MRI—Aid To Diagnosis In Foot Problems

by HEATHER SMITH THOMAS

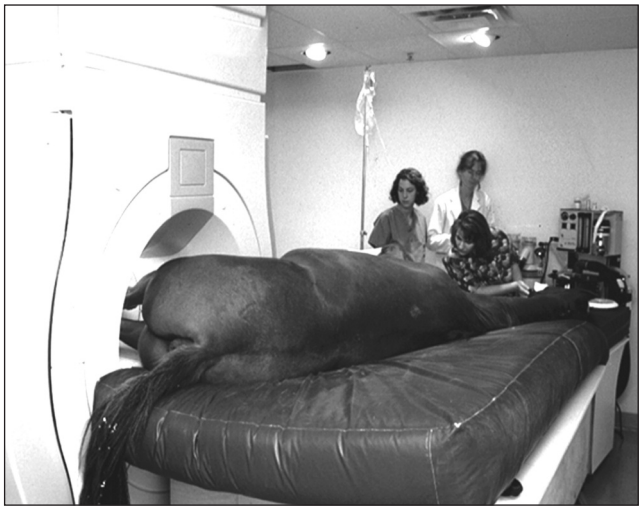
Magnetic resonance imaging (MRI) can produce images of the inner structures of the body, including a horse's hoof. This has become a very effective way to view those structures and discover what is actually wrong when trying to diagnose a lameness condition. Sarah Sampson, DVM, has been doing research on foot problems at Washington State University (WSU) for the last seven years, using a high-field magnet. This MRI has been available for live horses since 1997.

"Previous to having MRI available for horses, the only way we could look at the living horse's foot internally was with radiographs, ultrasound or nuclear scintigraphy (bone scan). Of these three imaging modalities, radiography was by far the most useful, but we have now realized (with the advent of MRI) how many pathologic changes we were missing in the bone. Ultrasound has never been very useful, because the hoof capsule impedes the ultrasound waves. Even ultrasound through the frog is very difficult, and the interpretation of findings can be misleading," says Sampson. Veterinarians often suspect certain injuries to soft tissue structures, but previous to MRI could not definitively diagnose many lesions except postmortem.

"When MRI became available, it was the first time we could see all the structures within the foot of a live horse—both bone and soft tissue structures. This enabled definitive diagnoses for many horses with foot lameness that was not possible before," she says.

Diagnostic Advances

"We've been able to divide horses with foot lameness into specific causes, including tendon injury (deep digital flexor tendon), ligament injury (collateral sesamoidean ligament, impar ligament, collateral ligaments), bone injury not visible on radiographs, cartilage and subchondral bone injury, inflammation of joints or tendon sheaths, and laminar issues that are not visible on radiographs. Horses may have laminitis, or a keratoma in the laminae that has not caused changes in the coffin bone on radiographs. Until a keratoma grows big enough to put pressure on the bone, we can only diagnose them with MRI. We've also been able to find cartilage and sub-chondral bone injuries surrounding the joints that are not visible with radiographs. There are fractures that are not visible with radiographs, especially stress fractures or non-displaced incomplete fractures. The coffin bone can be a particularly hard bone to identify fractures, and MRI has been able to define fractures that are not visible on excellent quality digital radiographs. There are also small flexor cortex defects on the navicular bone that are not visible with radiographs, but are easily visualized with MRI. We didn't know those existed until we started using MRI on horses," she says.



"We have found injuries to every structure in the foot, which were never visible on radiographs or ultrasound. A negative finding on radiographs does not mean the horse doesn't have a problem; it just means we are not able to see it with radiographs. There are many lame horses who have normal radiographs, but have severe pathological changes within their feet. Many of these horses can be helped with specific trimming and shoeing. This is where MRI can be helpful because it provides a specific diagnosis, which then enables specific treatment," explains Sampson.

