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The Lameness Locator Takes The Guesswork Out Of Identifying The Limp

This diagnostic tool allows veterinarians to back up their professional opinion with evidence-based analysis.

BY KIMBERLY FRENCH
PHOTOS COURTESY OF KEVIN KEEGAN

Two years ago, event rider and breeder Melissa Studenberg had a few horses with a case of the “not quite rights.” She took them to Unionville Equine Associates (Pa.) to pinpoint the cause of the slight lameness they were exhibiting.

The facility had recently acquired a device called the Lameness Locator, developed by Kevin Keegan, DVM, MS, DACVS. The Lameness Locator consisted of motion sensors and special software, and the veterinarians at UEA were testing it to determine whether or not they would invest in one as a gait analysis tool.

“My vet was experimenting with it,” said Studenberg. “The first few times they used it on my horses they didn’t charge me, and the one time they did charge me, it wasn’t outrageously expensive.”

One of Studenberg’s horses was contending with chronic suspensory issues and on the lameness scale probably wouldn’t even have been a Grade 1. The veterinarian initially thought the horse was off in the left front or in both front feet, but the equipment clearly

identified the issue was in the left front.

When the heel on his left front was blocked, the veterinarian determined he was slightly off on the right, but the number was much lower than in the opposing limb.

“It’s not a huge added expense and helps when you start doing the blocks because it provides the veterinarians with a numeric value,” said Studenberg. “It definitely won’t replace veterinarians, and I don’t see it in more rural veterinary offices, but it’s a good tool for veterinarians to have.”

Two Vets, Three Opinions

When Keegan embarked on his study of lameness nearly two decades ago, he never imagined his data, images and research would morph into commercially viable gait analysis equipment.

A professor of equine surgery at the College of Veterinary Medicine at the University of Missouri, Keegan was perplexed and stymied by the difficult process many veterinarians endure when assessing various forms of lame-

“It definitely won’t replace veterinarians.”

—MELISSA STUDENBERG

ness, the leading cause of reduced performance in all athletic horses.

Since lameness evaluations are subjective, five veterinarians could examine a horse at the same time, and each might provide a diagnosis that would be completely variable from their colleagues.

Also, once a certain type of lameness is identified, it often develops into multi-limb lameness, which makes it challenging to determine what the primary source is and what is truly the issue.

“There were an unacceptable number of cases where I didn’t know what was going on,” Keegan said. “I was interested in objectifying lameness evaluations and





Bluetooth technology captures data from the Lameness Locator sensors and transfers the information to a wireless tablet with software that produces a computer readout with the data results.

evidence-based information rather than just an opinion.”

Keegan compiled research from 1993 to 1995 using high-speed cameras, markers, commercially available gait-analysis equipment and a treadmill. When he felt he was armed with enough information, he joined forces with Frank Pai, a mechanical engineer professor at the University of Missouri, and Yoshiharu Yonezawa at the Hiroshima Institute of Technology (Japan) and developed algorithms to deduce the best indicators of lameness.

The group obtained grants from the National Science Foundation and proceeded with their research. About 10 years after Keegan started his research, his group decided they might be able to create a tool that would aid other veterinarians in their lameness evaluations.

“We were just going to develop a tool to use in the clinic. It was never something intended for commercial use, but then we realized people could benefit from this technology,” said Keegan.

The Lameness Locator Is Born

Keegan and his associates formed a company they called Equinosis (www.equinosis.com) in 2007, but they didn't complete a prototype of their gait analysis system, dubbed the Lameness Locator, until 2009. They distributed the new equipment to practitioners they called “early adopters” who provided feedback on their test results. The Lameness Locator first became available commercially in 2010 and has now been purchased by more than 90 veterinary practices and universities in the country,

with additional sales from abroad.

The Lameness Locator consists of three rechargeable electronic sensors, two of which are accelerators that are placed on the horse's head and pelvis, and the third is a gyroscope that is situated on the horse's right foreleg.

Each sensor weighs less than 30 grams and records gait vibrations at 200 times per second. The sensors also include Bluetooth technology that captures data up to 150 yards away and seamlessly transfers the information to a wireless tablet with Lameness Locator software that produces a computer readout with the data results.

