The equine back: how do you keep your horse's back healthy?

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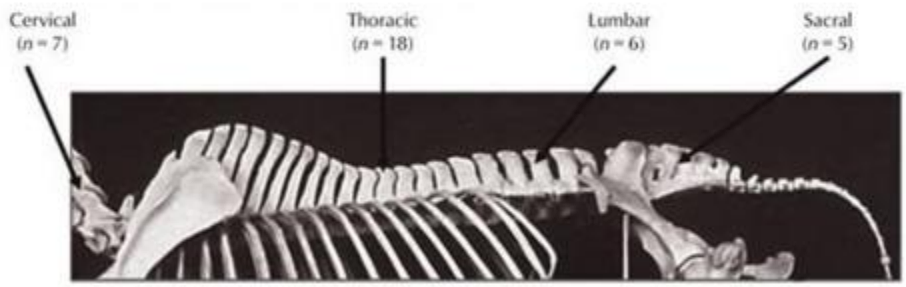
Part 1: Kissing spines, straightness, and the equine back: how does the back work, and how do you keep it strong & healthy?

This series of posts covers the structure and function of the healthy and pathological equine back, how to detect soreness, recover from injury, and improve strength. The equine back is a massive topic, and one that research is only just starting to reveal. This is a dramatically under-researched area, but recently the field has moved forward so fast that we have been able to discount many theories that once seemed very credible. This can make life a little confusing, but at least we do now have some good evidence behind our understanding of the back. First let's get the basics down.

The back, like all musculo-skeletal structures, is made of hard tissue (bone and cartilage), and soft tissue (muscles, tendons, ligaments and connective tissue). If you like tendons you'll love my last post (link here) but for now let's start with the bone: the spinal column.

Anatomy: hard tissue

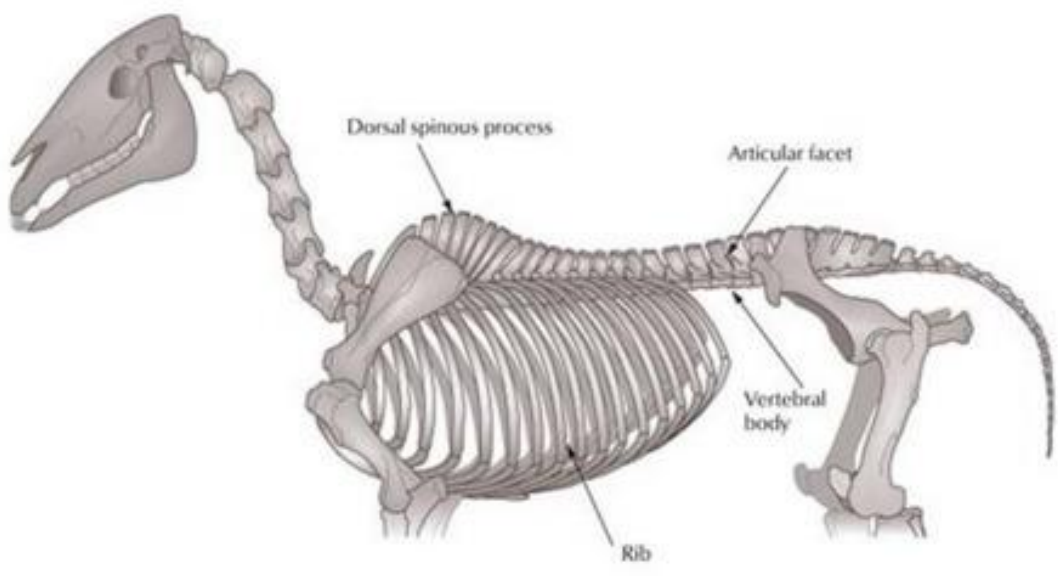


The spine is made up of vertebrae, and these little building blocks fit together like lego. They run from the head to tail and have different shapes according to their region: vertebrae can be cervical (neck), thoracic (with ribs on), lumbar (small of back, behind the saddle) and sacral (fused region running through pelvis) and coccygeal (tail). For now let's ignore the coccygeal vertebrae of the tail. Trying to hold your spine stiffly enough to carry a rider is hard, most animals can't, and with all that to cover your horse's ability to swat flies is not the crocodile nearest the boat. The tail is not completely irrelevant and can give us clues, but let's address those another day.

