

Conformation of the Horse: Relationship of Form to Function

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A thorough understanding of the conformation of the horse is fundamental to the approach of assessing musculoskeletal issues; lameness being the most significant; however, this information is also valuable in assessing the medical status of a horse for purchase, for selecting sires and dams for breeding and shoeing recommendations. A systematic approach to evaluating conformation will enhance the ability of the practitioner to determine defects in a rapid manner and avoid overlooking those issues that can contribute to current problems or predispose to problems in the future. Author's address: Littleton Large Animal Clinic, 8025 South Santa Fe Drive, Littleton, CO 80120; e-mail: marvinbeeman@msn.com. © 2008 AAEP.

1. Introduction

The purpose of this presentation is to provide: (1) an overview of the conformation of the horse, (2) an approach to the evaluation of conformation, (3) an evaluation of the effect that conformation has on the dynamics of equine locomotion, and (4) the correlation of defects in conformation that contribute to pathology in the horse.

The definition of conformation can be articulated in different ways. Webster's Dictionary simply defines it as the "form or outline of an animal." This can be applied to the standard diagrams of a horse from a lateral, cranial, and plantar view with plumb lines applied. This procedure establishes a basic visual means to determine if the limbs are straight and the angles are correct.

Another definition of conformation is "the symmetrical arrangements of its parts." This encompasses the horseman's perception of the "well-made" horse. Those parameters are often described as beauty, balance, and symmetry.

The third and most significant definition is the "relationship of form and function." This is the way that the horse's structure allows it to perform its method of ambulation either on its own or while working or performing for man. To better understand the conformation relationship of form to function, a standard of excellence of a horse should be established that considers the dynamics of locomotion coupled with soundness or lack thereof. In this discussion, the word "sound" is interpreted as being free of infirmities, usually lameness. In reality, the word "sound" means free of the "seeds" of disease, but obviously, this is next to impossible for any horse.

For years, much of a horse's success or failure has been attributed to its conformation. There are sketches and descriptions of Alexander the Great's horse Bucephalus (356–323 BC). The *De re equestri* by the Greek historian and philosopher Xenophon (430–354 BC) goes into detail about good and bad conformation. *An Essay on the Proportions of Eclipse* by Charles Vial de Sainbel¹ and *The Exterior*

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of the Horse by Armand Goubaux and Gustave Barrier² are extensive descriptions of the horse. There have been significant scientific works relevant to conformation from the time of Goubaux and Barrier to the present.^{3,4}

Conformation is not the only factor responsible for a horse's ability to perform the tasks man asks of him. Certainly, there are other intrinsic factors of the horse that obviously contribute to their athletic ability, such as the cardiovascular, respiratory, nervous, and digestive systems. The horse's unique quality to give maximum effort when asked is best referred to as "heart." In addition, there are numerous extrinsic factors that affect a horse's performance such as the degree of training, physical fitness, state of health, shoeing, tack used, and certainly, the rider.

Before exploring the depths of conformation, the type of horse needs to be put in the correct context. Type is defined as the inherited characteristics of an animal that fit it for a certain use.⁵ The Thoroughbred type is suited to running. The American Quarter Horse type is designed to perform activities that require quick speed and muscle mass. The Arabian type is suited to travel great distances with the least amount of expended energy. In an evaluation of the horse's conformation relevant to the type, it becomes obvious that one horse cannot do all the tasks that man asks of them. The difference in horse types is exemplified by the extremes of the miniature horse and the large draft horse. Correct conformation is fundamental in any type of horse.

In the assessment of a horse's conformation and the relationship of form to function, a standard of excellence must be established. Additionally, the dynamics of locomotion must be understood, and a correlation to soundness must be made. A standard of excellence is established by those horses that excel in the dynamics of locomotion to accomplish the tasks asked of them and in doing so, remain relatively free of unsoundness.

