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Featured Equine Hospital of the Month
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UC Davis Veterinary Medical Teaching Hospital

One of the roles of the University of California–Davis Veterinary Medical Teaching Hospital is to find clinical applications for newly discovered scientific tools and methods and to distribute them to both veterinary students and practitioners. New knowledge is moved from the research laboratory into practical treatment applications by skilled and highly specialized clinicians. As those treatment methods are proven, they are passed on to medical students in the hospital's teaching program and distributed to veterinarians through continuing education programs.

Diagnostic imaging is a prime example of how clinical research provides a basis for implementing a new technique throughout an entire veterinary field. It is not enough to be able to create an image of a body part or organ. Each new imaging technique that is developed requires a learning curve before it can be used in the field. We must develop a library of image interpretations that clearly establish what the images mean in terms of disease. Without such a library, new imaging methods cannot reach their full potential.

The UC Davis Veterinary Medical Teaching Hospital has long been involved in developing imaging techniques used in human diagnostics for use in equine medicine. For more than 30 years, Dr. Timothy O'Brien has been refining the role of radiology in equine research and diagnostics. Literally thousands of veterinary students and practitioners have been taught by Dr. O'Brien to properly use and interpret radiographic images. Now, with computed tomography (CT) scanning and magnetic resonance imaging (MRI), a new generation of equine imaging specialists at UC Davis and other teaching institutions will be required to educate students and clinicians in their use. A new library of knowledge needs to be created so that these imaging techniques can be incorporated into the equine veterinary field. What has been done by Dr. O'Brien over the past decades will now be taken up by Dr. Sarah Puchalski. Her work and that of others will take equine medical imaging far into this new century. The torch has been passed and new imaging territory is being discovered. This is an exciting time in a new and emerging area of equine medical science and Dr. Puchalski will undoubtedly lead many a student and veterinarian along the new path of discovery.

The UC Davis Veterinary Medical Teaching Hospital uses both high- and low-field–strength MRI scanners. The high-field–strength magnet is currently limited to small animals and postmortem evaluation of horses. The low-field–strength magnet is generally used to evaluate orthopedic structures up to the level of the carpus and hock. This allows us to obtain very high-quality images of the soft tissues and the bone, obtained in a cross-sectional manner. With this capability, we have been able to diagnose laminitis, heel pain caused by soft tissue injury, and tendon and ligament injury of the pastern and cannon bone region. Other applications have included the detection of early bone bruising that may predispose a horse to a catastrophic fracture and detection of fractures that have not yet displaced, making them impossible to see on routine radiographs. One of the main limitations of MRI

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Veterinarians preparing a horse for a CT scan at the VMTH

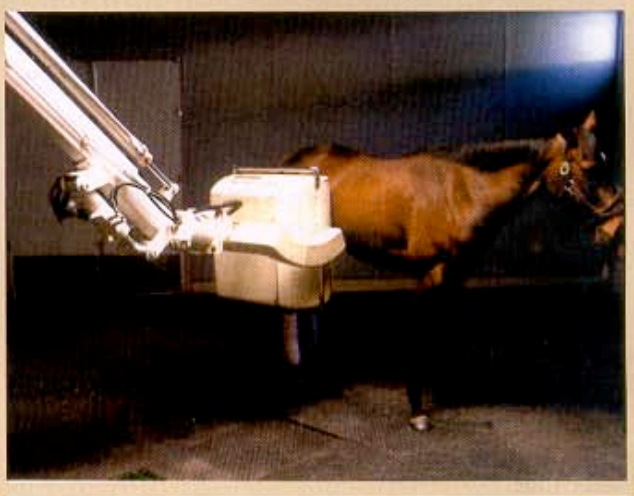
is that the calcium and phosphorus found in bone show up on all sequences as black, so that information about bone—particularly chronic bone remodeling, such as that found in arthritis and navicular disease—can only be inferred by the size and shape of the black space.

This low-field–strength MRI is a remarkable diagnostic tool that can be used in the standing, sedated horse. Scan times may extend to 2 to 3 hours. Several practical items must be addressed before using this MRI on a horse. First, a horse must be healthy enough to withstand several hours of sedation. In addition, all metal shoes and especially any nail fragments must be removed because they may interfere with the image quality.

Horse undergoing a CT scan of skull

Computed tomography, also known as computerized axial tomography (CT or CAT scan), is another technique that is available for use in horses. CT uses radiographs to create cross-sectional images of the body. In CT there is a circular "gantry" that houses the important electrical equipment that includes an X-ray tube positioned directly across from a semicircle of detectors. The detectors measure the strength and number of X-rays that pass through the patient from all angles around 360°, so that a cross-sectional map can be made of any given slice of the anatomy.

Ultrasound has classically been used for identifying tendon and ligament injuries. Currently, it is used at UCD for a vast array of abnormalities that include ocular, vascular, cardiac, lung, abdominal organs (liver, spleen, kidneys, and gastrointestinal tract), internal and external lymph nodes, and reproductive tract. It can also be used for identifying early bone infections and pelvic fractures that cannot be seen on radiographs. When considering diagnostic tests for a lame horse, ultrasound should always be considered first because it is relatively inexpensive, safe, and readily available.



Horse undergoing a bone scan with nuclear scintigraphy

Nuclear scintigraphy, or bone scanning, is another imaging technique used at UCD that is readily available for use in the horse. It is inherently different from MRI, CT, and ultrasound in that it is two-dimensional. Instead of taking cross sections of the anatomy, it produces a two-dimensional image of a three-dimensional structure. In other words, the entire limb is portrayed as a flat object, somewhat like a radiograph. Nuclear scintigraphy is a truly functional test. Rather than portraying the

The new Giannini Equine Athletic Performance Laboratory at UC Davis

anatomy as it stands, an image is developed based on the function of the underlying bone.