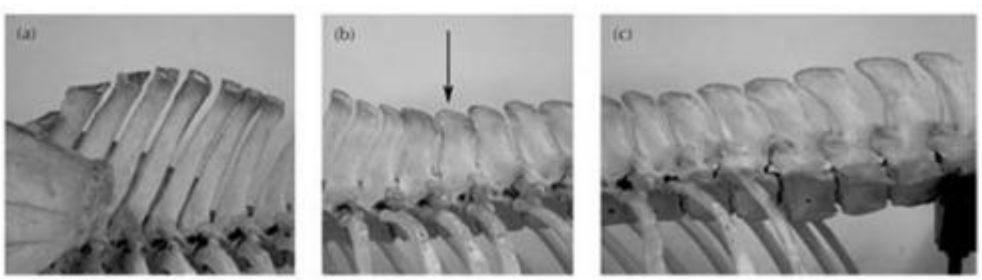
The number of vertebrae in any spinal region can vary, but the total number in the spine (without the tail) is pretty constant. Long backs are normally due to long vertebral bodies rather than having extra vertebrae. Each type of vertebra has a distinctive shape, although weird transitional vertebrae with characteristics of two adjoining areas are quite common. Each part of the spine is adapted for different functions and brings its own unique problems.

The spinal cord, a bundle of nerves carrying the messages from brain to body, runs down the spinal column through a line of holes called the vertebral arch. The arch is roomy compared to the cord so normal movement doesn't compress it, even when the spine flexes and rotates the cord is protected in this bone-encased canal. You wouldn't know it's there unless you needed to block a nerve, but osteoarthritis or fractures can narrow the canal and crush the cord, leading to seemingly-unrelated neurological symptoms.

The nerves branch off the spinal cord and exit through holes called the Intervertebral foramina, along with blood vessels and various other things. Occasionally a second pair of holes, the lateral foramina carries nerves. These holes are created if the caudal arch calcifies to divide the foramina and pinches on the spinal nerves. This means that even spotting the existence of lateral foramina justifies looking for spinal impingement.



Rising out of the vertebrae like sharks' fins are the dorsal spinous processes (DSPs, black arrows in above). There's a change in inclination of the DSPs (Picture b, below), as their role changes from supporting the soft tissue pull of head, neck and forelimbs (Picture a) to supporting the hind legs (Picture c). DSPs normally have spaces between them and usually don't come into contact with each other. In some cases on lateral x-rays the spinous process can look like they are overlapping, but even then they are often not actually touching as they are not quite in the same alignment - i.e. in an side-on X-ray they look like they overlap, but in fact are out of plane i.e. one is to the left of the next, and neither is in the central sagittal plane. Sometimes, however, there is contact, and remodelling, and even false joint formation. This is the dreaded kissing spines.



The vertebrae also have protuberances called articular facets, and these interlock, stabilising the spine and through their joints allow different movement at different regions. Thoracic regional mostly allows lateral bending and axial rotational, lumbosacral mostly about dorsoventral motion (rounding and hollowing). An incredible 83% of horses have asymmetrical facets, and yet we're surprised if one rein is easier.

The final fins coming out the spine worth noting are transverse processes. These provide stabilisation for the spine and lever arms for muscle attachments. In horses these have their own joints between them but not at every vertebrae. The amount of these joints not only varies between horses but these too are asymmetrical, which is pretty weird and probably something you should think about. The only other mammal this variability is seen in is the rhinoceros, and no one ever tried to make a rhino into a symmetrical athlete. Intertransverse ankylosis, a sort of arthritis in these joints, is really common, found in 50% of horses. It's not clear whether this actually causes back pain. Watch this space, and we'll see how the research pans out on this one.

