A photograph showing a dark brown horse's head and neck inside a large, circular CT scanner gantry. The horse is wearing a white protective mask over its eyes and nose. A person in a blue lab coat is leaning over the horse, adjusting the mask. The scene is set in a clinical or laboratory environment.

A horse going through the new, larger CT scanner, which allows the horse to be sedated and still stand during imaging.
photo courtesy Royal Veterinary College

TAKING A **LOOK** INSIDE

ADVANCEMENTS IN EQUINE IMAGING

BY MEGAN ARSZMAN

The world of medicine is always evolving. It doesn't matter if it's human, canine, or equine—new ideas and concepts are being tried and tested on a daily basis, all with the goal of improving health. Sometimes, developments have a trickle-down effect, helping other species wherein there was no initial intention. This has been the case with recent advancements in equine imaging: CT scanners, positron emission tomography scanners, three-dimensional imaging, and 360-degree digital radiographic studies.

University of California, Davis

The ability to put a timeline on an injury provides helpful information, not only for diagnosing but also treatment, thanks to the new positron emission tomography (PET) scanner that's available

at the University of California, Davis School of Veterinary Medicine's Center for Equine Health. The teaching facility is the first veterinary facility in the world to utilize this imaging technology for equine patients, and researchers are just starting to discover the machine's capabilities.

Mathieu Spriet, DVM, MS, Associate Professor in Surgical and Radiological sciences at UC Davis, has been interested in using the PET scanner on horses for a few years. What really sparked his interest was when he read a paper about how researchers were using a PET/CT scanner in comparison with an MRI to look into obscure foot pain in people. "It struck me because obscure pain is what we deal with every day," he says.

The main difference between a PET scanner and other imaging modalities is that a PET scanner is a "functional" imaging tech-

continued on page 330

TAKING A LOOK INSIDE: ADVANCEMENTS IN EQUINE IMAGING

continued from page 328

nique—meaning it can detect changes in the tissue because it observes activity at the molecular level. Other imaging techniques discover “morphological” information, because they can only identify changes in the size, shape, or density of structures. With a PET scanner, not only can you detect lesions missed with other modalities, but you can also tell if an injury is “active” (meaning just forming), rather than an old injury that may have been there for months or even years and shows up on other modalities as scar tissue.

“If you see something on a PET scanner, you know it’s an injury that’s active now,” Dr. Spriet says. “It helps to understand the meaning of different lesions, and it’s a great tool to use to follow the evolution of the lesion.”

The PET scanner can show if treatment for a current injury is working or not, whereas using a morphological imaging technique, like a radiograph or a CT scan, is limited in showing the level of healing that has taken place up to that point. “You hope to see a decrease in the signal of the lesion with PET, which shows that it’s healing,” explains Dr. Spriet.

Just one year ago, Dr. Spriet encountered a patient with a mystery lameness, and specialists debated as to which was the better imaging modality to use—the MRI or the CT. Now, with the PET scanner, he can combine the former with the CT scan to obtain the best of both worlds—the best resolution for looking at bone anatomy from the CT and the func-

tion of seeing what’s active on the bone via the PET scanner.

As of press time, the PET scanner had not been used on any horses outside of UC Davis, but Dr. Spriet’s hope is to do so in October 2016.

Royal Veterinary College, United Kingdom

One of the more difficult injuries for researchers to understand are neurological problems in the horse, the majority of which originate in the neck. Up until recently, there hadn’t been any machines large enough to allow scanning of the neck in the standing horse.

That is, until the Royal Veterinary College (RVC) in the United Kingdom acquired a CT scanner that’s 10 cm wider than a standard scanner, allowing for a horse’s neck to be scanned while the horse is still standing and conscious. While the scanner was originally created to help humans, who might be a little claustrophobic, it has also served a new tool for researchers to help improve diagnostic abilities and better understand neck problems in the horse.