2. Factor I: Standard of Excellence

This will vary with the purpose of the horses. The Arabian, the Morgan, and horses of this type are designed for excellence of movement of gait; this is in contrast to the American Quarter Horse and the Thoroughbred who are designed for excellence of speed of gait.⁵ Multiple subtle conformation differences are apparent in these examples of standards of excellence. The head and neck position, the angle of the shoulder, and the angle of the croup are three of the most significant factors that separate the standards. In fact, these factors also assist in defining the type of horse. Horses given a general objective established a standard. One of the purest modalities to establish a standard is through the trial by peers. Flat racing has to be one of the best environments to facilitate trial by peer. It has the least influence by man's judged opinions, because the proving grounds have the most constant of

variables. The distance is measured to the inch, the surface is relatively the same, the direction is the same, the weight of the load is the same, and the tack is very similar. Consequently, when a horse from this testing ground is the best, it should be studied carefully for its conformation attributes. However, this logic would cause the student of conformation to interpret that speed is the best evaluation of conformation.⁶ This logic does not hold true because speed and bad conformation equal a short-term racehorse. The best combination is good conformation, speed, and "heart." A visualization of this method of assessment of conformation can be seen in "The Perfect Horse" by noted equine artist Richard Stone Reeves; in this work; the artist used Tie Polleto's head and neck, Citation's shoulder, Jay Trump's forelegs, Vaguely Nobel's middle piece, Buck Passer's quarters and hindlimbs, and Graustark's color. In his description of "The Perfect Horse," he stated that "all the horses were top class runners indeed; there is hardly a top class runner in existence with faulty conformation." Another apropos statement is by W. J. Miles: "Who'er expects a perfect 'horse' to see expects what never was, or is, or e'er shall be."⁷ James Rooney, VMD, made a very correct statement: "Even near perfect conformation will not protect a horse from lameness if the external force departs too far from the normal range. Conversely, even a slight change in the external force can cause lameness if the conformation is too bad."⁶

3. Factor II: Dynamics of Locomotion

I believe the horse is one of, it not the best, mammalian athlete that God has created. Granted, they cannot run as fast as a cheetah or jump as high as many of the deer species; however, none of those animals run or jump with the weight of a rider on their back, which often approaches 15–25% of the horse's body weight and can be 2–3 ft above the horse's center of gravity. The gaits of the horse contribute to their dynamics of locomotion, and conformation is basic as to how the horse ambulates. The dynamics of locomotion are the result of synchronization of the actions of the horse's biological systems. The skeleton is the key to a horse's method of progression and the foundation of its conformation.

4. Factor III: Soundness

Unsoundness is defined as that system or structure that is not sound, not working, or painful. Musculoskeletal system infirmities are the most common infirmities that veterinarians encounter; however, defects in the respiratory, cardiovascular, digestive, and nervous system also alter the horse's dynamics of locomotion. Most lameness is the direct effect of stress, strain, and concussion on the musculoskeletal system; therefore, conformation defects that enhance these forces are the most significant and

provide a basis to establish what value should be assigned to the various conformation defects.

Unsoundness, most often lameness, usually determines a horse's useful lifetime. Therefore, conformation becomes the common denominator to the horse's ability to perform and stay sound.

The correlation of the three factors (standard of excellence, dynamics of locomotion, and soundness) provides a method to better understand the meaning of the conformation relationship of form to function. A method of assessing "balance" has been well illustrated by Gladys Brown Edwards.⁸ Synonymous with balance is the center of gravity of the horse as has been defined by many authors.^{2,5,9-11} The location of the center of gravity is helpful in understanding why 60–65% of the horse's body weight is born by the forelimbs. This fact explains why the front limbs are the sight of the majority of lameness.

The evaluation of conformation has been and is currently subjective; however, more and more objective evaluations of conformation are being developed with the advent of sophisticated research enhanced by the application of modalities. These modalities provide specific information as to the movement of the horse and define the effects of conformation on the movement of specific parts of the horse. Then, this information can be used to evaluate the alteration in performance and to understand the deleterious effects on the musculoskeletal system.⁴

As is the case with evaluating a horse for infirmities, a methodical, thorough system is the most productive method to assess a horse's conformation. To avoid overlooking important factors, the exam should be divided into five categories.

1. Head, neck, body, and balance
2. Forelimb (from the top of the scapula to the bottom of the foot)
3. Hindlimb (from the top of the croup to the bottom of the foot)
4. Type
5. Way of going

The need for equine practitioners to have an appreciation of a horse's conformation was very well said by R. H. Smythe, MRCVS in *Equine Medicine and Surgery*: "When those involved with the welfare of the horse possess some knowledge of conformation and its relationship to the dynamics of equine locomotion they can better derive ways of lessening the effects of injurious factors and they can better prognosticate the extent of the resulting lameness."¹² This statement very well explains the veterinarian's role in understanding the conformation of the horse; not only will this add to the veterinarian's ability to manage lameness, it will assist them in dealing with their clientele on horse shoeing issues, purchase examinations, and selection of breeding animals.