Nuclear scintigraphy has an important role in many different clinical situations. One of the most important roles is that stress or occult fractures can be identified in regions that either cannot be radiographed or are not able to be seen on traditional radiographs. Additionally, it can be used in cases where horses have nonspecific pain or lameness that is originating in many different limbs at the same time.

The Claire Giannini Hoffman Equine Athletic Performance Laboratory was recently dedicated at the UC Davis School of Veterinary Medicine. The 10,000 square-foot laboratory has over 6,000 feet dedicated to animal and analytical laboratories, offices, instrumentation rooms, horse preparation areas, and two rooms each housing a Swiss Mustang 2200 motorized equine treadmill. These treadmills are among the most sophisticated in the world today, reaching racing speeds of more than 37 miles per hour. The treadmills were specially built to allow horses to run either uphill or downhill, as well as on the level. Downhill treadmills are extremely unusual and allow certain types of experiments to be conducted using muscles in ways that cannot be duplicated by other means.

The new Equine Athletic Performance Laboratory will serve as a center for research into the pathophysiologic basis of diseases and problems that afflict equine athletes. It will allow researchers to develop new and refined diagnostic techniques for evaluating these problems and implement new therapeutic approaches for treating them. At the same time, a portion of the laboratory is dedicated to providing diagnostic services to clients of the Veterinary Medical Teaching Hospital who have horses with performance-related problems. The laboratory will provide a focal point for establishment of a new Equine Performance and Sports Medicine clinical program.

As part of the laboratory's mission to develop new diagnostic and therapeutic approaches to performance-related problems, the laboratory will interface with researchers in a number of scientifically related disciplines, including cardiovascular and respiratory physiology and medicine, biomechanics (**J. D. Wheat Veterinary Orthopedics Laboratory**), pharmacology and drug effects (**Equine Analytical Chemistry Laboratory**), and evaluation of

One of two new Swiss Mustang 2000 motorized equine treadmills

muscle structure and function the basis of exercise performance by the **Neuromuscular Disease Laboratory**. Dr. Monica Aleman spearheads the latter effort by applying sophisticated analytical techniques to assess changes in the skeletal muscle of horses with performance problems. Added to the broad range of other components that the EARL will be capable of analyzing (heart, lungs, metabolism, gait, and imaging), Dr. Aleman's work in determining the changes in muscle that contribute to a horse's performance problems will be invaluable.

The **UC Davis Veterinary Genetics Laboratory** (VGL) is a self-supporting unit of the School of Veterinary Medicine operating under the direction of Dr. Niels Pedersen, DVM, PhD. It is the largest horse parentage testing facility in the world and is renowned for genetic testing in horses. The laboratory was originally es-

The greatest resource of the UC Davis Veterinary Genetics Laboratory, aside from its staff, is its huge DNA bank and database. Pedigrees that have been DNA-verified are available for many generations of horses, depending on the breed.

tablished in the 1950s under the direction of Dr. Clyde Stormont for verifying parentage for cattle registries.

The VGL has developed and currently offers diagnostic tests for a number of equine genetic diseases and coat colors and has an active research and development program in this area. Tests for diseases include hyperkalemic periodic paralysis (HYPP), junctional epidermolysis bullosa (JEB), glycogen branching enzyme disease (GBED), and overo lethal white syndrome.

Historically, heritage has been an important component for horses, whether they were used for war, for riding pleasure, for working, or for breeding. It was a source of pride to know that one's horse descended from a respected bloodline. Thoroughbred horses have been traced to extraordinarily great runners. Similarly, other animals, such as sheep and cattle, have been bred for different qualities in a bloodline, such as for wool or for meat.

The Veterinary Genetics Laboratory performs approximately 150,000 tests annually for parentage verification, the bulk of which is to validate pedigree records for more than 30 breed registries. Testing is also performed to match a sire and dam with an offspring having unusual markings or colorings or to identify foals with similar markings, which a breeder suspects may have been misidentified after weaning. There are many instances in which the identity or parentage of animals comes into question. Genetic testing provides answers to problems such as these that are frequently encountered by horse owners and breeders.

In the early years of operation, all identity and parentage testing was carried out with blood typing analysis of serum proteins and red blood cell surface proteins. Today, all genetic testing is based on DNA assays. The laboratory not only continues to offer animal parentage verification for many livestock and companion animals, but has also expanded the work to include research and service for laboratory animals, wildlife species, animal forensics, genetic diagnostics, and genetic disease.

For several decades, the UC Davis Veterinary Genetics Laboratory has been a leader in equine genetic research. More recently, researchers have been involved in the International Equine Gene Mapping Project. Gene mapping involves using known animal genomes (human, dog, or mouse) to map the position of analogous chromosomes in the horse and plays a critical role in the study of genetic traits. One of its primary values is to allow scientists to identify genes that may be responsible for diseases for which the only cure is to avoid breeding. In horses, genes have been identified for hyperkalemic periodic paralysis (HYPP), severe combined immunodeficiency (SCID), overo lethal white foal disease (OLWFD), junctional epidermolysis bullosa (JEB), and glycogen branching enzyme disease (GBED). As a result, genetic tests are now available to screen horses for these diseases and to assist breeders in their breeding programs. Research on other diseases and performance traits continues at UC Davis and other universities around the world, and it can be expected that in the near future additional tests will become available to the horse industry.