The head sensor is attached to the halter with Velcro or a specially made head bumper. The other accelerator sensor is affixed to the midline of the pelvis by Velcro or tape, and the pastern wrap is also fastened to the leg with Velcro.

The horse is evaluated by trotting in a straight line while the sensors measure the motion of the torso. The software compares and contrasts the data from archives of information on sound as well as other lame horses. The printout is completed and ready for investigation immediately after the examination.

Although other lameness studies have been attempted, they all measured for different variables such as stride length and joint angle. Keegan and his colleagues decided on vertical motion of the torso, which determines any asymmetries in the head and pelvic position between the left and right halves of a horse's stride.

"That is where we received the highest correct classification," Keegan said. "They call this vibration analysis, specifically fault detections analysis. It's used to find cracks in beams and buildings. When a horse trots, it includes acceleration and deceleration, so the vibration analysis reviews the vibration, dissects it, and finds where the fault is affecting the vibration. For example, you can tell where the crack is in the structure by stimulating the vibration."

The Lameness Locator uses the algorithms to deduce lameness in each limb, if there is a secondary lameness and impact rates.

Out Of The Lab And Into The Office

"Unfortunately, I'm old enough to have a fair perspective on the equine lameness industry, and I've seen a lot of different gait analysis techniques come along that were supposed to be a fix, but then you find they never make it out of the research stage," said A. Kent Allen, DVM, of Virginia Equine Imaging in Middleburg. "The interesting part about this technology is it's pretty robust, and Dr. Keegan came up with some real novel sensor technology, gait-analysis technology and software. This is the only product I've known of to receive a National Science Foundation Grant—in fact, I think they are on their third one—that has ever made it out to commercial practice.

"We first started using it in the early days when Dr. Keegan was still developing it for the university," continued Allen. "That was when they were still working out the kinks, but we recognized it was going to be a very valuable clinical tool, so we helped them through their first two grants by doing a number of test cases, and as soon as it was available for purchase we went ahead and purchased it."

Jennifer Smith, VM, DACVS, from the New Jersey Equine Clinic in Millstone started using the Lameness Locator about a year ago when Scott Palmer, VMD, purchased one for the practice.

"He became involved with it when Equinosis performed a demo, and he was interested in validating the data for Standardbreds trotting and pacing while exercising," said Smith. "On many occasions we will have people tell us their horses aren't performing, then when they are brought in and jogged in hand, the lameness will be somewhere else or at speed it will present differently. I think this equipment has been very useful in picking up some of the subtle lamenesses people can't see during exercise or multi-limb lameness. A measurement like this provides concrete numbers for your analysis."

Before the Lameness Locator was made commercially available, Keegan added to its appeal for veterinarians by publishing several studies in *Equine Veterinary Journal*, the *American Journal of Veterinary Research* and

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▶ Lameness Locator FAQs

▶ **What does the sensor on the pastern measure and could it affect the Lameness Locator by causing the horse to react with the right front leg?**

This device is a gyroscope and keeps track of when the horse's limb is in the air or on the ground. The evaluation itself is determined by the accelerometers on the horse's torso and head. The movement of the horse's body is measured, not the movement of the limb. Placing the wrap on the horse's leg has no bearing on how the horse's torso accelerates and decelerates. The sensor doesn't need to be wrapped tightly to yield results, but it must be placed on the front of the leg. If it slides more than 90 degrees or to the back of the limb, it won't produce correct measurements. All other limb measurements can be approximated once the gait is established, and the algorithms are designed only to work with a sensor on the right front leg.

▶ **What exactly is the intent of the Lameness Locator?**

"Very few, and there will always be a few, who have taken the time to study it and who have actually had their hands on it dismiss it as a gadget," Keegan said. "I have frequently been coached by other veterinarians, businessmen and entrepreneurs that I need to make this a black box instrument, something that spits out red for lameness and green for soundness, something that requires little thought or effort to learn, and I have resisted. I have resisted because lameness is complicated, and it frequently takes experience, skill, time and hard work to sort out. I have also resisted because anything like this would really be a worthless gadget. The equip-

ment is easy to use, and it can streamline a practitioner's lameness evaluation because it takes out some guesswork, but you have to work at learning the analysis, and it is not meant to replace a veterinarian. It is to help them diagnose subtle and multi-limb lameness."

