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A longitudinal study of back dimension changes over 1 year in sports horses

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ABSTRACT

Major back dimension changes over time have been observed in some horses, the speed of which may be influenced by work type, skeletal maturity, nutrition and saddle fit. Currently, there are no longitudinal data quantifying changes in back dimensions. The objectives of this study were to quantify back dimension changes over time, to identify the effects of horse, saddle and rider on these dimensions, and to determine their association with season, weight, work and saddle management. A prospective, longitudinal study was performed, using stratified random sampling within a convenience sample of 104 sports horses in normal work. Thoracolumbar dimensions/symmetry were measured at predetermined sites every second month over 1 year; weight, work and saddle management changes were recorded. Descriptive statistics, and univariable and multiple mixed effects linear regression were performed to assess the association between management changes, horse-saddle-rider factors and back dimension changes.

Complete data was available for 63/104 horses, including horses used for dressage ($n = 26$), showjumping ($n = 26$), eventing ($n = 26$) and general purpose ($n = 26$), with age groups 3–5 years ($n = 24$), 6–8 years ($n = 28$), 9–12 years ($n = 24$) and ≥ 13 years ($n = 28$). There were considerable variations in back dimensions over 1 year. In the multivariable analysis, the presence of gait abnormalities at initial examination and back asymmetry were significant and had a negative effect on changes in back dimensions. Subsequent improved saddle fit, similar or increased work intensity, season (summer versus winter) and increased bodyweight retained significance, having positive effects on changes in back dimensions. In conclusion, quantifiable changes in back dimensions occur throughout the year. Saddle fit should be reassessed professionally several times a year, especially if there has been a change in work intensity.

Introduction

Correct saddle fit is important for optimal function of the equine back. A saddle that does not fit the horse may impair the structural development of the back and cause pain and muscle atrophy (Von Peinen et al., 2010). The shape of the horse's back influences the ease with which a saddle can be fitted correctly and thereby the distribution of the rider's weight. Horses working correctly with a well fitted saddle are more likely to exhibit a transient, exercise-induced increase in back width than horses not working correctly with an ill-fitting saddle (Greve and Dyson, 2014b).

Longitudinal studies have shown increases in muscle fibre cross-sectional area in horses in response to exercise (Rivero et al., 1992; Miyata et al., 1999). Repetitive immediate post-exercise changes in equine back dimensions may result in longer term changes (Greve and Dyson, 2014b). There are a number of other factors that may influence back dimension changes over time, including skeletal maturation, nutrition, alteration in bodyweight, season, conformation, duration and type/intensity of exercise, base line muscle development, core strength, lameness, back pain and the fit of tack. A better understanding of back dimension changes over time is important for determining how often saddle fit should be checked.

The aims of the study were to investigate changes in back dimensions over time in sports horses of variable age, from a range of work disciplines, working at different levels, and to determine the influence of horse, the fit of the saddle and rider data (skill level and posture), and the association with season, change in bodyweight, alteration in type and amount of work and saddle management changes. We hypothesised that changes in back dimensions over time were quantifiable, that seasonal variation would occur and that fluctuations in weight, work history and saddle management would influence the degree and direction of the back dimension changes.

Materials and methods

A longitudinal study was performed using sports horses in regular work, presumed by the rider to be sound. The study was approved by the Ethical Review Committee of the Animal Health Trust (approval number AHT 12.14; date of

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approval 20 August 2012) and there was informed owner consent. The study population was a convenience sample of 506 horses (Greve and Dyson, 2014c), selected based on proximity to the authors' institute. Within the study population, stratified random sampling was used select 104 horses representing four work disciplines (dressage, eventing, showjumping and general purpose, the latter including horses used for unaffiliated competitions) and four age groups (3–5, 6–8, 9–12 and ≥ 13 years). Data were collected from October 2012 to December 2013. Each horse was assessed every 2 months over 1 year. Horses that were abroad competing could not be included in certain examinations. Horses lost to follow-up were attributed to horses moving yard, being sold or humanely destroyed because of lameness or other health problems.

Baseline data (time-invariant data)

Age, breed, sex, height (from the horse's passport), estimated bodyweight (using a weight measuring tape; Equimax, Virbac), body condition score (BCS) (Henneke et al., 1983), work discipline and work level were recorded.

Saddle fit

The panels of the saddle were checked for evenness, uniformity of thickness and softness. The firmness of the flocking was graded as soft, firm or very hard using a three point scale. The left-right symmetry of the panels, and the presence of lumps or depressions were recorded using a yes/no grading system. The saddle type (tree, flexible or rigid, ± gullet; close contact or traditional fit; type of flocking) and any special pads and numnahs used were recorded.

The balance of the saddle was determined by assessing whether the lowest point of the seat of the saddle corresponded to the lowest point of the horse's back (Harman, 1999). A saddle fitted in balance has the centre of the seat of the saddle horizontal, while the lowest part of the saddle and the lowest part of the horse's back are aligned, and the panels have even contact with the back along their entire length. The suitability of the width and length of the saddle, and the size of the tree for the horse's shape, were assessed. The fit of the saddle, whether it was tipping forward or backward, were recorded and the total clearance of the spinous processes through the gullet were noted (Greve and Dyson, 2014c).

Dynamic examination

All horses were worked on the flat for 30 min by their normal rider. The riders were instructed to work the horse normally, depending on the work discipline of the horse and its stage of training. Near the end of the work period, video footage was recorded of each horse ridden in working trot rising both in straight lines, and in large (20 m diameter) and small (10 m diameter) circles on both the left and right reins, and in working canter both in straight lines and 20 m diameter circles on both reins. Ridden exercise was performed on grass, or on a variety of arena surfaces, depending on the facilities available at each venue. Video recordings were obtained from two corners of the arena, so that the horse and rider were assessed directly from behind on both reins and from the side. The video recordings of all horses were assessed by both authors, an experienced lameness clinician, a competition rider to upper national level and British Horse Society Instructor, and a veterinary graduate of 3 years, also an experienced competition rider. Both authors assessed lameness, saddle movement, saddle-slip, rider straightness and skill-level by consensus.

