

## **FUNCTIONAL ANATOMY OF THE HORSE – The Back**

**A top German veterinarian discusses why the horse *must* be stretched forward and down to be able to raise his back.**

**By Dr. Gerd Heuschmann, DVM  
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“Work him deeper” is a command often heard in riding arenas. And somehow every student has internalized that “the horse has to round his neck”. But hardly anybody ever asks why this is. Instead, riders pull and push – the horse’s head is down. However, the rider who realizes that this can’t be good often does the opposite: He allows his horse to go with his nose up too high, for the horse’s sake. In the following article, Dr. Gerd Heuschmann shows that both ways are wrong. The method to stretch the horse forward and down, postulated by the classical German riding doctrine, is not arbitrary invention but is based on a simple rule of nature. It has to do with the way the horse is constructed, especially in regard to his back. First of all, let’s clarify how a horse is built: The horse’s back is a bridge between his forehead and his hindquarters, which is made up of a certain number of vertebrae. This is why in German it’s called *Wirbelsaeule*, meaning something like “bridge of vertebrae”. This bridge consists of 18 thoracic (chest) vertebrae and, typically, of six lumbar (loin) vertebrae. These vertebrae are strapped together by numerous little joints as well as strong ligaments and muscles, which make this part of the spine extremely stable but give it only a little flexibility. In contrast, the seven cervical (neck) vertebrae are highly flexible and comparable to the human spine. Attached to the lumbar vertebrae is the sacrum, which is formed by the fusion of five sacral vertebrae and the coccygeal vertebrae (the horse’s tailbone), about 20 in number. The sacrum is connected with the pelvis through its flat transverse processes and a strong ligament, creating the so-called sacroiliac joint. Through this joint, the thrust from the horse’s hindquarters is transmitted over the “bridge of vertebrae” to the horse’s mouth.

### **The Ligament Carries the Weight**

A well-fed horse weighs about 1,100 to 1,500 pounds, which means that about 400 to 700 pounds permanently stress the bridge of vertebrae. This weight, however, does not rest on the horse’s skeleton alone. The nuchal/supraspinous ligament carries a big part of it. The tips of all the back’s spinous processes are covered by a tendon-like ligament called the supraspinous ligament. From the spinous process of the third thoracic vertebra, the supraspinous ligament continues as a strong, elastic neck strand – the nuchal ligament – toward the occipital bone (the base of the horse’s skull) and with additional ligament parts to every cervical vertebra. In the area of the withers, the nuchal ligament forms a broad “hood” – the attachment of the nuchal ligament to the withers’ dorsal spinous processes. When the horse stretches his neck forward, the nuchal ligament is put in traction, pulling on the withers’ spinous processes, causing them to rise. This effect extends all along the horse’s back – the traction is transmitted to the tendon-like supraspinous ligament, which, as a direct continuation of the nuchal ligament, connects all of the back’s spinous processes. As all of the back’s spinous processes rise, upward and to the

front, the thoracic and lumbar vertebrae follow. Thus, the horse's back lifts. In nature, for example when the horse is out on pasture, this process happens almost all of the time because the horse constantly lowers his head in order to eat grass. Consequently, the unriden horse is perfectly in balance.

### **Riding Forward & Down**

This balance logically is lost as soon as a rider sits on the horse's back. As a result of the unaccustomed burden, the young horse who feels the rider for the first time, contracts his back muscles and tenses up. The long back muscle is not designed to take vertical pressure; it tires soon and then begins to hurt. After a while, the horse can't keep up the tension in his back – the result is that his back sags. When this happens, the horse carries the rider's weight more or less only with his skeleton, without muscular support. Then, riders often say, "my horse drops his back," or "my horse hollows his back". These expressions, however, are not accurate since they suggest that the dropping of the back is the horse's fault, that he does it on purpose. He does not. The horse simply is exhausted. Unfortunately, there are horses that spend all their lives going alternately with a tense and then a dropped back under the rider. Sadly, it must be said that this condition most of the time is "homemade," a result of incorrect riding. For their riders, these horses are uncomfortable, difficult to sit to and extremely bouncy at the trot. For the horses, however, the consequences are even worse: They wear out quickly including their legs. *The long back muscle of the horse, an animal designed to run, is not suitable for carrying a rider.*

