Dynamics of the Rear Assembly Part 2

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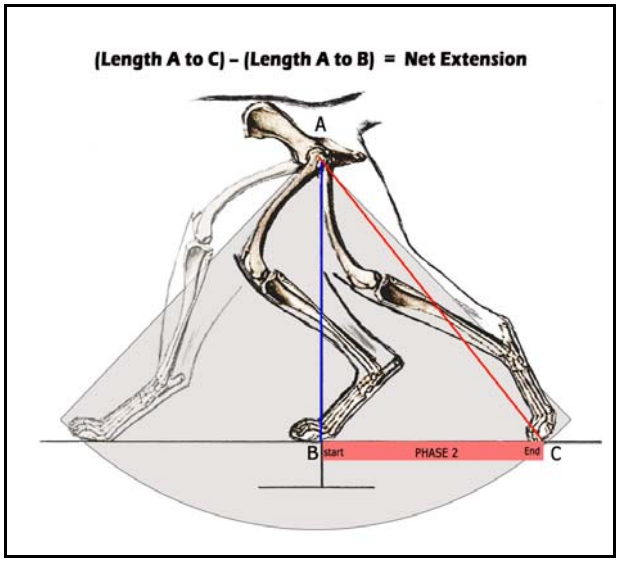
Editor's Note: *Please refer to pages 98-99, Issue 2 of 2010 for Part 1.*

In Part 1, I discussed rear action sequence, angulation and effective rear angulation. I will now continue with our discussion of the rear assembly.

Contact With The Ground
Simply put, the longer a dog's rear foot remains in contact with the ground while moving, the greater the opportunity the rear has to generate drive. This is simple logic. Longer bone lengths in the rear will increase the length of time the foot can push off the ground. At the gallop, sight hound breeders are aware of the benefit of increased foot contact and developed an arch to the topline of their dogs so they can reach further under themselves while galloping and significantly extend their dog's foot contact time with the ground.

Mechanical Advantage
As with bench pressing weights, the greatest push or kick comes just before you fully extend your joints. This is because the joint's mechanical advantage over the weight or opposing force increases as the joint's angle opens. For our dog, the full extension of his joints gives a powerful push at the end of their stride. Trotting breeds having too long of bones (very angulated), do not have enough stride length or foot contact time to fully extend their joints before the end of phase two, and because of this, they do not benefit fully from mechanical advantage. These dogs, who look like loaded springs while standing, will use more energy with each step, and because of this, they will have less stamina.

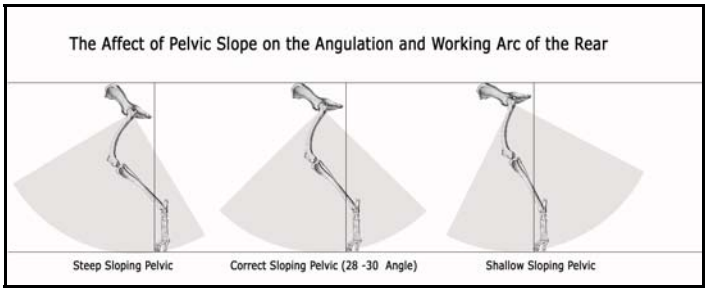
Taking Advantage of Both Conditions
The trick in determining effective rear angulations is having rear bone lengths long enough, correctly proportioned, and correctly positioned to maximize the foot's contact with the ground. While at the same time, making sure they are short enough to fully extend at the end of phase two in order to fully benefit from the increase in energy mechanical advantage provides. It is a balancing act and this explains why the more moderately angulated dogs have the better sustainable rear drives! Their bone lengths are just long enough to allow the foot plenty of contact time to push off the ground and yet short enough to fully extend the joints allowing for maximum benefit from mechanical advantage.



Net Extension - Figure 3

Net Extension:
Another area of importance is the net extension applied during the back reach in phase two. The net extension is the measured difference between the distance from hip joint to the paw at the beginning of phase two when the rear angles are closed and the distance from hip joint to the paw at the end of phase two when the rear angles are open. Net extension is a key component to determining the amount of rear drive a dog can generate. This is where rear angulation has proven to be deceptive. Many times, dogs displaying less angulation while standing possess greater net extension than dogs displaying more angulation while standing. If the length of phases 1 or 2 are shortened, or compromised, many times it lessens the net extension.

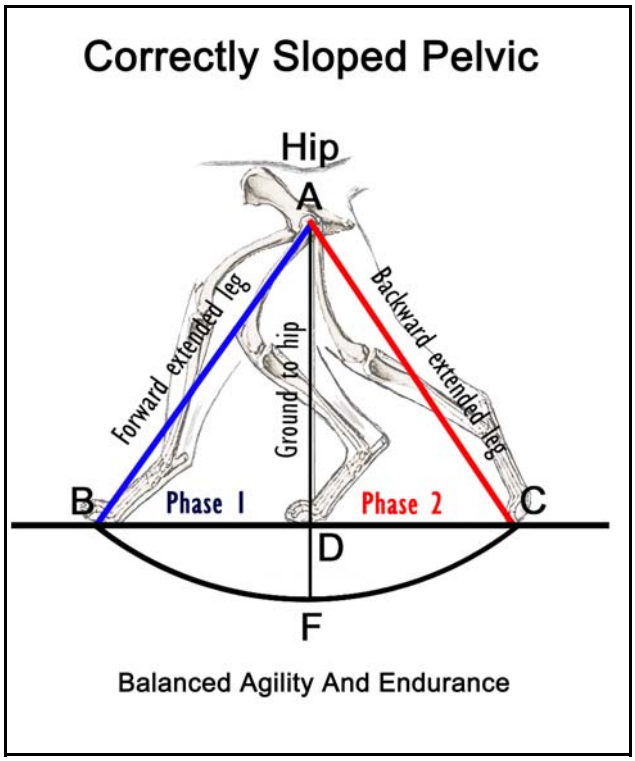
When phase 1 is shortened, less bend between the stifle and hock joints is created and can result in less bend opening in phase 2. When phase 2 is shortened, there is not enough length of back reach to fully open the bend created in phase 1.This is why phase 1 and phase 2 are equally important in a correct rear assembly. Structural reasons for this will be covered later.