Bacteriologist Szent-Gyorgyi in 1950 said when describing a single cell that "there is no real difference between structure and function; they are two

sides of the same coin. If a structure does not tell us about function it means we have not looked at it correctly."^a This statement adds succinct evidence as to why conformation of the horse should be evaluated as it relates to the function.

Conformation defects distract from the standard of excellence, limit the dynamics of equine locomotion, and predispose the horse to unsoundness. Most often, there is a combination of defects present in a horse that can be considered to be contributing to the lameness. There has been considerable literature produced that relates conformation defects to unsoundness. Most of the opinions expressed are based on experience and qualitative observations rather than scientific fact; recently, however, more quantitative and/or analytical work has been done.³ As a result of the recent research using modern technology, the empirical observations may or may not be proven. Until that happens, we must press on with what we have perceived to be correct from evidence-based medicine. An example of evidence-based medicine showing significant issues is the case of a field hunter that had a combination of conformation defects; when he was subjected to considerable stress, strain, and concussion, he became unusable from the infirmities that developed. In addition, a critical review of his history as a field hunter revealed several deficits in his function that could be attributed to his conformation faults. The horse was closely observed from birth to his necropsy by the author.

The conformation of the foot is critical. The "mouth of the funnel" is where all of the concussive force is transmitted to the external surface. The foot can be variable in shape and size depending on many factors such as breed, type, specific use, and even geography; however, Goubaux and Barrier² stated that, in all cases, the foot should be proportional to the height of the horse, his weight, his conformation, and his special aptitudes. It behooves the veterinarian to be very aware of the specific anatomical structures, especially those structures that are so critical for the support of the tremendous amount of force that is generated at the hoof-ground interaction. Asymmetrical feet are a conformational defect of significance. In the author's experience, uneven feet (especially front feet) are an issue of consequence in that >60% of the lameness encountered in the foot will be in the one that has a smaller frog, more vertical bars, enlarged heels above the coronet band, and a greater distance from the bearing surface of the heel to the coronet band. "No frog, no foot; no foot, no horse" by Lafosse¹³ is still as important today as it was several hundred years ago. The dorsal surface of the hoof wall and the dorsal surface of the pastern should be parallel. These angles vary a great deal from horse to horse. The angle of the foot and pastern has a physical effect on the angle of the fetlock, which is the major site of the change of direction and absorption of the force being directed down the limb.

Therefore, a short upright pastern is believed to increase the concussion on the fetlock, the phalangeal joints, and the foot. A long, sloping pastern will generate excessive hyperextension of the fetlock, which puts strain on the suspensory apparatus of the limb. A broken angle of the pastern also generates excessive strain on the phalangeal joints and supporting soft tissue structures. The fetlock should be sufficient in size to absorb and change the direction of the forces being directed down the limb.

The plumb line concept is very useful in understanding deviation of the limbs that is considered to be detrimental to the horse's ability to perform and remain free of unsoundness. The basic premise is that strain and concussion will be concentrated where there is a change of direction in the plumb line stress. The line dropped from the tuber of the spine of the scapula should bisect the column of limb to the fetlock and fall just behind the heel. The defects of the forelimb that are noted from the lateral view above the fetlock and pastern are over at the knee, back at the knee, camped under, camped out, and tied in below the knee. It becomes obvious that the carpus conformation is critical because it is the major joint that virtually makes the forelimb function like a spoke of a wheel when the limb is full weight bearing. Then, when the breakover portion of the stride is activated, it becomes the major flexor joint of the forelimb. Therefore, the carpus must be large, facing squarely rostral, and positioned medially and laterally equidistant between the radius and the third metacarpal bone. The third metacarpal bone should be relatively short in relationship to the length of the radius because of the mechanical advantage that this creates. It functions as a lever for the muscles and tendons of the forelimb to position the foot in the most optimum position. It also has to be sufficient in size to withstand the forces on it.