The question remains: How does a horse carry a rider? As we've seen in nature, it's mainly the nuchal ligament that helps the horse lift his back by stretching it forward. The same principle is true even more when there's the additional weight of the rider. When a rider sits on the horse, the horse balances him out with the weight of his neck and head, which act as some sort of lever – just like scales. But since on a young horse or a horse that is incorrectly muscled, the muscles of the horse's upper neck are too weak to do the lever's carrying work, the following rule applies: The heavier the rider, the lower the horse's head must be initially. Now you also will understand why a young horse has to be ridden forward and down. For the ridden horse, the head-and-neck lever acts like a balancing rod that helps the horse carry the rider's weight more easily. At the same time, the different back muscles and croup are released so they can serve their original task, which is locomotion. Now the horse can move with a swinging, relaxed back. However, it's crucial that the horse lets his stretched neck fall down *passively*. If the rider uses too much hand and bends the horse's neck *actively*, the horse curls up or leans on the bit. Have you ever thought about what effect your rein influence has on your horse's neck? A little bit of physics helps you understand the impact of the reins. Consider three points: The first is the attachment of the nuchal ligament to the base of the horse's skull just below the ears. Below that is the atlanto-occipital joint where the last cervical vertebra meets the skull. Third are the bars of the mouth where the bit rests. If you examine these three points closely, you will see that they, just like the head and the neck, follow the lever principle as well: This means that if you have 40 pounds "in your hands," for example, these 40 pounds create a multiple of applied (compressive) force at the point where the nuchal ligament is attached to the horse's skull. Now you will also understand why permanent influence of this kind causes damage at that point. Injury of this kind is extremely painful and makes progress in the horse's training impossible.

### **Are You on the Right Track?**

Your horse's neck will indicate if you are riding him correctly, because nowhere else can you see the development of muscles and muscle groupings better than on the neck. As I said, on a well-ridden horse, the muscles on the top of the neck are constantly in use and, like all muscles that are working, they gradually increase in size. The neck becomes wider, the triangular indentation between the cervical spine and the crest of the neck, which is well visible on a young horse's undeveloped neck, fills up with correct training. These neck muscles are, unlike the horse's long back muscle, able to do passive carrying work in the long run. The muscles on the bottom of the neck – the neck flexors – don't get stronger but rather decrease a bit, and the jugular groove will become more distinguishable. In the course of the training, the horse will develop a beautiful and even convex arch. The neck also appears longer. The development of the neck muscles tell us if a young horse is being trained correctly.

### **Swinging Back: But How?**

Let's sum up again: The goal of our riding is to make the horse's back "swing". Only a swinging back ensures that the horse is able to carry the rider in the long run without wearing out. And only with a relaxed, swinging back is the horse able to optimally utilize the full potential of his locomotive system. It must be stressed that the horse's long back muscle is for locomotion, not to carry the rider's weight! Remember that the nuchal/supraspinous ligament carries the weight. A horse with a tense or sagged back is impeded in his ability to move. He "falls apart" – is disconnected – or moves insecurely or with tension, and his hind legs are not able to move freely and unconstrained. Unfortunately, not everybody is able to recognize a truly swinging back. Even among experts and judges, one still can find people who prefer a horse that shows spectacular leg action over one that is not quite as remarkable but goes in a truly relaxed, loose manner. While the hind legs in combination with a tense back lose their natural freedom of movement, the horse's back muscles also can't work undisturbed when faulty leg and rein aids disturb the natural rhythm of the horse's hind legs. Therefore, in order to allow the horse's back to swing, it is imperative to ride rhythmically. Do you remember the training pyramid? Now you know why rhythm is a quality that comes first in the pyramid's hierarchy.