Lameness

Horses in the study were divided into six categories based on the lame limb(s): non-lame; forelimb (FL) lameness; hind limb (HL) lameness; FL and HL lameness; quadrilaterally reduced cranial phase of the step; and stiff, stilted canter.

Saddle movement and saddle slip

Whether the saddle stayed behind the scapulae, extraordinary movement of the saddle from side to side or the presence of saddle slip to one side were recorded. Saddle slip was defined as the movement (slippage) of the saddle consistently to one side when observed from behind. An overall saddle slip grade was obtained for each horse using a 0–2 scale (Greve and Dyson, 2013b).

Rider crookedness and skill

The weight of the rider (based on the rider's estimate), sex, previous injuries and known physical, postural asymmetries and awareness of saddle slip (if present) were recorded. Rider 'crookedness' was defined as an asymmetric position of the left and right shoulders and/or left and right tubera coxae, assessed from behind, by consensus of both authors using a yes/no grading system. Rider ability was categorised as riding school level, average (regular riders who competed at less than advanced national level) and expert (competed at or beyond advanced national level).

Data collected at each subsequent examination (time variant data)

An estimate of each horse's weight and BCS were obtained at each examination. Information comprising season, work history, changes in management, changes in saddle use and any changes in rider were recorded. Saddle change was defined as a professionally-assisted saddle fitting, using a yes/no grading system. Saddle fit was reassessed if saddle change had occurred. Change in work was categorised into three groups: (1) lower intensity exercise and/or level, or rest; (2) exercising regularly with a similar type of work, intensity and level; and (3) increased exercise, higher intensity (increase in duration of trot, canter and/or jumping) and/or level (increase in difficulty of work). A yes/no grading system was used for rider change and changes in management, e.g. turn out, physiotherapy or Bowen treatment, and/or problems requiring veterinary assistance.

Objective assessment of thoracolumbar shape

The thoracolumbar shape and symmetry were measured at the level of the 18th (T18), 13th (T13) and 8th (T8) thoracic vertebrae, identified by palpation of the ribs and at a site one third of the distance in a caudocranial direction between the point of the elbow and the point of the shoulder (shoulder region). A flexible curve ruler (Jakarflex 100 cm, Crystal Edge) was shaped around the dorsum, perpendicular to the dorsal midline, to follow the body contours and the resultant shape was drawn on graph paper; the repeatability of this methodology has been determined previously (Greve and Dyson, 2013b). All measurements were performed with the horses standing squarely on a level surface, before exercise. The thoracolumbar shape was measured every second month over 1 year. Ratios of the width of the horse's back 3 and 15 cm ventral to the dorsal midline, determined from the lines drawn on graph paper (Greve and Dyson, 2013b) were calculated for each of the four measurement sites.

Thoracolumbar symmetries

Asymmetries between left and right sides at each site were determined by rotating the flexible curve ruler 180° in a horizontal plane and comparing it with the pre-drawn curve. The number of horses with minor left-right asymmetries was established using a coefficient of variation (CV) of 4% (0.6 cm) and major left-right asymmetry was defined using a CV of 8% (1.2 cm) (Greve and Dyson, 2013b).

Subjective assessment of the thoracolumbar region

The thoracolumbar region was inspected and palpated (Girodroux et al., 2009). The presence of tenderness and stiffness in the epaxial musculature was recorded. Photographs of the thoracolumbar region were obtained from behind with the horse standing squarely, on a level surface with the neck straight. Visual appraisal was correlated with objective measurements.

Statistical analysis

Sample size was calculated based on preliminary estimates of the standard deviation (SD) of the sum of the absolute back width changes at 3 and 15 cm ventral to the dorsal midline at each site after the second examination of 104 horses. This resulted in a SD of 4.2 cm at 3 cm and a SD 5.9 cm at 15 cm. A total sample size of 50 horses was required to provide a study with 80% power and to be 95% confident of detecting a difference at each site ≥ 1.2 cm (coefficient of variation of 8%) based on a previously published repeatability study (Greve and Dyson, 2013b).

Descriptive analysis was carried out for horse, saddle and rider data. Differences in back-shape widths 3 and 15 cm ventral to the dorsal midline between subsequent examinations, overall changes throughout the year and ratios between the widths at 3 and 15 cm were considered as outcome variables for each region. The first analysis used a two sample *t* test to assess the direct effect of saddle change (yes or no) and change in bodyweight (≥100 or < 100 kg) and one-way analysis of variance (ANOVA) was used to assess the effect of work change (rest/reduced or no change or increased), without taking into account other confounding variables. The mean, standard error (SE) and median for each region were summarised for overall changes over the year.

A univariable, mixed effect linear regression was performed to assess the relationship between horse, saddle and rider factors, and outcome variables. All analyses were adjusted for the clustering effect of yard. Those variables that were statistically significant at $P < 0.20$ were put forward for inclusion in a multivariable, mixed effects linear model. Biologically meaningful interaction terms for all variables retained in the final model were assessed. Final model results were reported as parameter estimates (±SEs) and *P* values. All statistical analyses were performed using SPSS Statistics 20[d], with significance set at $P < 0.05$.

Results

The numbers of horses measured were 104 (100%) at time 0 and 2 months; 97 (93%) at 4 months; 87 (84%) at 6 months; 83 (80%) at 8 months; 67 (64%) at 10 months and 63 (61%) at 12 months.