Vetwatch

ROSSDALES EQUINE HOSPITAL & DIAGNOSTIC CENTRE
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DIAGNOSTIC DIGITAL IMAGING for lameness and poor performance

Lameness and poor performance cases are frequently referred to Rossdales Equine Diagnostic Centre (REDC) for a definitive diagnosis and recommendation for treatment. Early detection of a problem can often prevent more serious injury and our veterinary surgeons undertake a detailed clinical examination to identify the potential problem areas prior to undertaking diagnostic imaging. But how do these imaging techniques work and what are the indications for their use?

Radiography, ultrasonography, nuclear scintigraphy (bone scanning), magnetic resonance imaging (MRI), computed tomography (CT) and infrared thermography are digital imaging techniques, which we frequently use at REDC. Depending on the nature of the individual case, any combination of these techniques can be used, where appropriate, to ensure accurate diagnoses are made and enable us to formulate effective treatments, particularly of more complex conditions. The healing of some conditions can then be monitored by repeat imaging.

Digital Radiography

Diagnostic radiography uses ionising radiation (or 'x-rays') produced by an x-ray generator. The beam of x-rays penetrates the tissue and, depending on the tissue density, is absorbed to varying degrees. In the original analogue x-ray systems the x-rays were captured behind the area being imaged, on film, which was then developed manually by a series of chemical processes. With digital radiography, the x-rays are captured by an electronic digital detector plate, which are scanned and the resulting radiographic images transmitted to computers, where they can be viewed almost instantly on high-resolution screens. The advantages over the traditional analogue systems include the ability to store the images electronically as digital files as part of the patient's medical record, which can be viewed on any networked computer in the practice and printed on a variety of media, as required. Additionally, the images can be magnified, or manipulated for brightness, contrast and clarity, greatly enhancing the diagnostic potential of the images. Radiographs are best used to visualise pathology related to bone and, with digital radiography, it is now possible to visualise more of the surrounding soft tissues and detect the presence of small bone fragments and foreign bodies.

Ultrasonography

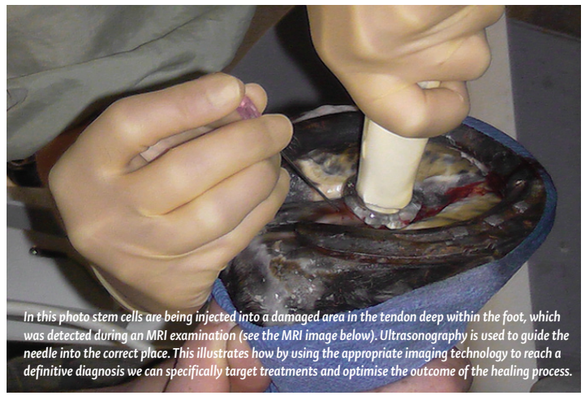
Diagnostic ultrasonography uses the acoustic energy of sound waves emitted by a transducer (probe) to image tissue. The sound waves 'echo' back when they hit tissue of varying densities. The returning waves are detected by the probe and converted to an image on screen. Ultrasonography can be used to visualise a variety of structures including tendons, ligaments, joints, vessels and internal organs and is frequently used in both orthopaedic and medical diagnostic investigations.

Ultrasonography is not just used for diagnosing injuries: it is also frequently used to monitor the healing of lesions (abnormal tissue), to guide interventional procedures such as biopsies and ultrasound guided medications (e.g. when pathology has been detected in the joints of the neck, back and pelvis), and to monitor broodmare reproductive cycles and to detect pregnancy, monitor foetal well-being and examine the ovaries and uteri of mares.

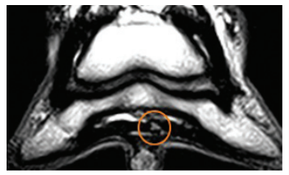
Nuclear Scintigraphy

Nuclear scintigraphy (commonly known as 'bone scanning') is a diagnostic imaging technique in which a radioactive compound ('radiopharmaceutical' or 'tracer') is injected intravenously. In the hours following injection, the tracer is taken up into the skeleton, which becomes temporarily radioactive, the radioactivity within the bone decaying over time. The external detector (or 'gamma' camera) captures the decaying radiation and forms images on the computer screen. Bone that is rapidly turning over (or 'modelling') emits more radiation than the surrounding bone. This is used to detect radioactive 'hot spots' both in normal areas such as joints and the growth plates of young horses, and in areas where abnormal bone is present, such as fractures, subchondral bone injuries and in cases of joint disease.