Another problem on the way to a swinging back is the faulty seat of the rider. A rider who is tense in his back himself, tends to vertically hammer on the horse's back at the trot so that the horse, of course, tenses up in the back, too. As a consequence, the horse doesn't let his neck fall down, the neck muscles are not being used, and his back, by tensing up or dropping, is fighting with the rider's weight. The more careful and supple the rider's seat, the quicker the horse relaxes his back. As a basic rule, the rider should post the trot until the horse's back is relaxed, and only then should he sit the trot. When sitting the trot, a good rider sits in the direction of the muscle fibers – which means from the back to the front. When it's the right moment to sit the trot depends on the individual horse and rider. Now you will understand why, at the beginning of every lesson, after an initial warm-up phase at the walk, one has to loosen up the horse. The goal is to achieve a warmed-up, relaxed and loose back. Only then does it make sense to proceed with your work. Many riders apply a rule of thumb in their warm-up – 10 minutes walk, 10 minutes rising trot and ready we are – which is humbug because not every horse has loosened up after this time. As the case may be, it can mean that the rider will have to spend the whole lesson, sometimes even weeks or months to achieve this goal. The magic word for a lesson in real harmony, however, is *Losgelassenheit* – the horse moves freely forward in a relaxed manner, seems happy and content, and his muscles contract

and relax rhythmically at every stride. This is why *Losgelassenheit* is on the second rank of the training pyramid, right after rhythm – the horse's legs leave and touch the ground in an even rhythm and step equally far forward.

### **Back Training**

Gymnasticizing is a word we often use to describe the training of the horse. Basically, it means nothing other than systematically building up certain muscles and muscle groups. It's not different from what we humans are striving for when doing gymnastics or strength training in a fitness studio. While with a 3-year-old horse, the balance is found mainly at the trot, back training especially suitable for the older horse includes repeated canter departs, long canter departs, long canter phases on a trail ride and riding up a hill. It's also helpful to do work over poles or low cavalletti or even low jumps, which encourages the horse to use his back. In the course of the training, the horse's flat back muscle will get more developed, and you will clearly see the muscles' rhythmic play at every gait.

### **Back Problems: Homemade or Bad Conformation?**

Many back problems are homemade, which means they are the result of incorrect riding and gymnasticizing. When the horse has a back that is constantly tense, the back muscles will degrade and become flat – a result of lacking blood circulation. A permanent dropping of the back can lead to numerous spinal injuries because, as we have seen, when a horse drops his back, it's mostly his skeleton that carries the burden on his back. There also are horses that have problematic conformation, which make back problems more likely. A faulty conformation of the head-neck part (horses that are thick at the throat or horses that have a swan neck) as well as short back (square horse) can lead to back problems in the long run. A short and strongly muscled back naturally has a lot of carrying power, which might lead you to the assumption that a rather short, compact horse is more suitable to carry a rider than a horse with a longer, "softer" back. However, this is a wrong conclusion. Horses with short backs are especially the ones who tend to be tense and more difficult to loosen up. There are two reasons why this happens: First of all, on a short, less-elastic back, the stress is less distributed than on a long one. And second, what makes it even more difficult, is that on a short-backed horse, the saddle often lies on the broad, lateral extensions of the lumbar vertebrae are rigid. This inevitably leads to tension as the horse will try to avert stress in this weak area. Therefore, horses with very short backs are much more likely to be tense in their backs than horses with longer backs, and for the rider of a short-backed horse, it will be more difficult to eliminate that tension. Following this logic, a rider can also be too big for a horse. If your horse has massive problems with *Losgelassenheit* and contact (*Anlehnung*), check his anatomical characteristics as well as your influence as a rider. When doing this, be self-critical and don't only look for faults on your horse's side. Remember, the horse has no bad intentions. *He only reacts!* When the horse is correctly built, tensions and back problems are *always* the result of permanent incorrect influence of the rider. On the other hand, horses with a problematic anatomy of the back can be permanently used in the sport without being damaged if they are trained correctly and consistently.