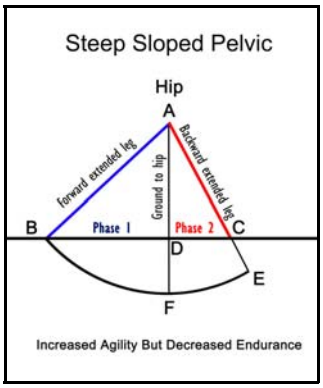


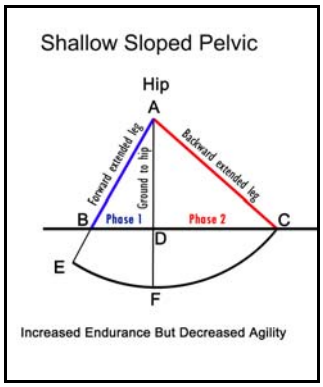
Pelvic Slope's Affect on Angulation:
The angled slope of the pelvic helps determine the angulation you see when the dog is standing. Dogs having the same proportions and length to their bones of the rear assemble, can visually display different angulation depending on the slope of their pelvic. Notice the changes in the amount of angulation associated with the different pelvic slopes in the figure above. A dog with a more steeply angled pelvic will have more turn in the stifle and hock than the dogs having a more moderate or lesser angled pelvic. Again, this is dependent upon all the other bone lengths and proportions being the same.

So, looking beyond the angles of the stifle and hock is important for accessing the true angulation of a dog!

There are 4 graphics here for the Working arcs







Segment A to B represents the rear leg's forward reach extension

Segment A to C represents the rear leg's back reach extension

Segment B to D represents phase 1

Segment D to C represents phase 2

Segment A to D represent the distance from ground to hip at the end of phase 1 and beginning of phase 2

Segment D to F represents the amount of joint bend at the end of phase 1 and beginning of phase 2

Segment C to E represents the joint bend remaining at end of phase 2

Segment B to E represents the amount of joint bend at beginning of phase 1

AC - AD = Net Extension

The Pythagorean Theorem Applies

$AB = \sqrt{(BD)^2 + (AD)^2}$ and $AC = \sqrt{(DC)^2 + (AC)^2}$

Any change in phase 1 (BD) or phase 2 (DC) requires in a change of AB or AC

Pelvic Slope's Affect on Rear Arc:
The angled slope of the pelvic (hip bone) is very important to movement! Arguably, the pelvic is the most important component of the rear assembly, because it controls and restricts where the other parts of the rear assembly can operate. Its positioning restricts or increases their effectiveness! We often talk about the slope of the croup and the set on of the tail, but their true importance is as a visible indicator of the slope of the pelvic. The lower the slope of the croup and tail set on is, the steeper the slope of the pelvic is. It is the slope of the pelvis which determines the working arc of the rear. A steeply angled pelvic will increase the under reach, but reduces or restricts the follow through. A shallow angled pelvic increases follow through, but reduces or restricts the under reach. It has been determined a more moderately angled pelvic (28 – 30 degrees) is the most effective slope for trotting breeds. This allows for a more balanced under reach and follow through.

Steeper pelvic slope:
A steeper pelvic shifts the working arc of the rear assembly forward, increasing foot contact and action in phase 1, and reducing foot contact and action in phase 2. Often, the closing of joints created in phase 1 are unable to fully open in phase 2 reducing the benefit of mechanical advantage as the joints fully extend.

Advantages - increases action in phase 1 - a steeper pelvic gives a dog greater agility because it allows the rear to get under his bodies center of gravity more effectively. Quarter Horses are the premier cutting horse of the horse world because their steeper pelvis gives them the ability to turn on a dime. It also will help compensate for a poorly constructed front assembly by providing more lift to the front. A steeper pelvic increases early speed. It helps the Quarter Horse to be the fastest galloping horse in a quarter mile.

Disadvantages - reduces action in phase 2 - a steeper pelvic directs more energy downward against the ground and less energy directed forward. Because of this, it reduces endurance. A bad combination is a steep sloped pelvic with a shorter bodied dog because of the interference of more forward reach of the rear has with back reach of the front assembly during a trot. It forces the dog to have lateral instability causing crabbing or some other unnatural foot action to compensate.

Shallow sloped pelvic:
A shallow pelvic shifts the working arc of the rear backward, reducing foot contact and action in phase 1 and increasing foot contact and action in phase 2.

Advantages - increases action in phase 2 – a shallow sloped pelvic increases mechanical advantage and directs more of the energy created toward moving forward than support. It increases endurance. Some of your best endurance race horses have less slope to their pelvics.

Disadvantages: less action in phase 1 – a shallow sloped pelvic decreases agility because the dog has increased difficulty getting their legs up under their bodies center of gravity. Because of this, it restricts the rears ability to help compensate for a poorly constructed front. Especially fronts with short upper arms. The lack of support from the rear causes the front to drop giving the topline a high in the rear appearance when moving..

A bad combination is a shallow sloped pelvic on a long bodied dog. This dog will lack in agility and in his ability to jump.

Again, it comes down to balance. A correctly angulated pelvic allows for equal forward reach and back reach which results in balanced manuverability and endurance.

Steven Robinson & Hoover

We will continue with our discussion of the pelvic slope and energy transfer in the next issue.