Journal of Equine Veterinary Science 40 (2016) 6–15

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Original Research

Association of a Subjective Muscle Score With Increased Angles of Flexion During Sitting Trot in Dressage Horses

V.A. Walker*, C.A. Tranquille, S.J. Dyson, J. Spear, R.C. Murray

Centre for Equine Studies, Animal Health Trust, Newmarket, Suffolk CB8 7UU

ARTICLE INFO

Article history:
Received 24 September 2015
Received in revised form 19 January 2016
Accepted 20 January 2016
Available online 28 January 2016

Keywords:
Equine
Back
Kinematics
Collected trot
Stability

ABSTRACT

Dressage requires the horse to be supple through the thoracolumbosacral region, and movement should allow for efficient locomotion and expression, but excessive thoracolumbosacral movement is likely to be detrimental to the soft tissues of the vertebral column. It is not known how development of the musculature relates to thoracolumbosacral movement in the ridden dressage horse. The aim of the study was to investigate the relationship between grading of muscle development and back kinematics. Thirty-five horses (Novice to Grand Prix level) in active dressage training were ridden in sitting trot in a straight line by their normal rider on an artificial surface. Thoracolumbosacral angles were derived from high-speed motion capture. Muscle scores were assigned based on visual assessment and manual palpation of the left and right sides of the neck, abdomen, thoracic and lumbosacral (LS) regions, pelvis, and hindlimbs. Our findings suggest that there is a relationship between muscle scores and kinematics of the back in ridden dressage horses. There was an association between neck trunk, thoracolumbar, LS angles, and dorsoventral difference between withers and tuber sacrale markers and muscle scores. Muscle scores assigned during clinical examination were related to the back kinematics of dressage horses ridden at a collected trot. Observations from this study suggest that thoracic, abdominal, and LS muscle development is important for achieving gait patterns which are desirable, according to equitation texts, at the collected trot.

1. Introduction

The thoracolumbosacral region (which will be referred to from hereon as back) has several functions during locomotion, including providing support and stability while facilitating movement in three planes: flexion and extension, axial rotation, and lateral bending. During the trot, the back region moves in a sinusoidal pattern with two peaks (flexion) and two troughs (extension) per stride [1–3]. At a slow trot, the back is passively flexed and extended through movement of the visceral mass [2]. The flexion peaks occur during the swing phase when the limbs are not in contact with the ground and the extension troughs occur at the stance phase when the diagonal limbs are in contact with the ground and therefore supporting the weight of the horse and rider [1–3]. Back stabilization can be achieved through both passive (bone, ligament) and active (muscular) mechanisms [1]. Back extension is actively moderated by the action of the back flexor muscles (e.g., rectus abdominis), and flexion is actively moderated by the back extensor muscles (e.g., longissimus dorsi) [2,3]. The influence of head and neck position on back kinematics has also been illustrated in ridden [4] and unridden horse [5,6]. To provide a stable support platform for the rider, training of the horse should aim to stabilize and improve coordination throughout the head, neck, and back [1].

At collected trot, the horse works with a shorter frame and the hindlimbs become more propulsive compared with working trot and the forelimbs work to elevate the forehand relative to the hindquarters. To achieve this, the neck and back of the horse need to be flexed [7]. The thoracic serratus ventralis and pectorals are important in support

* Corresponding author at: Centre for Equine Studies, Animal Health Trust, Newmarket, Suffolk CB8 7UU.

E-mail address: vicki.walker@aht.org.uk (V.A. Walker).