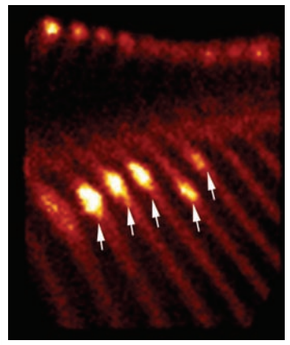
Bone scanning is a safe procedure for the horse, but as it uses ionizing radiation, it is only used in licensed premises and conditions, in cases where there is a specific indication to do so and where a diagnosis cannot be made using other imaging techniques.



In this photo stem cells are being injected into a damaged area in the tendon deep within the foot, which was detected during an MRI examination (see the MRI image below). Ultrasonography is used to guide the needle into the correct place. This illustrates how by using the appropriate imaging technology to reach a definitive diagnosis we can specifically target treatments and optimise the outcome of the healing process.

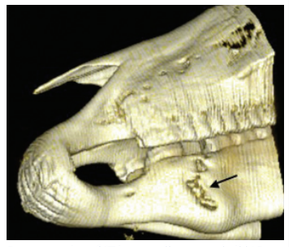


Some horses with foot pain have damaged an important soft tissue structure within the foot, which cannot be seen on x-ray images. The example here is an MRI image showing a hole (or 'core lesion' ringed) in the deep digital flexor tendon deep within the foot.



Bone scan image showing the left side of the chest of a young racehorse which fell whilst at exercise. Though apparently unhurt after the incident, his racing performance became poor. The image shows a number of 'hotspots' (arrowed) representing the presence of multiple rib fractures.

A CT image of a horses head at the level of the eyes. All levels through the head from nose to neck can be viewed. The whole content of the head can therefore be investigated and this type of image can be used to assess, for example, the roots of the teeth and dental sinuses for signs of infection and for the presence of tumours.



Post processing of CT images allows us to build 3D pictures. The example here is a pony with an infection of a tooth and the surrounding lower jaw bone (arrow). This image was used by our surgical team to plan the best way of removing the tooth.

It is an important diagnostic aid in cases where:

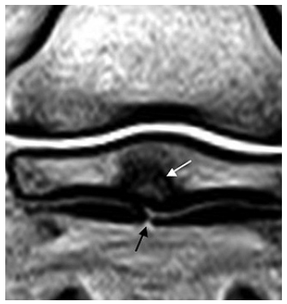
- an area of lameness has been localised using nerve blocks but no abnormalities have been detected on radiography or ultrasonography of this area.
- nerve blocks have failed to localise the site of lameness.
- there is multi-limb lameness or a history of poor performance.
- it is not possible to easily radiograph the area of interest - e.g. in cases where neck, back or pelvic pathology is suspected.

If a 'hot spot' is detected on a bone scan, further investigations are often necessary (such as radiography or ultrasonography) to further evaluate the cause of the increased activity in the bone at that site and to reach a definitive diagnosis.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is a relatively new imaging technique that uses a strong magnetic field and the magnetic properties of water molecules within the body to generate images. Unlike radiography and scintigraphy, it does not use ionising radiation. In horses, it is primarily used to image the foot, where soft tissue injuries occur that cannot be visualised with ultrasound as the foot is encased in the hoof capsule. However, it is also commonly used to investigate lameness related to the fetlock or knee (carpus), particularly of Thoroughbred racehorses and injuries to the proximal suspensory ligament. MRI is an advanced imaging technique and is only used when the site of lameness has been localised to a specific region but a conclusive diagnosis has not be reached using other techniques such as radiography and ultrasonography.

