising radiation, so there are no hazardous biological effects to either the horse, or the vets and technicians carrying out the scan.

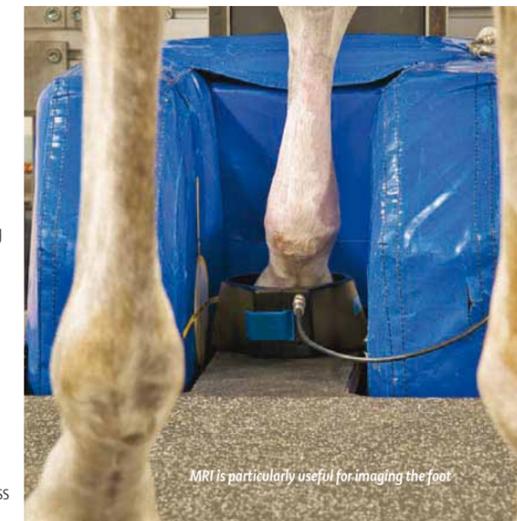
When is an MRI scan appropriate?

MRI scans are reserved for cases where lameness has been localised to a specific region by nerve and joint blocks and a definitive diagnosis has not been possible using other imaging techniques. In almost all cases an X-ray and/or ultrasound examination will still be necessary. In some instances, disease may be suspected but not confirmed on X-rays and MRI may be indicated to fully evaluate the injury. A good example of this is in the detection of stress fractures in racehorses (e.g. those in the fetlock joint and upper cannon region). MRI is not a screening technique. It is imperative that everything has been done to specifically localise the site of pain, otherwise the wrong area may be imaged wasting time, money and possibly leading to an incorrect diagnosis. Only the lower limbs (up to and including the knee and hock) can be imaged. However, the higher up the limb the scanner is positioned

the more motion artefact is present on the images, preventing detection of certain injuries. Not all horses make suitable patients for standing MRI procedures. Some horses will not tolerate the procedure well, or are too small to be comfortably positioned within the magnet. Your veterinary surgeon will best advise you as to when it is appropriate to use MRI in lameness diagnosis. Factors such as cost, insurance status of the animal, the length of time the horse has been lame, whether the lameness is improving satisfactorily over time and whether or not any medications have been carried out may influence the decision.

What can I expect on the day of the scan?

MRI scanning is a complex and advanced imaging technique and takes much longer than X-rays or ultrasound. Most cases have been lame for significant periods of time and it is essential to allow time to



MRI is particularly useful for imaging the foot

gather all the information needed, complete any necessary nerve blocks and to acquire a comprehensive set of MR images. The scan takes about one hour per site scanned depending on the complexity of the case and the temperament of the horse. The scan generates between 300-500 images per foot and the radiologist will need time to read the images and reach a diagnosis. At RosSDales Diagnostic Centre, we admit the horse on the day of the scan and keep the horse overnight to allow

the radiologist and lameness clinician to discuss the case in light of the information the MRI has provided. The horse then relaxes in his stable whilst decisions are made regarding his management. The following day any other procedures or necessary treatments can be carried out. This may seem a little inconvenient to some owners, however, it maximises the chance of us getting to the bottom of the problem, formulating necessary treatments and therefore optimising his chance of recovery.

A week in brief...

Monday: A National Hunt horse has injured his knee during a crashing fall over fences. He has been referred to RosSDales' orthopaedic surgeon Richard Payne to repair the fracture under general anaesthesia. Radiographs are



The horse's knee is positioned in the gantry of the CT scanner

inconclusive about the degree of fragmentation of the radial carpal bone (bone within the knee), which is commonly injured in this type of fall. It is decided that a computer tomographic (CT or CAT) scan is the best way of assessing the fracture and planning the surgical repair.

Tuesday: Today I'm giving two



CT 'slice' through the fractured bone in the knee. These type of images help the surgeons to plan how best to repair such injuries.



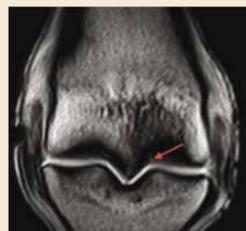
Sarah Powell with fellow speakers (left) Dr Tracy Turner (Minnesota USA) and Dr Renate Weller (Royal Veterinary College) at the British Racing School

lectures at a course entitled 'No Foot No Horse' at the British Racing School, Newmarket. Speakers from the UK and abroad are lecturing on a range of topics including hoof biomechanics, farriery and treatment of horses with foot pain. My lectures are about how MRI is incorporated into the lameness investigation and how different forms of navicular syndrome appear on MR images.

It's also a great chance to catch up with our referring vets and find out how some of the cases referred to us have been getting on!

Wednesday: A 3-year-old Thoroughbred colt is referred to the MRI facility for further evaluation of right fore lameness which has been localised by my colleague Mike Shepherd MRCVS to the fetlock

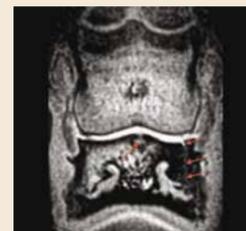
region. The colt galloped on Saturday and Mike noticed the lameness during a routine pre-race trot up on Monday evening. X-rays were taken but did not reveal any reason for the lameness. The MRI examination revealed the presence of a small fracture line in the condyle (lower cannon bone) within the right fore fetlock. The fracture is in the very early stages and may



Fissure fracture (arrowed) in the condyle within the right fore fetlock.

be some way from propagating to a complete fracture; however the decision is made to err on the side of caution and not to race the colt the following week. Instead he will be rested for several weeks prior to gradually returning to training. Without the benefit of the MRI the colt may have suffered a more severe injury.

Thursday: A 5-year-old riding horse has been referred for further evaluation of foot pain. This gelding had fractured his pedal bone several months ago, and initially responded well to rest and the placement of a special shoe. Recently, an intermittent left fore lameness was reported. Radiographs revealed the fracture was healing as expected and the degree of lameness did not fit the usual pattern for such an



MRI image of the coffin joint with a central cyst-like lesion (centre arrow) and a fracture of the lateral wing of the pedal bone (right arrowed)

injury. An MRI scan of the foot revealed the fracture still to be 'actively' healing as we would expect at this time. However, it also revealed a large subchondral 'cyst-like' lesion within the pedal bone, which was not shown on the earlier X-rays. These 'cysts' are often associated with intermittent lameness and could explain why

this apparently straightforward case had not been going according to plan!

Friday: A 3-year-old Thoroughbred racehorse has been reported by the rider to show signs of back pain. I visit the yard on Friday evening to clinically examine the horse and assess for signs of hind limb lameness, which may mimic back pain. I ultrasound some of the joints in the back and our mobile radiography team meet me at the yard. X-rays reveal impinging ('kissing') dorsal spines in the back, which may explain the signs the rider reports. Although this is a complex diagnosis to make, I medicate the spaces between the dorsal spines. If any improvement is seen, this helps us to assess the significance of the imaging findings.



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