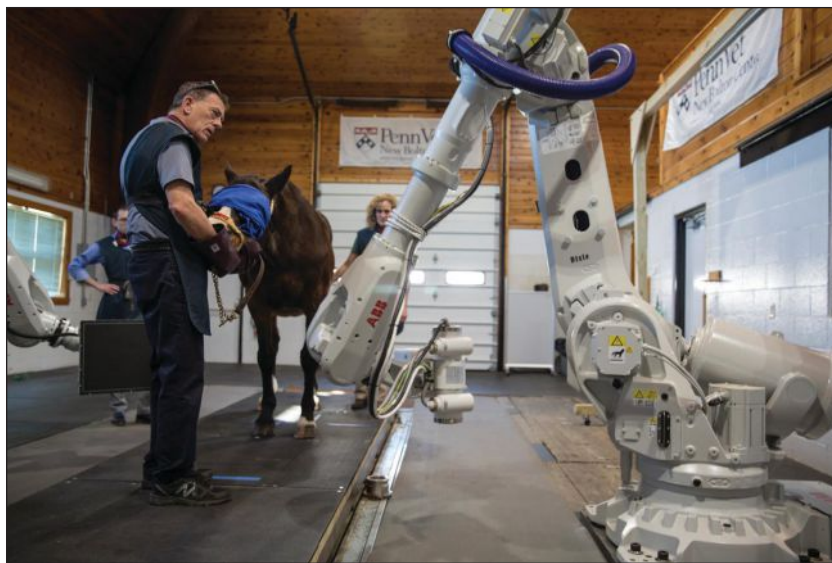
The RVC was the first to install a CT scanner for horses in 2003 in the UK, allowing researchers to

perform more than 2,000 scans on the head, feet, and parts of the neck. In the spring of 2016, this larger CT scanner was installed, allowing more of the horse’s neck to be examined while the animal remains in a standing position.

“Traditionally, to see problems of the spinal cord, the horse has to undergo general anesthesia, which has a relatively high risk of death in horses,” explains Renate Weller, DMV, PhD, MRCVS, FHEA, Professor in Comparative Imaging and Biomechanics at the Royal Veterinary College.

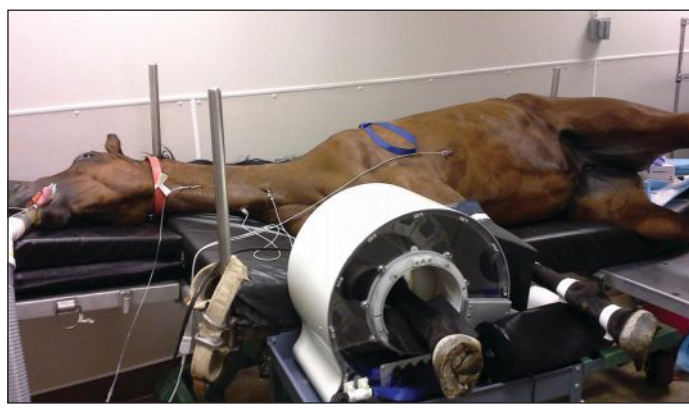
The availability of this scanner now gives veterinarians a chance to work with horses that might just have a slight neck injury that’s not life threatening. With the larger CT scanner, horses don’t have to lie down for diagnosis. Instead, the scan can be performed while the horse is standing under light sedation, which is associated with a much smaller risk.

“We were one of the first to install a CT scanner, and did horses for years, but we didn’t do it often because the horse could die under general anesthesia,” explains Dr. Weller. “Now, we can do more horses that are standing with some sedation, so we’re able to use the scanner much more often because the risk is much smaller. This allows us to gather more data on neck conditions and improve



Equimagine Robotic Imaging Machine at University of Pennsylvania

Credit Steven Minicola - University Communications



A horse having a scan of a left front leg

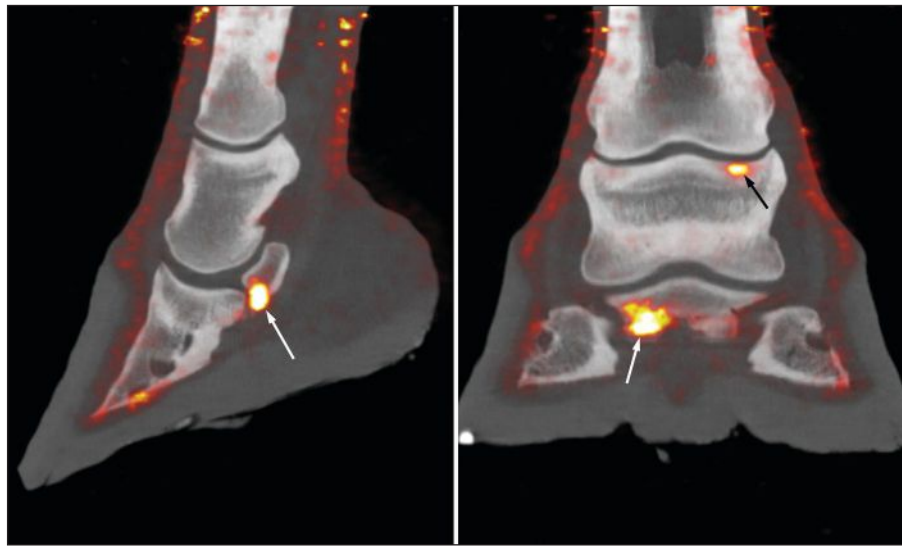
continued on page 332

TAKING A LOOK INSIDE: ADVANCEMENTS IN EQUINE IMAGING

continued from page 330

not only our diagnostic abilities, but also inform prognosis and allow us to develop new treatment strategies.