The Hallmarq equine MRI system was installed at Rossdales in 2006 and we have used the information it provides to achieve an accurate diagnosis and tailor appropriate treatment and rehabilitation periods in almost one thousand horses since that time. In addition to its established role in our clinical caseload, we are currently running a number of clinical research studies into the future potential of this exciting technique. From a practical viewpoint, an MRI scan can take up to 2 hours to complete and can be carried out either on standing sedated horses or those under general anaesthesia. The scan generates up to 400 images of the area under investigation. For this reason, horses are admitted to our Diagnostic Centre and are required to stay overnight following the scan. This enables us to undertake a complete and thorough examination, discuss at length the treatment options with the horse owner and carry out any indicated treatment(s) the following day.



Even when bone damage is visible on x-rays some horses may require an MRI examination to more fully evaluate the extent of damage. This MRI image shows an ulcer (or 'errosive lesion') on the back of the navicular bone (white arrow), which could be seen on x-ray images. However, the MRI image also allows us to see that there is a 'split' in the deep digital flexor tendon next to the bone injury (black arrow), the healing of which can be monitored by follow-up examinations

In this digital xray image of the right fore fetlock of a showjumper, a faint dark (or 'radiolucent') line is seen at the joint surface (arrows). This represents a fracture line and, should this horse be exercised with this 'crack', a catastrophic pastern fracture may develop. The ability to manipulate the appearance of digital xrays on screen enables us to detect more easily subtle findings, that may otherwise be missed, potentially saving lives.

Computed Tomography (CT)

CT technology uses multiple x-ray beams, which rotate around the patient to produce 'slices' through the region of interest. The CT scanner at REDC is a 'multi-slice' scanner enabling four x-ray slices as little as 1mm thick to be generated for every revolution of the gantry. Hundreds of two-dimensional (2D) slices can be taken through the area of interest to produce images of exquisite detail, without the overlap of structures seen on conventional radiography. It is particularly useful in complex anatomic areas such as the teeth and sinuses, and to look in fine detail at bone-related problems in the lower limbs, for which the horse is under a general anaesthetic. Our system is one of only two in the world capable of scanning the heads of standing sedated horses (size and temperament permitting!) without the need for general anaesthesia, thereby reducing the cost of the procedure and removing the risk associated with general anaesthesia.

The post processing of CT images allows reconstruction of 3-dimensional views from its 2-dimensional slices. We are able to 'rebuild' the area of interest after the scan and rotate it around to view it from all angles. This enables greater precision in diagnosis and treatment and greatly enhanced surgical planning prior to the removal of infected teeth, the surgical repair of complex fractures or resection of tumours, for example.

Smaller patients, such as young foals, are amenable to examination of almost any part of the body, once again opening up vast areas of new interest, diagnosis and treatment.

Infrared Thermography

Thermography measures skin surface temperature by detecting changes in skin blood flow. This can be a useful adjunct to the other diagnostic techniques and is most useful for early identification of inflammation in soft tissue and bone. It also can be used to monitor the healing process. We find it most useful for tendon, foot and back problems. Blood flow can be altered in response to underlying injuries and cases of body wall dysfunction. An infrared scanner converts radiation emitted from the skin into electrical impulses, which are transferred onto a thermogram (colour visual image) on a video screen. Different colours indicate variations in temperature, red being the hottest and indicating areas of inflammation.

This brief overview of the most important diagnostic imaging techniques currently used for horses and ponies is intended to help the reader understand their basic principles and use. Further articles are planned to discuss each technique in greater detail.

Vet Profile

Name: Sarah Powell
Qualifications: MA VetMB MRCVS
Year of Qualification: 2002
Main interests: Equine orthopaedic disease: investigation and the use of MRI and CT imaging.

I left school aged 16 to work for the late Harry Thomson Jones at his racing yard in Newmarket. Nick Wingfield Digby, currently Managing Partner of Rossdale & Partners, undertook the veterinary work in the yard at that time. It was Nick who inspired me to go back to college, take my A levels and apply to veterinary school.

I graduated from the University of Cambridge Veterinary School in 2002 and joined Rossdales in 2005. My current role is senior imaging clinician at Rossdales Equine Diagnostic Centre, where we are proud to be recognised as world leaders in equine diagnostic imaging techniques. I am particularly interested in further developing our advanced imaging techniques (MRI and CT) and it is a subject on which I have published regularly. Additionally, I have lectured throughout Europe, Australia and the USA and have helped a number of other veterinary practices improve their own imaging 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.

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