"An important point to understand is that even if a lesion is discovered on radiographs, such as changes in the navicular bone, this may not be the only problem or the worst problem within the foot. MRI can be important for horses who have some changes on radiographs but their lameness examination and clinical signs don't fully agree with that as the primary cause of lameness," she says.

"Horses can have more than one problem in their feet. They may have had coffin joint arthritis for years and yet suddenly become more lame. Or it may be a horse who has been lame and a veterinarian has taken radiographs and finds coffin joint arthritis or navicular bone change, but decides to do an MRI anyway. A lot of times, we find other things as well, that are often more important in the clinical history of the horse. We may find cartilage damage that has

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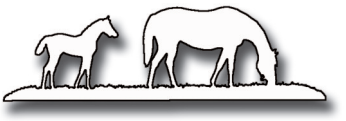

Down on the Farm Cont'd.

become more severe, or a tendon injury that was not evident," says Sampon.

"Many horses who have a mild lameness issue then sustain an acute (and completely separate) injury to a tendon or ligament that causes a new and more severe lameness. MRI gives us the whole picture, and that's not possible with other imaging modalities at this time," she explains.

"The MRI has been the only thing we've ever had that tells us everything that's wrong inside the foot. It's beneficial for horses when owners/veterinarians want to make sure they have identified every problem, or the veterinarian is not satisfied that what they see is the actual cause of the current lameness problem," says Sampson. There are a lot of reasons to evaluate a horse with MRI, and we are still learning. She feels we are only at the beginning of understanding how helpful MRI can be in the diagnosis of pathologic changes in the horse.

There are two categories of horses who go into the MRI for foot problems. "One group is horses with bilateral forelimb lameness, typically diagnosed with navicular syndrome and sent to us for MRI evaluation. The other group of horses have unilateral foot lameness that is suspected to be traumatic in nature and this can affect the front or hind foot," says Sampson.

The navicular syndrome horses block to the heel or sole region, whereas the horses with a front or a hind foot injury might block to the heel/sole region or sometimes the whole foot must be blocked. "Whether pain is coming specifically from the heel/sole region or from the entire foot, we always image the whole foot, up to mid-pastern. With nerve blocks, it is difficult to know exactly what structures are desensitized. MR images must be done of the entire area that could be desensitized," says Sampson.

Diagnostic Surprises

Obtaining a definitive diagnosis early in the course of a lameness will often save the horse owner a lot of money. Often by the time an MRI is done, the owner has already spent a lot of time and money on exams, nerve blocks, various treatments, etc., without a definitive diagnosis. "For instance, we've found horses with coffin bone fractures that were not visible on radiographs, but were treated like navicular syndrome because they blocked to the heel. But they don't heal because they don't get the rest they need, and are not put in the kind of shoe they need," she says.

"I had a horse come in last year that blocked to the heel. This was a moderately lame eight-year-old and the owners worried that they had the beginnings of navicular disease. The horse had been moderately lame for about two months and they turned it out to pasture. We took six projections of the front foot with digital radiographs and could not identify a cause of the lameness, so this horse underwent MRI of both front feet and it was clear there was a non-displaced fracture of the coffin bone that entered the back of the coffin joint. This horse had inflammatory changes within the medullary cavity of the bone surrounding the fracture line, as well as changes that indicated the horse had been trying to heal the fracture for some time," says Sampson. Following MRI, a definitive diagnosis was made and treatment was based on this.

"The horse needed to undergo a prolonged rest period and be shod in a special shoe to eliminate excess movement of the coffin bone so it could heal. This horse was not as lame as we often think of horses with coffin bone fractures to be and, therefore, a fracture was not suspected. With proper diagnosis via MRI, this went from a horse we thought might have navicular syndrome to a horse with a good chance for future soundness," she explains.