The sacrum is made of five vertebrae that fuse at around the age of five years, and two centres of ossification (growth plates) that also fuse at 5.5 and 5 years, give or take 1.5 years. The sacroiliac joint is where the vertebral column articulates with the pelvis, and where the push from the hindlimbs is communicated to the spine. It's a specialised shape to cope with transferring this much load - most moving joints have interlocking shapes that help hold them together but this joint is made up of flat surfaces held together entirely by very strong ligaments, and yet is a key site of flexion/extension in athletic function. As a result this is a common site of problems and pain, with degeneration often undiagnosed until post-mortem. In the pictures below of Sox jumping, the sacroiliac extension then flexion is seen, just behind the numnah.

Growth plates in the pelvis fuse around 5.8 years. By around I mean again +/-1.5years, and give or take 1.5 years is a lot of variation. When we give a 1.5 year standard deviation (+/-1.5years) this means that a 4 year old horse may already have completed this growth, and equally a 7.5 year old horse that had not would still be in the normal range. Tuber sacrale and tuber coxae are the highest and widest points of the pelvis respectively, and also the last to fuse. This means that they can suffer a little of knocked in the young horse. Otherwise, contrary to popular belief, I wouldn't lose sleep over unfused bones.

Disc problems such as slipped discs are common in humans and dogs but not horses, who only have a small amount of disc material between each vertebrae, and a relatively immobile spine. Very occasionally disc degeneration is seen, but almost never herniation (slipped discs).

Conformation

A flatter pelvis has been associated with improved soundness (trotters), and improved performance (showjumpers and dressage) and yet a less flat pelvis (higher L5 angle) is linked to a higher range of motion and tendency to flex and extend this region more. Using a greater degree of motion in the region seems to push the supporting structures to the limit and cause more injuries. Other conformational aspects such as length and curvature of back contribute to the amount of motion, and so risk of injury. The vertebrae are interlocking and any relative movement causes a strain on the structures.

Soft tissue

The movement and support of the back is achieved by many layers of muscles, and there are many ways to group them. The muscles of the vertebral column can be divided into those running next to the spine (juxtavertebral muscles) and those nearer the surface (paravertebral muscles). The juxtavertebral muscles or intrinsic back muscles connecting the vertebrae provide support, stabilisation and motor control. These muscles have a lot of innervation so give the proprioceptive feedback that keeps track of spinal position and motion. The paravertebral muscles are larger, less innervated and provide gymnastic motion - flexion, rotation and lateral motion of the spine. The interlocking of the vertebrae means that the spine doesn't really have the ability to bend laterally without also rotating, so these movements require the entire spine, and very little bending at any one single joint.

The spine is supported by the muscles that run along and above it (extensors), and the ventral muscles running beneath it (flexors) including the abdominal muscles and the sublumbar muscles (iliopsoas muscles). By finding an equilibrium between the two sets of muscles the horse is able to move efficiently by holding the spine in enough tension to support a rider and transfer power from the limbs.

Factors contributing to injury: carrying a rider

Carrying a rider's weight can lead to many spinal lesions including impingement of the spinal processes and arthritis of the facet joints. Carrying an uneven rider and trying to do sports can add muscle strain to these.

Walk, trot and canter require a lot of passive movement from the spine, with the muscles mostly act in a restraining fashion. As the limbs move the spine extends and twists most at the points of common pathology. The precise spinal movement varies a lot between horses (large interhorse variability), but is very consistent in any one individual (intrahorse). Extension and twisting are particularly seen in diagonal support at trot and canter, where strong hip extensor muscles and abdominal muscles are essential to restrain the movement and avoiding strain on spine from movement.

When a horse takes a rider the weight of the rider naturally hollows the horse's back, putting it under threat of damage such as spinal impingement. Muscular effort is needed to round the back and to stabilize it in this position, making it more able to carry the rider's weight, to step under with the hind legs, and to transfer the push from the hind legs effectively. To achieve this the horse needs a large amount of muscle tone. For example abdominal and short back muscles are also particularly important for stabilising the back to allow propulsion from the hindlegs for collected movements, flying changes, and jump take off. In dressage horses pectoral muscles control the descent of the forelimb during extension - and can become overstretched and damaged if extension is not controlled. Similarly as the horse has no collar bone, movement at the shoulder, including bending or landing, requires a stabilized spine for the shoulder muscles to anchor to. The muscles of the shoulder are particularly common but overlooked sites of injury in the showjumper - taking the brunt of the landing by supporting the trunk in a sling of muscle between the forelimbs. The same shoulder muscles, particularly the trapezius and rhomboid muscles, can be common sites of anxiety related tension. The jumping pictures are of Sox an outwardly calm but inwardly worried showjumper, with me his slightly podgy, unbalanced rider. His trapezius gives him a lot of trouble.

