

A Fracture Test?

Ongoing research may lead to a new way to test for fractures- before they happen

By Andrea Caudill

Here's a tantalizing thought: what if you could test for fractures- before they become catastrophic- with a simple blood test?

A team of veterinarians and researchers at Colorado State University is busy working toward that possibility. The team is headed by C. Wayne McIlwraith, BVSc, Ph.D., DSc, FRCVS, Diplomate ACVS. He holds the Barbara Cox Anthony University chair in orthopedics and is a professor of surgery and director of the school's Orthopaedic Research Center.

"A lot of bone injury and fractures are the end result of an insidious process of bone degeneration," McIlwraith said. "The importance of this is, if we can diagnose the disease early, we can prevent fractures."

How Fractures Happen

"When I'm operating on a chip fracture," McIlwraith said, "A lot of people say, 'Well, the horse took a bad step,' or something like that. That's not usually the case."

"Whether it's a chip or a slab fracture, we don't get those in normal bone," he said. "What happens is the bone gets diseased first from the cyclic trauma of racing and training. Then that leads to various other things and leads to the fractures we get. In other words, chip fragments, even though they might look fresh on an X-ray, come from diseased bone."

Chris Kawcak, D.V.M., Ph.D., Dipl. ACVS, an assistant professor in the department of clinical sciences at Colorado State and another researcher on the project, has done extensive research into the process of microfracture.

"Microfractures occur within any material structures that undergo repetitive stress, such as bone," he said. "Microscopic cracks in the bone are a normal response to the continual stress the bone sees. Normally, the bone will remodel these cracked areas and strengthen the area. This remodeling process involves rapid reabsorption of the damaged bone followed by a relatively slow formation phase in which the bone matrix is formed in the site and mineralized. There are several locations in which this can become abnormal. If the remodeling cascade is too slow, or the work too hard, then the microfractures can accumulate and cause a clinically detectable fracture or chip."

In addition, he said, if the horse continues to be worked hard while the bone is remodeling, especially during the reabsorption phase before new bone is formed, then the bone can fracture through these areas of reabsorbed bone.

"This is a tenuous phase for young horses," he said. "The bone tries to repair, but since the first phase is reabsorption and the formation phase is slow, the horse is placed at a sensitive time in which the bone is weak and prone to fracture."

The point of fracture, he said, is different for each bone and each individual. At the point that you can detect microfractures, the process is already under way.

Current Diagnostic Methods

Methods available to diagnose damage early can be expensive, unwieldy, or unavailable. X-rays generally cannot show subchondral bone disease unless it is severe, McIlwraith said. One exception is the third carpal bone in the knee.

Nuclear scintigraphy, or bone scanning, is an option. Typically done after a lameness is diagnosed, it can recognize a horse with a stress fracture.

McIlwraith said, “When a horse gets lame behind, at least in southern California, it’s a stress fracture unless proven otherwise. So people take (the horse) in for a bone scan and diagnose the stress fracture, because you often can’t see them on radiographs. Then they lay the horse up, the injury heals, and you prevent catastrophic injury.”

“In long bones, such as the tibia and cannon bone, nuclear scintigraphy has been used successfully to identify those horses that have problems,” Kawcak agreed. “However, in the joints, it is difficult to use this to discern normal remodeling from pathologic changes.”

The downside of a bone scan is the cost- \$500-600 for one set of limbs, or \$1000 or more all the way around..

Other diagnostic tools are a CT (computerized tomography) scan, which is an x-ray machine that rotates around the body to provide a three-dimensional image, and an MRI (magnetic resonance imaging) scan which uses a magnetic field and radio waves to create an image.

Both are effective diagnostic tools, McIlwraith says, but are not very practical because both - with the exception of a hoof-only scan – require anesthetizing the horse.

What the future holds

McIlwraith, together with David Frisbie, D.V.M., Ph.D., Diplomate ACVS, and his colleagues in Southern California, recently completed a study, funded by the Grayson-Jockey Club Research Foundation, on 200 Thoroughbreds in southern California. They followed the horses in training for a year. When a horse was injured, they drew blood and compared it to the horse’s blood sample prior to injury, as well as to age- and sex-matched controls with no injuries. During the course of the 10 months of the test, McIlwraith noted, more than 80 percent of the horses had to be taken out of training or undergo surgery.

The study completed, the researchers discovered serum biomarkers that indicate breakdown products of cartilage and bone in the blood. With those markers known, the team is in the process of developing a test that will check for them with a simple blood test.

“In humans, those with osteoporosis show changes in blood markers of bone remodeling,” Kawcak said. “taking that to the horse, we can use some of these same markers to identify horses with potential problems.”

Mcilwraith estimates it will take about two years for the test to become commercially available.

“Say a horse is a bit off and the trainer’s not completely happy,” McIlwraith said. “A lot of times, you don’t see an obvious lameness, you just have poor performance. You take their blood, and if they’ve got some biomarker levels that are worrying, then you can put your money into imaging techniques to define it further.

“Diagnosing the damage early is key,” he said. “Catastrophic fractures are one of the worst things that happen to us with horses. Barbaro (TB) has received a lot of publicity in the last year, but his injury would have started with microdamage. We are not there yet with biomarkers, but we will be soon. And if you could’ve diagnosed that before he ran in the Preakness, you could have known it was there.”