"Another case was a five-year-old stallion who blocked to a palmar digital nerve block on a front foot. Multiple radiographs had been taken at different times and all were normal. He had been blocked multiple times to try to pinpoint the problem and it was always localized to his heel region. He remained lame for over a year and eventually came to WSU for MRI. We found he had an epidermoid cyst (an abnormal mass) in the lowest part of his digital flexor tendon sheath that was impinging on his deep digital flexor tendon. Many people don't realize the digital tendon sheath extends through the pastern and down into the heel bulbs," says Sampson.

"Once we saw the mass with MRI, we were able to go tenoscopically into the sheath and remove it surgically. That horse has been in performance now for more than three years and is sound. We often encounter lesions like this. Something turns up that you would never suspect. It gives some of these horses a very good chance to have a normal life. If people are trying to decide whether an MRI will make a difference for their horse, we tell them that for over 90 percent of the horses we put in the MRI for foot issues, it changes how we treat them," she explains. This can make all the difference in helping the horse recover.

"If there is something odd going on in the foot, we can see it. We had a horse recently with a middle phalanx (short pastern bone) stress fracture that wasn't visible on radiographs. We get a lot of cases that are not navicular horses, even though they block to the heel and are sensitive to hoof testers. They have something else going on that would remain unknown, without an MRI."

Two Types Of Magnets

The MRI machines utilize either low-field or high-field strength magnets. "Low field strength magnets are usually 0.5 Tesla or lower. High field strength magnets are 1 Tesla or bigger. The standing magnets are about 0.27 to 0.3 Tesla so they are low-field magnets. There are also some low-field magnets that you have to anesthetize the horse to image them. They are typically under 0.5 Tesla but because of the configuration of the magnet the horses have to be lying down and anesthetized," explains Sampson.

"People need to realize that the magnet strength affects the images you get. With all the high-field strengths, the horse must be anesthetized. Magnet strength is directly correlated to the resolution of the image. The higher the

strength, the better the resolution. It's like a television screen from 20 years ago, versus the high definition screens available today. The resolution can also vary a bit between magnets of the same field strength, depending on the magnet itself, the hardware and software being used, and the room housing the magnet," she says.

"This can affect the images. The smaller the anatomic structure, the less easily it will be seen with a low-field magnet. The bigger the structure, the easier it will be to see, but you will also lose detail on some of the small structures like the impar ligament or cartilage. You may not see those at all (or they may not be very clear) with a low-field magnet. So it is important that people understand what type of magnet their horse will be imaged with, and understand what may or may not be able to be seen," she says.

In future, there will be more machines around the country, and more opportunities for horse owners to utilize this service. "There are several universities with magnets now, and a growing number of private equine practices that have high-field or low-field magnets. We were initially the only one in the U.S. able to MRI live horses, but as benefits of this diagnostic modality has become recognized, more veterinarians are realizing how important it is to be able to offer this diagnostic tool. It's a matter of economics regarding whether practices or universities choose a low-field or highfield strength magnet; the high-field magnets are much more expensive and have higher overhead costs, but the price has decreased over the past 10 years. Eventually more veterinarians will be able to afford them," says Sampson. The cost to the horse owner for this diagnosis may drop later, as well, since this cost is based on the price of the magnet and the expense to run it.

MRI Provides More Information Than Necropsy

Magnetic resonance imaging can show more about some body tissues than any other diagnostic modality, even better than necropsy in some ways. "We still compare everything to the 'gold standard' which is considered to be necropsy—looking at the limbs after a horse dies or is euthanized. But the MRI can actually reveal more than we can find on necropsy," says Sampson.

"We can get thinner slices (images) of everything, as opposed to just taking the foot apart, looking at the outside and making certain cuts through different areas. With the MRI we are able to look at 'slices' that are only three to four millimeters thick, throughout the whole foot. Also, since it's still a living structure, we can see changes at a molecular level. So this can tell us more about every structure within the foot, and the entire extent of each structure is imaged. Often, even after a horse is humanely euthanized, we will go ahead and MRI the foot afterward because we know we can usually gain more information from that than from a necropsy."