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Body conformation in Indian sporting horses

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Abstract
The value of athletic sport horse depends mainly on performance in various games which is a combination of conformational, physiological and behavioral traits. Conformation traits comprise body measures, joint angles, leg stance and hoof quality. Measurements are carried out on live horse and/or from photographs with determined reference points using tape meter, weight measuring tape, height stick and goniometer. This conformation measures are used to select sport horse with less chances of musculoskeletal lameness. This method was upgrading by photography, computers and video recorded images, digital photography as advances in computer technology is increasingly prevalent in measurements of conformation, Investigations have confirmed relationships between traits like conformation and gait, performance and orthopedic health. Conformation of horses and its relationship to performance and musculoskeletal problems is very much established but on the other hand little subjective and objective data are available about Indian Sporting horses.

Keywords: Conformation, performance, topline, symmetry, linear, angular, bony prominences, radiology

Introduction
Speculation
Many of the conformation traits are known to have results but have presented difficulties in interpretation and have not synthesized hitherto into a coherent whole. The present paper outlines a theory directed to this end.

Effect of conformation
The evaluation of conformation in relation to speed helps in predicting success or failure of any horse as a racing animal and added that the highest chance of success can be attained by judicious blending of practice with science (Salib 1949) [36]. Poor conformation of limbs contributes to musculoskeletal problems or actually can be the cause of lameness in some cases (Adams, 1974) [2]. Conformation, condition of limbs and feet of a horse determines the method of progression (Clayton, 1986; Stashak, 1995) [7, 41]. Rooney (1968) [34] pointed out that law of biomechanics makes it very reasonable that horses exhibit specific relationships between different parts of their musculoskeletal system. This may cause excessive strain and injury to specific parts of their anatomy. Later on Oliver, Langrish (1991) [31] and Globe (1992) [13] independently reported that conformation is often used to predict the probable anatomical site for injuries which is considered to be multifactorial in race horses, *viz*. with genetics, racing surface, number of starts, age of the horse, pre-existing pathology, biomechanics (conformation) and trauma being implicated as potential etiological factors (McIlwraith,1986; McIlwraith, Yovich and Martin, 1987; Mohammed, Hill and Love,1991; Dolvik and Klemetsdal , 1994, 1996 and 1999; Anderson *et al.* 2004). [27, 29, 30, 9, 10, 11, 3].

Methods of conformation evaluation Subjective method
Subjective evaluation of conformation is the traditional and still the primary method of evaluating equine conformation (Adams, 1973) [1] but it varied greatly between judges as it based on experience or opinion and very little is based on research (Magnusson and Thafvelin, 1985b) [24]. In this method, assessment of the curvature and proportions of the topline, assessing the balance of the forehead in relation to the hindquarter, straightness and symmetry of limbs, hooves quality, assessment of depth and length of the muscles in the forearm and chest was performed from left side and right (off) side of the horse (Adams, 1973) [1]. Stashak (1987) [40] reported that limb conformation of a horse standing squarely on a firm, flat surface with an experienced handler is critical to evaluate.

Horses often stand camped out, both behind and in front, simply as the result of improper positioning. Butler (1985) and Seidlitz. Willeke and Von Butler-Wemken (1991) [6, 39] mentioned that subjective evaluation of equine conformation is usually based on experience or opinion. Every country has its own protocol based on specific standard and regulations of breed for judgment (HÖlmstrom, 2001) [17].

Semi-objective Method

Semi objective method for linear conformation trait evaluation which allowed the quantitative description of static conformation of thoroughbred horse (Mawdesley, *et al*. 1996) [26]. Measurements were made for 27 selected traits and various abnormal conformations were included in one chart for easily guidance. This procedure was adopted for Warm blood (Koninklijik Warmbloed Paardenstamboek Nederland) as well as for Friesian (Koninklijik Friesch Paarden-stamboek) horses in Netherlands at studbook admission (Pretorius, 2003) [32].

Objective (quantitative) Method

Quantitative approach to measure conformation traits was undertaken in the 18th century by Bourgelat (1750) [5]. In the 19th and early 20th century, other researchers has developed hippometric methods and took into account the joint angles and inclinations of the limb segiments. Earlier researchers in this field pointed the importance of standardized animal stance while evaluating equine conformation through photographic or human observations (HÖlmstrom *et al.*, 1990 and Mawdsley *et al*., 1996) [15, 26]. This method was documented by Schmaltz (1906) [37], Schottler (1910) [38] and Rosio (1927) [35] for measurement of conformation of live animals. Some peculiarities of this method are:

A. **Standard Height Stick:** The measuring stick on a level was an accurate, practical and satisfactory method for scaling of the lengths measured (Hickman and Colles, 1984) [14].
B. **Photographic Measurements:** Magnusson (1985) [23] and Holmstrom and Philipsson (1993) [18] developed and utilized a method of marking horses and measuring linear and angular conformation from still photographs with the assistance of reference points as described by Kronacher and Ogrizek (1931) [21] and Langlois (1979) [22].
C. **Reference points:** Holmstrom (2001) [17] described that evaluation of conformation was carried out by the bony prominences of wings of the atlas (Cranial end), spine of scapula (proximal end), greater tubercle of humerus (posterior part), transition between the proximal and middle thirds of the lateral collateral ligament of elbow joint, the lateral tuberosity of radius (distal end), the space between the fourth carpal and the third and fourth metacarpal bones, the proximal attachment of the lateral collateral ligament of the fetlock joint to the distal end of third metacarpal bone, the proximal attachment of the lateral collateral ligament of the pastern joint to the distal end of the first phalanx, lateral angle of the ilium (proximal end), centre of the greater trochanter of femur (anterior part), proximal attachment of the lateral collateral ligament of the stifle joint to the femur, the attachment of the long lateral ligament of the hock joint to the plantar border of the calcaneus bone, space between fourth tarsal and third and fourth metatarsal bones, the proximal attachment of lateral collateral ligament of fetlock joint to the distal end of the third metatarsal bone and the proximal attachment of the lateral collateral ligament of the pastern joint to distal end of the first phalanx.