0737-0806/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jevs.2016.01.011

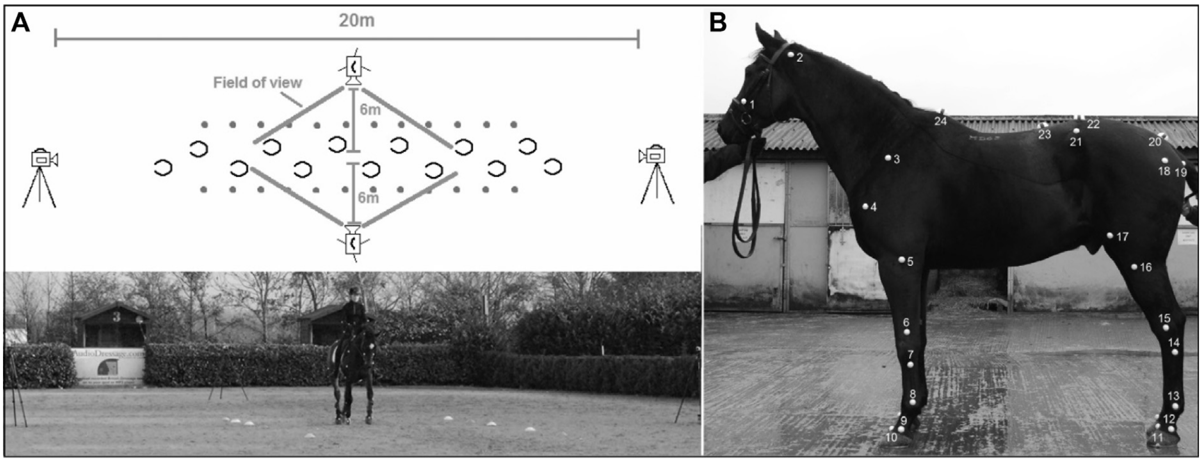

Fig. 1. Arena set up (A) for testing; showing field of view and runway used. (B) Marker placement for data collection: (1) rostral aspect of the facial crest, (2) wing of atlas, (3) proximal aspect of the scapular spine, (4) over the cranial eminence of the greater tubercle of the humerus, (5) the lateral epicondyle of the humerus over the lateral collateral ligament of the elbow, (6) lateral styloid process of the radius, (7) proximal aspect of the third metacarpal bone at the junction with the base of the fourth metacarpal bone, (8) distal aspect of the third metacarpal bone over the lateral collateral ligament of the metacarpophalangeal joint, (9) lateral collateral ligament of the distal interphalangeal joint (designated coronary band), (10) dorsal aspect of the hoof wall at the level of the coronary band, (11) dorsal aspect of the hoof wall at the level of the coronary band, (12) lateral collateral ligament of the distal interphalangeal joint (designated coronary band), (13) distal aspect of the third metatarsal bone over the collateral ligament of the metatarsophalangeal joint, (14) proximal aspect of the third metatarsal bone at the junction with the base of the fourth metatarsal bone, (15) midtalus, (16) proximal aspect of fibula, (17) medial epicondyle of the distal femur, (18) proximal aspect of the greater trochanter of the femur, (19) ischiatic tuberosity, (20) top of tail, (21) proximal aspect of the tuber coxae, (22) tuber sacrale, (23) spinous process of the fourth lumbar vertebra, and (24) spinous process of the sixth thoracic vertebra.

and elevation of the thorax, and along with the rectus abdominis and external abdominal oblique muscles, they lift the abdomen and enable flexion through the thoracolumbar (TL) and lumbosacral (LS) regions [8–10]. The long back muscles (longissimus dorsi, intercostalis, gluteus medius) are responsible for moderating flexion of the back [2] and facilitating limb movement [11]. Flexion of the LS region is crucial for the caudal weight shift during collection which is facilitated by the caudal pelvic tilt through the action of the gluteal, hamstring, and psoas muscles [8]. It is proposed in equitation texts that this and contraction of the longissimus dorsi and intercostalis and consequential elevation of the neck through the action of splenius and semispinalis capitis cause TL flexion and the forehand to be elevated relative to the hindquarters [8,11,12].

Although body condition scoring is frequently used as a guide for nutritional advice [13–15], there is no comparable scale for evaluation of muscle development which could potentially be useful in relation to training, nutrition, and detection of orthopedic problems, such as pelvic or hindlimb fracture [16]. Alterations in muscle development may be related to back pain [17,18], lameness [19], conformation [20], rider [21,22], saddle fit [23], and exercise history [24]. Visual and palpation assessment of the posture

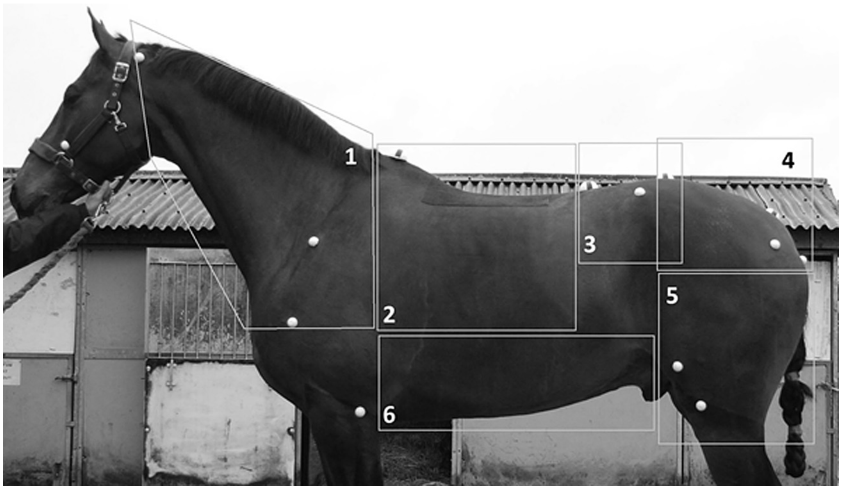

Fig. 2. Regions assigned muscle scores (see Table 1): (1) cervical, (2) thoracic, (3) lumbosacral, (4) pelvic, (5) hindlimb, and (6) abdominal. The figure also illustrates some of the marker placements used for measurement of angles and distances between landmarks.