# These Feet are Made for Moving

**By Lynn Williams M.A. SHP**

I am a freelance writer and a Hoofcare Professional. In the latter area, I was trained by Dr. Hiltrud Strasser, a German veterinarian, who pioneered the modern barefoot horse movement. As part of our training, SHPs are required to understand and to consider the **whole** horse when assessing the form and function of the feet. This is a return to older traditions of hoof care in which the hoof – and the ground parallel pedal bone within it - was viewed as the foundation of the horse. Strasser differs from older traditions in many other respects however. Most notably she challenges the old adage 'shoeing is a necessary evil', arguing that even the perceived benefits of nailed on shoes are harmful. (1)

Without a balanced hoof, there cannot be a balanced skeleton; without a balanced skeleton, there cannot be healthy muscle; without healthy muscle, there cannot be athletic performance. And, for a prey animal whose primary defence is flight, cramped, tired or weak muscles affect it at a most fundamental level – its confidence in its ability to flee from danger and to stay with the herd. Dr. Strasser also emphasises the importance of looking at the horse in zoological terms to determine its fundamental species' needs.
Most horse people do not pay enough attention to the implications of the horse being a trickle feeding, herd dwelling, prey animal with no night/day rhythm, genetically programmed to graze 18 hours a day, and able to sleep standing up. (2)

The posture the horse stands in for most of its life is head low i.e. the position it adopts when grazing and resting. Head high posture is only for long distance vision, signalling threat, mutual grooming, browsing trees, or display. All these involve the horse holding that posture only briefly. If the horse is forced into long-term head-high posture, the consequences are many and dire – and range from muscular-skeletal problems to metabolic ones. (3)
The load bearing structure of the body is the skeleton, the bones of which are held together by ligaments, and moved by muscles which are attached to the bones by tendons. For the horse's skeleton to be able to bear weight efficiently, the powerful nuchal and supraspinous ligaments have to be under tension. The former runs from the poll to the withers and the latter from the withers to the pelvis. The horse's centre of gravity lies just behind the elbow. Correct placement of the withers is judged by a perpendicular line running from the highest point of the withers to just behind the elbow and touching the ground half a hoof's length (or one pedal bone length) behind the bulbs of the heel.

**The correct placement of this fulcrum point is essential for the ligament systems to function properly i.e. enable the cervical and lumbar -sacral spine to support the horse's considerable body mass**.
If these ligament systems are not in tension, (as is the case with a head-high posture) the muscles have to weight bear more and for longer than they are capable of doing. Even for the business of staying upright when at liberty, this posture is tiring; add a rider and tack and expect athleticism from the animal, and muscles will quickly go from tired to painful.

Riders obviously impact massively on their horses. But, consider the far greater impact of the rider, if the horse comes to a schooling session or competition with cramped and tired muscles, strained or ossified ligaments, weak or worn joint cartilage or inflamed tendon attachment points. Even the most skilled and sensitive rider is going struggle to offset the obvious effects these will have on athletic performance – assuming they can be offset. We can do much to make tight muscles more supple and strong, as Dr. Heuschmann demonstrated, but serious forms and/or degrees of damage may be worsened by attempts to 'work the horse through it'.

Of critical importance to the horse's health and fitness is the fact that, proper engagement of the nuchal and supraspinous ligaments is essential to the operation of the **stay apparatus.** Many people think the stay apparatus is the mechanism by which the horse fixates one hind limb, by locking the patella, to allow the muscles in the opposing limb to relax. But this is less than half the equation. The horse mainly sleeps standing up. (4)

60+% of its weight is carried on its front limbs so it has to lock its entire skeleton in balance to be able to relax and regenerate the muscles in its neck, shoulders, front limbs, back and abdomen whilst it is upright.
It does this by means of a complex interplay between lever forces and alignments involving a critical balance between extensor and flexor tendons of the front limbs, the joints of the limbs, the thorax and the fascia of the biceps and triceps muscles which fixate the shoulder and elbow joints. (5)

A horse which cannot operate its stay apparatus has to use constant muscle tension just to remain upright and it can only fully relax and regenerate its muscle tissue when it is lying down. Constant muscle tension leads to energy deficit, muscle fatigue, lactic acid build up, loss of muscle tone and mass and muscle pathologies. In some horses it leads to over-developed musculature such as that seen so-called bulldog chests, in others it leads to muscle wastage. There is every reason to suppose that many muscle pathologies have their origin in a failure of the stay apparatus. (6)

The relationship between the balance of the forelimbs and the angle of the shoulder is a critical factor in the operation of the stay apparatus and of overall soundness and performance.