The radius is the site of the majority of the muscles that flex and extend the lower limb. Therefore, the longer that it is relevant to the metacarpus makes the lever action more efficient. The olecranon and the olecranon fossa of the humerus is vital to the fixing of the lower limb to act as a "spoke of the wheel." Therefore, the length of the humerus is vital to position the spoke of the wheel very near to a vertical line below the center of gravity of the horse. The length of the humerus is difficult to visually evaluate, but it is a very important structure.

The scapula and scapulo humeral joint need to be evaluated together. It should be noted that there is very little articular movement in the scapulo humeral joint, even at speed. The significant function is two-fold; the scapula rotates around a point in its middle, and it glides back and forth on the rib cage. Therefore, three factors are important in evaluating the conformation of the "shoulder": (1) angle, (2) length, and (3) positioning of the attachment to the rib cage.

In viewing the forelimbs from the front, the plumb line from the middle of the scapula humeral joint to the ground establishes the correct alignment of the forelimb. It should bisect the column of bone including the foot from the elbow to the ground. Common defects are in at the knees, toe out, base narrow toe in, base narrow, base wide, off-set knees, bench knees, and pigeon toed.

The plumb line application for the hindlimb has a similar application. From the lateral, the line view dropped from the tuber ischii should touch the point of the hock and continue touching the leg along the plantar surface to the fetlock. Deviations from the normal are sickle hocks, camped out behind, and post legged. The hock is the major articulation for the dramatic flexion of the hindlimb that is necessary to advance the limb; however, the post-legged defect also involves the femero tibial articulation. The hock is the most common site of hindlimb lameness, but the stifle is becoming more and more of an issue because of the straighter hindlimb in many of the larger breeds.

The plumb line application from the rear on the plantar view is from the tuber ischii bisecting the hindlimb to the ground. The deviations of significance are cow hocks, base narrow, and base wide. Note that a cow-hocked problem is present when the points of the hock are closer together than the fetlocks. Hindlimbs can toe out and not be cow hocked.

Conformation defects in the rear fetlock, pastern, or foot are similar to those in the forelimb; however, they are more tolerable because less weight is placed on them than the forelimb.

The conformation of the head contributes significantly to the function of the horse. In addition, it is one of the hallmarks of the horse's beauty. Several points contribute to both the beauty and function. The length of the head needs to be only large enough to provide space for the teeth, to allow room for the turbinates to temper the air going to the lungs, and to catch debris. Large nares are essential to permit maximum air intake. Excessive length and depth only adds excessive weight to the "balance ball" on the end of the balance arm (the neck). Large eyes located at the edge of the forehead enhance the arc of vision. A clean throat latch along with significant width between the mandibuli is important. All of this makes sense because everything that makes a horse function passes through the throat latch area: air, food, blood to the brain, and the spinal cord. A long neck enhances the horse's ability to adjust its balance and reduce weight on the forelimbs. The withers are very important if horses are to be ridden to help keep the saddle off of the top of the scapula and in the middle of the back without excessive pressure from the girth (cinch) on the rib cage.

The back (thoracic and lumbar vertebral column) should be flat to be the most efficient to support the large mass of the viscera and a rider. Also, it is the lever that facilitates the elevation of the forelimbs,

head, and neck, which is critical to horse's various functions. The croup (sacral vertebra) should be long whether or not it is sloping or flat (the Arabian versus the Quarter Horse). The heart girth (rib cage) should be deep, because it provides the framework to house the viscera.

Confirmation is inherited—good and bad. There seems to be a difference of opinion as to the value of the heritability. Science will hopefully provide a better answer in the future.

In summary, the evaluation of the conformation of the horse continues to be based on age-old empirical practices. However, research is providing the equine practitioner with more sound data to either support or refute concepts that have evolved through years of acute observation and the correlation of good and bad qualities that affected a horse's ability to perform or caused musculoskeletal infirmities. The breeding of the horse provides the genetic background in attempting to predict the potential ability. After that, conformation becomes the deciding factor as to whether or not an individual may be used for a specific function. It would be simpler if the only necessary criteria were those stated by the famous Italian horse breeder Federico Tesio who said that a "horse gallops with his lungs, perseveres with his heart and wins with his character."¹⁴

Until such time that it is proven otherwise, the root of studying conformation should include those factors that relate the horse's form to its function.

They should be based on a standard of excellence, the dynamics of locomotion, and soundness.

References and Footnote

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