Canine Locomotion: Similarities and Differences to Horses

M. Christine Zink, DVM, PhD, DACVP, DACVSMR, CVSMT

With increasing numbers of dogs competing in sports competitions, it is critical for veterinarians to thoroughly understand canine locomotion and gait. While equine gait is taught in veterinary school, few curricula include information about canine gait, which has both similarities and differences to horses. Dogs are built very differently from horses and that is reflected in their use of different gaits. In fact, dogs use some gaits that would be considered completely abnormal in horses.

There are three structural features that make dogs different from horses:

Dogs have a much more flexible spine. Horses have 17 (Arabians) or 18 ribs and a large intestine full of hay in various stages of digestion. As a result they have minimal ability to bend their vertebral column. In contrast, a dog has only 13 ribs and a low-volume intestine. In addition, dogs have a comparatively longer lumbar area (7 lumbar vertebrae as compared to 6 in the horse). Further, horses have joints between the transverse processes of L4 to L6, reducing the flexibility of that part of the spine. Thus the dog is able to flex and extend its spine to a much greater degree than the horse. This produces a great deal of power for forward drive. Picture the image of a greyhound that can be seen on the side of buses. You would never see a horse with its legs extended so far forward and backward. That is the incredible power of the canine spine. In fact, despite their difference in size, the stride length of a greyhound at a gallop is approximately the same as that of a thoroughbred horse running the Kentucky Derby.

Unlike horses, dogs have a separately functional radius and ulna. These bones allow the dog to rotate the front limbs on their axes. This allows dogs to make very sharp, accurate turns and to fine-tune their front limb movements.

Dogs have feet that can grip the ground and that have more sensation than horses' hooves. This improves a dog's sense of where their feet are (proprioception) and improves their turning ability, making more complex gaits a possibility.

Canine Gaits

Overview

In dogs there are four main gaits: the walk, trot, canter and gallop. Horses use these same four gaits, but, importantly, dogs have two different ways of cantering and two different ways of galloping and the canter and gallop that dogs perform preferentially are different from those used by the horse. In addition, dogs have a transitional gait between the walk and the trot that is called the 'amble.' There also is a relatively common, but abnormal gait in dogs called the 'pace,' which is a normal gait for some breeds of horses.

The Walk

When a dog walks, it first moves one rear leg forward, then the front foot on that same side. Then it moves the other rear foot forward and then the front foot on that side. So the pattern of footfall for the walk is RR, RF, LR, LF (repeat). When a dog is walking, there are either two or three feet on the ground at any given time. The walk is the only dog gait in which there are ever three feet on the ground.

The Amble

As a walking dog speeds up, each rear foot that steps forward is quickly followed by the front foot on the same side. Eventually it begins to look as if the two feet on the same side of the dog's body are moving forward together. However, if you look closely, or view a slow motion video, you will see that there still are moments when there are three feet on the ground, and thus this gait is still a form of the walk. It is essentially a fast walk.

Ambling dogs look very ungainly. The rear end sways from side to side and the dog doesn't lift the rear feet very high, often scuffling them along the ground. Not only that but an ambling dog often moves at the same speed as a dog that is moving at an easy trot. This wasted horizontal energy is why the amble

is not a preferred gait and really should be used only for short periods when transitioning from a walk to a trot or when a tired dog wants to rest the muscles that it uses when trotting.

The Pace

Another reason why the amble is not a preferred gait is because it's just a short step away from the pace, which is an abnormal gait for all breeds of dogs. If an ambling dog continues to gradually speed up, eventually the two feet on the same side of the body that are moving forward together end up bearing all of the dog's weight. The two legs on the other side of the body then move forward and bear the dog's weight, with a moment of suspension in between. Now the dog is pacing. In a pace, there are only two feet on the ground at any given time, either both right or both left feet.

The pace is a very inefficient gait because the dog's center of gravity keeps shifting from side to side and the dog has to use energy to keep recentering its weight. That energy could be used to drive the dog's body forward instead. In addition, pacing dogs cannot respond quickly when a change in speed is required.

The Trot

This is the dog's most efficient gait. Wolves have been known to cover 100 miles a day, mainly using the trot. When trotting, a dog moves diagonal front and rear feet forward together. First are two diagonal front and rear feet move forward (e.g., RF-LR) then there is a moment when the dog's whole body is suspended in the air, then the other diagonal front and rear feet move forward and bear the dog's weight (e.g., LF-RR).

The trot is the best gait to use for aerobic conditioning for canine athletes because it is the only normal gait that requires each side of the dog's body to work equally hard during exercise. Each front and rear leg must support the dog's body without help from the opposite leg.

The Canter

There are two variations in the pattern of footfall for this gait, so most people find this gait a bit more complex to understand. In the classical canter, first one rear foot moves forward, then the other rear foot and the diagonal front foot move forward together, then finally that last front foot. So the order of footfall is RR, LR-RF, LF, or LR, RR-LF, RF, depending on which lead the dog is using. Of the two rear or the two front feet, the second one to strike the ground is called the lead leg, because it is placed on the ground physically ahead of its partner. So in the first example above, the dog is using the left lead in both the front and the rear. In the second example the dog is using the right lead in both the front and the rear.

The classical canter is how normal horses canter. Dogs use this form of the canter only about 10 percent of the time. The rest of the time they use the rotary canter. In the rotary canter, the dog uses different lead legs in the front and the rear. So the order of footfall is either RR, LR-LF, RF, or LR, RR-RF, LF. The rotary canter allows dogs to turn very sharply and with greater drive from the rear. In horses, however, this gait is referred to as cross cantering and it is considered undesirable because it is uncomfortable for the rider.

The Gallop

The gallop starts with the dog's spine flexed and two rear feet on the ground, one foot (the lead foot) slightly ahead of the other. The dog then extends its spine, stretching its front feet forward, which hit the ground, one slightly ahead of the other. The dog then flexes the spine to bring the rear feet forward to start the cycle again. When the dog uses the same lead in the front and rear, the gait is called the transverse gallop and is the same type of gallop used by horses. But when the front legs are on a different lead from the rear, it's called a rotary gallop and is used by dogs preferentially. In fact, it is very uncommon to see dogs use a transverse gallop.

References

1. Zink MC. In: Zink MC, Van Dyke JB, eds. *Canine Sports Medicine and Rehabilitation*. Wiley-Blackwell; 2013.