**The foundation of the stay apparatus are four ground parallel pedal bones without which it is not possible to have equal loading of all the joints and bones of the skeleton.** Unless the pedal bone is level to the ground (side to side and front to back), the coffin joint is destabilized and this will impact on all the other joints in the limb. The greater the degree of imbalance, the greater and more immediate that impact will be.(7)According to Dr Strasser, and most older texts, ideally the scapulo-humeral angle should be greater than 90 degrees which gives a shoulder angle of 45-55 degrees to the ground. This angle places the withers back and up relative to the croup, while a steeper shoulder angle moves them forward and down relative to the croup.

The withers are formed by the top portions of the thoracic vertebrae and ideally are around 2.5 cms (1”) higher than the croup. Broad, high withers allow for a greater flexibility through the back and spine. The nuchal ligament, which supports the head and aids the extensor muscles of the neck, extends from the base of the skull and anchors onto the withers where it connects to the lumbo-sacral part of the supraspinous ligament. Other muscles that move the neck and head, also anchor to the withers and **proper stretch through the topline and neck starts here.** Conformationally correct withers grant more freedom to both the neck and back by enhancing the fulcrum effect.
A horse's length of stride depends on the conformational angles of the shoulder and foreleg – the longer a stride, the faster the horse can move and the fewer steps it needs to take to cover the ground, which reduces fatigue and stress and strain on the limbs. The angle of a shoulder and pastern is dictated by the length of the humerus and the pastern bones. The longer these bones are, the longer the stride the horse can achieve.

But, whatever the length of the humerus and pastern bones, all horses and ponies should have an angled pastern and scapula that complements the angle of the frontal surface of a healthy pedal bone which is always around 45 degrees in the front feet (and around 55 in the hinds). An upright pastern and steep shoulder is a pathological situation – something is out of balance – most commonly  - the pedal bone.

If a horse does not load its heels fully, (8) it takes up the resulting slack in the flexor tendon first by tightening its muscles, and then, because muscles tire quickly, (9) by steepening its shoulder angle. The withers move forward and the line from the highest point of the withers to the ground runs through the humerus. Vital muscles, tendons and ligaments in the head, neck, back and quarters are all adversely affected as the fulcrum effect of the withers is reduced.
**A horse which stands with its pastern and shoulder unnaturally steepened is on the forehand**.

No amount of training will change the fact that this situation means its stride is unnaturally shortened and it therefore hits the ground more often and more heavily. Concussive forces are increased and the dampening effects of the natural hoof, pastern and shoulder angles are decreased.
Because of the importance of a harmonic angle between the hoof wall and pastern, when a horse presents with a steep shoulder and pastern angle, the farrier may dress the hoof to match – by leaving the heel high and/or the toe short.

But, what if the horse has steepened its pastern to take up slack in the flexor tendon, (and as a consequence steepened its shoulder angle) because it is unwilling to load a painful heel?(10)

If the hoof is dressed to match that steepened pastern/shoulder angle, this not only fails to deal with the underlying pathology, it exacerbates all the soundness issues associated with an upright pastern and shoulder – short choppy stride, increased concussive damage, degenerative joint disease etc.

Critically, it also **overloads the laminar attachment at the toe and predisposes the horse to founder**. (11)

When a joint deviates from its physiologically correct position, the body attempts to stabilise it, initially by holding it place by muscle action. But, muscles tire and allow the unstable joint to flex abnormally. Microscopic tears in ligaments eventually ossify (12) and articular cartilage is worn away, resulting in erosion of joint surfaces. The longer the situation is in place, the greater the degree of damage and the more difficult it is to correct. (13)

Whilst there clearly are differences in the length of the pastern and humerus between horses and of the shoulder angle, the angle of the toe wall in all front feet should be around 45 degrees which reflects the normal angle of the frontal surface of a healthy, ground parallel pedal bone.

Changing this angle by leaving heels too high, jacking them up with wedge pads or shortening the toe, locks the horse into a posture that is analogous to you walking around on tip toes with your shoulders pulled up to your ears. Add an unstable rucksack weighing around 15 kgs to your back and a mechanical contraption in your mouth that straps your chin to your chest and have someone kick you in the ribs to make you perform athletically - and you'll have some idea of how many horses feel when being ridden.