▶ **Does the device take into account limb length disparity or high/low hoof pairs?**

Yes. Keegan and his associates artificially constructed limb length and hoof angle asymmetry in both fore and hind limbs to test if this was a problem. They discovered induced limb length and hoof angle asymmetry did not alter any movement of the torso, either short or long term, as the soft tissue sling linking the limb and the vertebral column minimizes this circumstance. In the hindlimbs, induced limb length or hoof angle asymmetry does affect results but only over hours or days. Within several days, no effects can be measured.

▶ **Does asymmetry of amplitude in fact equal pain? And are there studies that look at factors that do cause asymmetry of amplitude?**

For Keegan, this theory was a major concern when the equipment was in the developmental stages, but he found horses are remarkably symmetric in their vertical torso movement on a straight line at the trot, even when the way they move their limbs is quite asymmetric. He claims this is not true for longeing, and while he acknowledges there may be sound horses displaying sizable asymmetry in their vertical torso motion, that would be extremely rare.

the 2010 World Veterinary Orthopedic Congress in Italy. He also contributed to lameness and gait analysis studies for the *Equine Veterinary Journal*, the 2005 American Association of Equine Practitioners Convention and Veterinary Clinics of North America, Equine Practice.

His research buttressed the data discovered while working on the Lameness Locator, such as head and pelvic positioning, while also demonstrating that many veterinarians will have an entirely different evaluation of a horse if their examinations are based solely on the naked eye.

While his validation was an integral reason veterinarians have begun to purchase and use the product, Smith said there's another element to the equipment's success.

"I think it's really nice for the client," she said. "This is a good way to verify our diagnosis, and it's a useful tool to show to the client so they can gain some perspective. The feedback from them has been excellent. I think horse people are pretty open-minded, and it's a cool set of equipment. They want their animal to have the most up-to-date technology."

Although Allen doesn't use the Lameness Locator in every lameness evaluation, he agrees with Smith that it aids in diagnosing more complicated cases.

"We do not perform routine medicine or preventative health care, as we are just a lameness and sports medicine practice," he said. "We tend to use the equipment in more complex cases. I do know practitioners who don't see as many lameness cases as we do tend to use it on every lameness case, which is probably a great idea. But we focus it more on multi-limb lameness cases where we are trying to quantitate a block on or with a bone scan. We also use it anytime there is a discrepancy in what we have seen previously or what a referring veterinarian has sent us, or if there is a question on the history of the horse if it is presenting for the first time. We find it incredibly valuable, and it is one of those technologies the more it is put to use in complex cases, the better it performs because those are the cases where human error creeps in."

As a horse owner, Studenberg appreciates the device as a tool, but she sees

it as a supplement to her veterinarian's experience, not a replacement.

"You still have to rely on your veterinarian's naked eye," she said. "Obviously, I don't think my vets would have put it on if the lamenesses were not subtle, because if you are grade 2 or grade 3 lame, you don't need the Lameness Locator. But for those hard-to-diagnosis lamenesses it's helpful."

Allen and Smith believe this equipment has a bright future and will become more available through an increased number of practitioners in the coming years.

“The more it is put to use in complex cases, the better it performs because those are the cases where human error creeps in.”

—DR. KENT ALLEN

"It's like any technology," Smith said. "The more popular it becomes, the cost decreases, so financially more practices will probably look into purchasing it. Technology is a funny thing, as at first a lot of people are all about it, and then it has to be tried. When that has been done, and it's determined this is something that is going to stick around, then everybody is on the ship. The company also seems to be continuing to improve. Initially you could only trot the horses in a straight line for the evaluation, but they have developed a test system for longeing. Obviously, a horse's gait changes under those conditions, and it's really nice to have something with different scenarios available, because a lot of horses are only lame in one position or direction. I think enhancing their system can only be a good thing." 🐾



The Lameness Locator evaluates soundness based on the vertical motion of the torso, so the gyroscope placed on the horse's right foreleg should have no bearing on how the horse's torso accelerates and decelerates.

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