Although objective methods for conformation evaluation will probably play a more important role in the future, but traditional subjective evaluation will always be important.

Limited number of objective conformation studies based on height, girth and cannon bone circumference has been carried out, usually in the context of heritability. Such proceedings were carried out on the live horse and/or from photographs with the assistance of reference points (Fedorski and Pikula, 1988) [12].

Holmstrom *et al.* [15] had reported that when measurement was taken from live animals, a uniform stance for photographs is important for accuracy and repeatability.

Variation in limb placement and weight distribution can significantly influence angular conformation measurements.

Magnusson's Method

Twenty-five anatomical points were chosen for paper marker placement on the live animal. Points chosen were easily palpable and not heavily influenced by muscle, fat or hair locks. The anatomical points were the end of bones and center of joints, lines between these points coincided with lines and axis used in subjective horse evaluation. Horses are measured in a standardized and square position using a measuring stick in each photo for scaling, and linear and angular measurements were taken from projected images of the photographs (Magnusson, 1985) [23]. Morphometric measurements are taken with a flexible measuring tape (Mawdsley *et al.*, 1996) [26].

This was eventually replaced by photography and computers (Magnusson and Thafvelin, 1985a) [25] and video recorded images (Hunt, *et al* 1999) [16]. Recently, digital photography and advances in computer technology is increasingly prevalent in objective measurements in conformation research (McIlwraith *et al*., 2003) [28].

Distortion Error

Measurement error occurs while translating the 3-dimensional (3D) animal to 2- dimensional (2D) image due to planar differences between markers. Increasing the focal length of lens from 40mm to 200mm significantly reduces this distortion (Magnusson, 1985) [23]. When compared to measurements taken from a 3D system, 2D measurement error averaged 2 cm with a maximum error of 5 cm for the scapula length (Weller *et al.*, 2006a) [42]. Corrections for "fish-eye" distortion caused by video and camera lens attributes ranged from 0 cm at the center of the screen to 2 cm at edges of the image (Hunt *et al*., 1999) [16]. A fish eye lens is an ultra-wide angle lens that produces strong visual distortion intended to create a wide panoramic or hemispherical image. Full-frame fish eye lenses enlarged the image circle to cover the entire rectangular frame. The picture angle produced by these lenses only measures 180 degrees when measured from corner to corner (Kingslake, 1989) [20].

Camera Placement

Camera placement is an important concern when utilizing photographs to measure conformation. The camera should be placed at a height as close to as possible that of the center of horse's thorax (behind the apex of the heart) (McIlwraith *et al.*, 2003) [28]. Overly high camera placement causes

significant overestimation of horizontal and vertical linear measurements taken from the upper half of the frame (Hunt *et al.*, 1999) [16].

Weller *et al.* (2006a) [42] reported that utilizing a single practiced individual to mark all animals in a study is often done to control error associated with differences between applicators. Mean differences of more than 2 cm for neck, trunk length, croup length and tibia were reported, when it was performed by a single individual with help of multiple marker applications. Length measurements distal to the carpus and tarsus averaged less than 1cm difference between marker applications. Angular absolute value differences between markers average 3.2° (McIlwraith *et al.*, 2003) [28]. It is worth to mention that each of objective conformation evaluation's authors (Magnusson, 1985; HÖlmstrom, *et al.*, 1990; Johnston *et al.*, 1996; McIlwraith *et al.*, 2003 and Robert, Valette and Denoix, 2013) [23, 15, 19, 28, 33] used different reference points from each other.

Objective radiological method for limb conformation evaluations

Barr (1994) [4] used an objective radiological method for assessing the degree to which horses is 'back at the knee' (hyper extended). This unique method provides the advantage of allowing an assessment of skeletal without complication of variations in the shape or bulk of soft tissue. He suggested that if this angle was greater than 180°, it represents a carpal flexion (over at the knee) precisely and if it was less than 180°, it represents hyperextension (back at the knee).

Live Animal Measurements

The most straight-forward methods for quantifying linear conformation to take measurements on live animal. These methods have been used extensively in equine growth research as accepted methods of quantifying linear conformation (Denham, 2007) [8].

Animal Stance

Very little research is available for quantifying the effects of stance on angular conformation. Therefore, using a standard position helps to reduce errors due to stance variations. Quantitative conformational analysis, act as a admiration to the traditional evaluation to enhance the authenticity in the prediction of performance potential in young horses (Hölmstrom and Philipsson. 1993) [18]. While taking measurements from live animal, a uniform stance for photographs is important for accuracy and repeatability. Changes in limb placement and weight distribution can significantly influence angular conformation measurements (Weller *et al.*, 2006a) [42].

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