From our perspective, the horse's weakest biological systems are its locomotor and digestive systems. Given the critical importance of these to the horse in zoological terms, we have to look to what we do to the horse to explain why, in domestication, these systems fail so often and so catastrophically. Blaming it all on inherited weaknesses is a cop out. Ignoring it is simply inhumane.
Conformation is often assumed to be what the horse is born with. It's a fact that some horses are better able to cope with the demands of high level athletic performance than others but, much of what we consider to be poor conformation is actually created by us.
If a horse comes into training with stiff sore muscles and inflamed tendon attachment points because it has been unnaturally confined or because it has been isolated and spent hours with its head high looking for other horses, or because its skeleton is out of balance and it has had to use its muscles more than it should just to stay upright; if its digestive system is in crisis from long hours without forage and unnatural feeds high in carbohydrate fed to human convenience not the horse's natural pattern of trickle feeding; or if it has jarred up because of a loss of shock absorption through shoeing and/or contraction – no amount of careful, sensitive riding is going to completely negate the effects. It may delay them, it may extend the utility of the horse but these sort of conditions will – inevitably – affect performance and they will reduce the horse's quality and length of life.

## Notes

(1) The **consequences of poor hoof form and function** are wide ranging and affect the horse psychologically, anatomically, histologically and met-

abolically. For an animal with a small heart (half the size of a cat's relatively speaking) which is expected to perform athletically whilst carrying a rider or towing a cart, the auxiliary pumps of healthy feet are vital to its circulatory health. Healthy feet are also vital parts of the shock absorption system and ensure mechanical protection and good traction. Shoes affect all of these functions to some degree and at some point. How much and when depends on a range of factors such as how old the horse was when first shod, shoeing intervals, the balance of the trim, the terrain the horse is worked on, whether it is given time without shoes etc. I cannot go into all the effects of shoeing here but consider this one fact: a hoof is expanded when it is weight bearing and its vascular tissue is relaxed and fully suffused with blood; when it is lifted, it is in its narrowest form and its vascular tissue is under pressure. When the farrier fits the shoe, the hoof is narrowed. Given the pattern of expansion of the hoof wall from the zero point at the toe to the heel, fixating the wall with nails changes the pattern of expansion and creates a tension point in the wall behind the last nail. It is a simple, mechanical fact that the shod hoof cannot expand and contract in a physiologically normal way. For a full explication of the ill-effects of shoeing read Dr Strasser's books: Lifetime of Soundness and Shoeing: A Necessary Evil?

(2) **The horse in zoological terms** is a nomadic, herd dwelling, prey animal that evolved from a five- toed forest dweller into a single-toed prairie dweller. Its primary defence is its ability to react instantly and explosively to a threat, to accelerate away from it, and to maintain a moderate pace over very long distances. Its secondary defences are bucking and kicking. It is a trickle feeder (grazing up to 18 hours a day) has a single, small stomach and long hind gut and is an efficient metaboliser of high fibre, low sugar grasses. It has no night/day rhythm, is highly social and hierarchical and can form intense friendship bonds. Isolation and confinement are – invariably – stressful, how much depends on factors of age, temperament, habituation etc but all horses are happier being at liberty and in the company of others of their own kind.

(3) **Standing head high with a hollow back** forces the weight unnaturally onto the heels – which usually results in an underslung heel conformation. This is commonly seen on the front feet of confined horses and the hind feet of horses which try to unload their front feet by bringing the hind legs under the body.

(4) **The horse lies down briefly to sleep once or twice a day**. It will stretch right out for even briefer periods thought to be when it gets its REM (dream) sleep. Horses that are highly stressed may not lie down, a lack of REM sleep may explain some hypertensive or neurotic behaviours.

(5) See Hoof Orthopaedics and Holistic Lameness Rehabilitation by Dr. H. Strasser DVM

(6) **Horses with unbalanced front feet often display unnatural muscle development** – sometimes misinterpreted by people as areas of fat. This is especially common in the pectorals (bulldog chest) latissimus dorsi, tri-

ceps and extensor muscles. Chronic inflammation of the trapezius muscle may be implicated in the development of unnatural crests. In a study I am conducting into unnatural crests, **every** horse I have studied to date with an unnatural crest has, or has had, long periods of standing with its heels unloaded and/or having high heels/short toes. Crests are often accompanied by unnatural muscle development in other areas or, when the condition has been in place for a very long term, with unnatural muscle wastage.