Reducing the risk of and recovering from injury

Symptoms of back-related problems can vary from none to dramatic. The majority of horses with back pain show only poor performance and many sacroiliac problems are only diagnosed post-mortem. Horses might show "behavioural problems" such as rearing, bucking or avoiding the saddle or rider in the case of kissing spines, and restricted range of motion in the case of arthritis or muscle lesions, muscle wastage or hind limb plaiting in the case of sacroiliac pain, etc. Quite often back problems get missed, just because the symptoms are so diverse. Even when a back issue is suspected it can be hugely complex to diagnose.

During episodes of back pain the multifidus muscles, running along the spine, are selectively affected, and lose symmetry and size. Even after pain resolves, they do not naturally return to their previous size without intervention. This is turns increases the trouble that the horse is having, as they are no longer able to support the problematic area effectively. It is entirely possible that the cycle starts with localised wasting of one muscle, which then fails to stabilize the spine effectively causing back pain, which in turn leads to muscle spasm, shortening and disuse. In humans performing exercises to strengthen these muscles reduces long term recurrence of back pain, and it's been shown to that strengthening the muscles that move and stabilize the spine has similar effects in horses.

Research has suggested that there's benefit in starting core exercises of these spinal support muscles - of the spine abdomen and back - before the start of ridden work, and continuing them throughout the horse's career, in particular during lay off or after injury. Many back injuries occur as the horse has no means of communicating a minor injury or stiffness, whereas a human with lower back pain would be allowed to rest. Jean-Marie Denoix is fond of saying both "engagement is the only way of exercising a horse without making it suffer" and "no abdominals, no back".

Core mobilization exercises in horses include the exercises commonly referred to as carrot stretches - asking the horse to reach forward, down, and to his side using a target such as a carrot. On first inspection these stretches don't appear to do much and hence these were much derided when introduced as ways to increase suppleness and relieve boredom in the stabled horse. However over the last few years research shows that these exercises require the horse to use his spinal muscles to maintain his balance whilst he holds each new position and so both strengthen these muscles and correct asymmetry. As such they are some of the most important tools in the rider kit. To start with the horse is asked to reach his head to his chest, between his knees, to his elbow, and to his stifle. These stretches target different muscle groups and open up different facets of the spine. In other cases a hand pressed on the sternum, side or rump of the horse as resistance can encourage muscle use. I'll cover exercises and mobilisation in more detail in the next post.

Mobilisation exercises can be combined with work on a slope to develop strength and suppleness through the back. This is not necessarily the aerobic fitness work of cantering up hills, but for example a slow deliberate trot on a 20m circle, ideally the lunge or with a standing rider so that the back is free, using both the slope up and down hill, and even poles to encourage cadence and rhythm. The horse's topline needs to be extended, nose lowered. Side reins aren't going to help, although a chambon can encourage stretching and understanding. This is the type of exercise that when used twice a week can show a great improvement in horses with weak or damaged backs. As with all strengthening work, little and often is the most useful approach.

Back problems can come from a variety of causes - lack of warm-up, rushing the undeveloped horse to attempt activities or movements too early, asymmetry in the rider, "natural" asymmetry in the horse, tweaks during activity that aren't allowed to rest. Problems in the limbs frequently lead to problems in the back, as any woman that has tried to walk in heels will tell you. The difference is that in horses we need to spot and correct these problems through our own vigilance.

Part 2 and Part 3 will cover the back musculature, function and dysfunction in more detail, detecting muscle soreness or weakness, the effect of training aids and discuss how to apply hill work, exercises, stretches, therapy and massage. Please note that this site constitutes discussion of athletic development and performance, and does not give clinical advice.

Some pictures adapted from Henson, 2013