### **The Raised Back of the Horse**

We've seen that when the horse stretches forward and down, the nuchal ligament is put in traction, which, in turn, raises the spinal processes of the withers forward and upward and, subsequently, raises the back. When there is a forward acting force, there has to be a backward acting one, too, to support the forward acting force. This becomes clear when you look at the inclination of the spinous processes with all the

muscles and ligaments attached. When the horse stretches his neck forward and down and the nuchal ligament is put in traction, the spinous processes of the first 15 thoracic vertebrae, withers included, are inclined backward. The spinous processes of the remaining thoracic vertebrae and lumbar vertebrae, however, are inclined forward, in the opposite direction. The respective muscles and ligaments attached to these spinous processes, the nuchal/supraspinous ligament on one side, the big croup muscles including parts of the thigh muscles on the other, follow this system of opposing forces along the horse's back. I call this system "*Obere Verspannung*", or "upper contraction system". It has a key function in lifting the horse's back. There's also a contraction system on the underside of the horse (*Untere Verspannung*), consisting of the abdominal muscle as well as the iliopsoas muscles situated beneath the lumbar portion of the spine. Although these two muscle groups play only a minor role in raising the back, they have to be mentioned, too. They come into play when the horse pulls his legs toward the body in the suspension phase, when the legs are all off the ground, especially at the canter. This is why horses that do a lot of work at the canter – common in dressage but also racehorses – show more tone in these muscles and the tummy appears slimmer. The real carrying work, however, happens in the moment of support, when the horse has a foot on the ground, and is done by the upper contraction system. The upper contraction system consists of ligament-like structures and white muscle fibers that work like powerful rubber bands and are able to do long-term, passive carrying work. With one exception, the lower contraction system with its abdominal and iliopsoas muscles mainly consist of red muscle fibers that have "active" tasks, such as pulling the leg toward the body in the suspension phase.

### **The Light Seat & the Lever Principle**

Do you remember your last physics lesson when your teacher was talking about the lever principle? A lever is a simple machine that makes jobs easier by using a small force (effort force) in order to overcome a larger force (load force). So, by using a pry bar (a long lever arm), you can magnify the effort force on the other end of the bar using relatively little energy. This principle also applies to horses: Head and neck are the lever arm or the effort force; the distance from the withers to the deepest point of the rider's seat is the load force. When using a light seat, the rider additionally sits as far forward as possible, with a forward upper body, in order to keep the load force as small as possible. The light seat is always a big topic in my seminars. I believe that it's not used enough in modern dressage training. Commonly, horses are started as 3-year-olds, and when there's a focus on dressage, these poor dressage babies are ridden in sitting trot and worked like mature horses. Also, most dressage riders ride with stirrups that are too long and don't even know what "light seat" means. In the early 1930s, the cavalry times, riders used the so-called "*Remontesitz*" (*Remonte* is a German word meaning young horse), a seat specifically designed for young horses ridden at the trot and similar to the light seat used at the canter. When using this seat, the rider shortens his stirrups a bit, takes his seat slightly off the saddle, easing up his horse's back and letting his weight elastically spring down, through the ankles, into the stirrup bar. This kind of seat is a wonderful way to bring young horses into a relaxed balance characterized through *Losgelassenheit*. The first two years under saddle serve only one purpose: to build up and develop the right kind of muscles and the ability to carry. A long dressage stirrup and a straight dressage seat have no application in a 3-year-old!

### **On Light Hands**

How many pounds should you have in your hands for a good, light contact? This question is not so easy to answer. On a perfectly educated horse that has reached

the highest levels of dressage, it's only the weight of the reins. A young horse, however, is much more dependent on the mechanical aid the reins give him. A young horse just started even needs a sideways guiding rein. A horse that is ridden freshly forward but hasn't learned to carry yet also needs more support through a secure contact, which can be several pounds sometimes. The more the horse is able to shift his weight onto his haunches with a supple and free back – showing that he is signaled increasingly by a confident, sublime weight aid that is *losgelassen* – the less important the influence of the rider's hand is. To always find the right dosage, that's the art in dressage. It's impossible to give a number.

### **The Training Pyramid**

If you look at the horse's anatomy, you will see that your goal for every riding lesson is to work, step-by-step, from the qualities of the training pyramid – no matter what level your horse is on. With a young horse, that means working on rhythm, *Losgelassenheit*, contact. With an older, more experienced horse, after having checked if the first three qualities are in place, you can work on *Schwung*, straightness and collection. *Schwung* is the energetic push off and spring of the hind legs. The power created is transmitted over the rounded back.

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