“Horses with neck problems can show such a wide range of clinical signs; it’s unbelievable,” she says. “Say, I have a horse that refuses to turn to the right. There could be a million other things



Combined PET and CT images of the foot of a 20-year-old Thoroughbred. The PET demonstrates an active lesion of the navicular bone (white arrows) as well as abnormal uptake in the bone adjacent to the pastern joint (black arrow).

This second lesion was not seen on the CT, but suggests early degenerative changes that could lead to the development of a bone cyst.

going on in the neck or elsewhere—it could be a lameness issue, a back problem, or the rider... I’m fairly confident that the CT scanner will be able to help shed light onto those cases where we’ve really struggled so far,” Dr. Weller says.

Equimagine at University of Pennsylvania

Using imaging modalities in the standing horse is one thing that has continuously improved through the years. Now, clinicians and researchers at the University of Pennsylvania’s School of Veterinary Medicine (Penn Vet) have a machine that can examine a horse in motion.

The New Bolton Center collaborated with Four Dimensional Digital Imaging (4DDI) in the development of a robotics-controlled imaging system called EQUIMAGINE. Like the previous two modalities, the EQUIMAGINE system has both equine and human applications. However, the University of Pennsylvania is the only veterinary teaching hospital in the world to use the system.

With EQUIMAGINE, the horse doesn’t need to be under anesthesia. He’s awake, standing, and can even be moving. Two robots, controlled by a technician in a control room, rotate around the horse, offering a three-dimensional image of the horse’s body. First, an equine patient is led up a ramp and onto New Bolton Center’s Jeffords high-speed treadmill while under light sedation. Two robotic arms move together—one has the emitter and the other has a

detector. It only takes approximately 30 seconds to capture the images. Because general anesthesia isn’t necessary, there’s one less risk involved, which also makes the procedure less expensive. Also, the EQUIMAGINE can collect two-dimensional CT images, while producing three-dimensional images and 360-degree digital radiographic studies.

Researchers will be able to see parts of the horse’s anatomy that haven’t been able to be viewed before using CT, due to limitations with previous diagnostics. Initial work is being done on the head, neck, and limbs—areas that researchers believe have the greatest clinical need.

With time, the researchers at Penn Vet hope not only to be able to completely scan the entirety of the horse, but also to produce extremely crisp, clear images of very finite areas and view the horse’s anatomy while in motion on a treadmill.

Clinical trials started in May and New Bolton plans to start taking in patients in September.

The Future of Imaging

Dr. Weller believes that the future of horse health starts with the owner. She believes that owners are becoming more educated about their animals and want to better care for their horses, which makes diagnosis faster and easier, at times.

“Owners are much more aware when things go wrong with their horses, so they bring it to the attention of the veterinarian much earlier than they used to,” she says. “Hence, we see much more soft problems, so we really need to work with all we have to get a diagnosis.”

For example, Dr. Weller recalls when she began practicing veterinary medicine; she’d see severe cases of osteoarthritis or navicular in horses. She doesn’t see that as much any more, because owners seem to be more in tune with their horse’s bodies and health than in years past.

“I’m so excited about the future of equine diagnostic imaging,” Dr. Weller says. “We’re currently using a dynamic X-ray system that shows the horse’s skeleton in movement for research purposes, and I can’t wait to start using this as a clinical tool.”

As most modern technology looks to become smaller and more portable, Dr. Spriet hopes to see imaging technology go in the opposite direction and continue to get larger, in hopes of being used on horses of all sizes.

“We’re still limited on imaging for the larger body parts of the horse,” he says. “We have CT and MRI for the distal limbs, but we’re still looking for better ways to see the neck. An MRI can show the foot on up to the hock, but it’s difficult to see the stifle and shoulder. I think, in the future, we’ll be able to use current imaging modalities on all the body parts of the horse to better understand the horse and his pain.”