(7) **Theories which posit an acceptable deviation from ground parallel of up to 10 degrees rotation** ignore the anatomical fact that the frontal surface of the pedal bone in the front foot has a consistent angle of 45 degrees; the hoof is a cast around the bone i.e. it follows the angle of the bone and continues past the end of it to the ground where it meets the forward and downward growing sole. If the wall of the front hoof is steeper than 45 degrees at the toe, the pedal bone is, by definition, rotated. One famous dressage horse with very high heels had a toe angle of close to 60 degrees. Anatomically this means the pedal bone was rotated by 15 degrees. If that rotation was accompanied by separation of the bone from the hoof capsule, the horse would be diagnosed with severe founder.

(8) **Heel pain** is disturbingly common in the modern horse. Dr Strasser's theory (in very simple terms) is that shoeing and / or unnatural lifestyle (terrain, movement, trimming style) prevent correct wear of the hoof and cause various forms and degrees of contraction of the different parts of the hoof which inhibit hoof mechanism (the expansion and contraction of the hoof capsule) and, as a consequence, reduce blood supply which affects nerve function. The shoe works primarily by desensitising the hoof but she maintains that because of the pattern of arterial blood flow into the hoof, the supply to the toe is disrupted sooner and to a greater degree than the supply to the heel which is why the horse remains sensitive to pain in the heel region and often prefers to load even a damaged toe.

(9) Over time, the inward pressing hard horn of the heels and bars causes **bruising of sensitive tissue and atrophy of the frog, bulb, digital cushion structures**. The digital cushion is an area of dense fibro-cartilaginous material running between the lateral cartilages. Strasser describes it as a sling rather than a cushion whose function is to dampen downward, compressive forces generated by the pastern bones. Bowker's work into the effects of lack of movement in critical formative stages on the development of the digital cushion indicates that, horses exposed when young to high levels of the physiologically correct, heel first landing with appropriate amount of movement on firm terrain, develop much stronger, denser digital cushions than horses which have not been exposed to such conditions. He supposes that, what is viewed as a normal digital cushion, is in fact a degenerated one. If he is correct, the healthy DC may play an extremely important role in dampening both concussive and compressive forces and aiding both in expanding the heel and preventing contraction. The difference between a healthy DC and a highly degenerated one is like the difference between a pad of high density foam and a bath sponge.

(10) The vicious circle that is established by unresolved heel pain leading to the **steepening and overloading of the frontal region of the hoof** has consequences for all the biological systems of the horse. In identifying the source of heel pain, the role of **the bar**s, which are the same horn as the wall and grow at the same rate, (twice that of the sole horn) must be considered. Unless the heel is correctly loaded and continually worn, the height of the heels and bars will increase faster than the toe. These important structures, the primary function of which is to prevent over-expansion of the hoof on high impact, have to go somewhere. In the narrowing forms of contraction, they become levered high into the hoof high in the region of the navicular bone where they press on sensitive tissue. In a splayed hoof form they will grow across the sole crushing the solar corium in the area known in conventional terms as, the 'seat of the corn'. Both forms of impaction may grow right under the frog.

(11) **The role of the stress hormones cortisol and adrenaline** need to be considered. Chronic muscle pain is stressful and how the horse reacts to it is depends on the effects of the horse's naturally produced opiates – endorphins and encephalines - which have a calming, dulling effect and the effects of adrenaline which prepares the animal for flight and which is undoubtedly the cause of a lot of nervousness and excitability. The other hormone produced by the adrenal gland is cortisol which prepares the animal for sustained activity by causing glucose to be released into the blood stream. Its role in laminitis and insulin resistance has yet to be fully explored but, a horse whose body is in a constant state of muscle tension must also be in a state of metabolic disequilibrium.

(12) **Low ringbone** is ossification of the ligaments in the coffin joint; **high ringbone** - the pastern joint; bone spavin – the hock joint. **Side bone** is the ossification of the ligamentous attachments of the lateral cartilages caused, according to Dr. Strasser, by unnatural break-over created by the rigid metal shoe.

(13) The 'show trot' that Dr Heuschmann referred to, the horse throwing its front legs out in an exaggerated fashion (goose stepping) has serious implications for the ligaments in the lower leg. A shoe usually doubles the weight of the hoof. We therefore undo nature's work in making the pedal bone very light both to reduce the effort involved in moving it and the oscillation effects on the limb in flight. Watch a slow motion video of a horse doing this sort of extended trot and you will see tremendous oscillation of the hoof as it is in the protracted phase of the stride. The bigger the hoof and /or the heavier the shoe, the greater is this effect. Constant repetition of this unnatural oscillation damages the ligaments and inflames tendon attachment points. This would also be a factor in the unnatural length of stride in harness racing horses.