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Original Research

Thermographic Evaluation of Racehorse Performance

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ABSTRACT

The present study was aimed at identifying the key thermographic diagnostic areas essential for monitoring the effect of training on racehorses. The study involved monitoring 15 racehorses in 13 imaging sessions over a period of 10 months. Temperature measurements were made at a total of 46 regions of interest (ROIs) at the distal parts of the limbs and the back. To account for the influence of ambient temperature on each ROI measurement, values were adjusted to a constant ambient temperature of 12°C, estimated using regression analysis. The horses in the study were divided into two groups based on the value of success rate in racing competition. During the research period, none of the horses were identified as injured by routine veterinary investigation. Successful horses had significantly warmer adjusted ROI temperatures than their less successful counterparts at both carpal joints, the third metacarpal bones, the left fetlock joint, the left front short pastern bone, the left tarsus joint, and the caudal part of the thoracic vertebrae. The study tested a protocol for recording body surface temperature in racehorses, which was shown to increase reliability by adjusting for variations in ambient temperature. When analyzed on the basis of sporting performance, the protocol identified 14 ROIs that were associated with superior performance, most of which were at the limbs on the left side.

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1. Introduction

The health and training performance level of horses can be evaluated by behavioral, hematological, and biochemical changes in the body during physiological effort. Previous studies have investigated basic physiological indicators such as blood chemistry and pulse rate [1–3], but they have not provided evidence of the changes to the equine musculoskeletal system that occur in response to regular training.

Jodkowska [4] identified the possibility of monitoring the impact of training through the measurement of body surface temperature, which is influenced by the vascularity and metabolic activity within and below the skin surface. Thermography is a noninvasive measurement method enabling abnormal patterns of skin surface temperature to be detected by means of infrared imaging. Potential veterinary applications of thermography have been described [5–8]. These reports mostly address the detection of injuries caused by training overloads, especially at the back and the distal parts of the limbs of the horse [9–11]. Normal thermographic patterns in the horse have also been described, enabling improved diagnostic interpretation of equine thermography [5,12,13]. To date, however, no study has located the optimal body regions for reliable thermographic evaluation of musculoskeletal impact on horses. Therefore, the present study was aimed at identifying the key thermographic diagnostic areas essential for monitoring the effect of training on racehorses.

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2. Materials and Methods

2.1. Study Population and Data Collection

The study was approved by the Local Ethical Committee for Experiments on Animals of Wroclaw University of Environmental and Life Sciences. Thermography measurements were obtained from 15 clinically healthy racehorses of two breeds (12 Polish Half Breed and three Arabians), all aged 3 years. All horses were trained for flat racing at Partynice Race Course (Poland) during the 2012 season. Performance data such as orthopedic injuries, training intensity, and success rate (SR, prize money per race) for 2012 were collected for each horse. The horses were housed in individual stalls with common management and training regimes. All horses were trained and raced in a clockwise direction. The protocol for thermography was as previously described by Van Hoogmoed et al [14] and Soroko et al [15]. Horses were examined at rest before daily exercise. Dirt and mud present in the imaging field of view was brushed away 15 minutes before examination and approximately 10 minutes were allowed to pass before scanning to ensure the transient heat generated by brushing had subsided before obtaining baseline measurements. The brushing was performed symmetrically. To minimize the effect of environmental factors, thermography was always performed at the same place within an enclosed stable. The distance of the animal from the camera was fixed for all imaging at 1 m, and the emissivity (ε) was set to 1 for all readings.

At each imaging session, a series of six thermographic images were taken of the dorsal, lateral, and medial aspects of the distal part of the forelimbs (Figs. 1–3); the dorsal aspect of the distal part of the hind limbs (Figs. 4 and 5); and the dorsal aspect of the back (Fig. 6) using a VarioCam HR infrared camera (uncooled microbolometer focal plane array; resolution, 640 × 480 pixels; spectral range, 7.5–14 μm; InfraTec, Dresden, Germany). A total of 13 imaging sessions were conducted over a period of 10 months. At each session, the ambient temperature in the stable (T_{amb}) was measured by a TES 1314 thermometer (TES, Taipei, Taiwan).

Regions of interest (ROIs) were determined for each thermographic image. On each image of the forelimbs 10 ROIs were defined (Figs. 1–3), allowing temperature measurements to be made bilaterally at the dorsal, lateral, and medial aspects of the carpal joint, third metacarpal bone, fetlock joint and short pastern bone; the dorsal aspect of the hoof; and the lateral and medial aspects of the heel.

On each image of the hind limbs 5 ROIs were defined (Figs. 4 and 5) allowing bilateral measurements at the

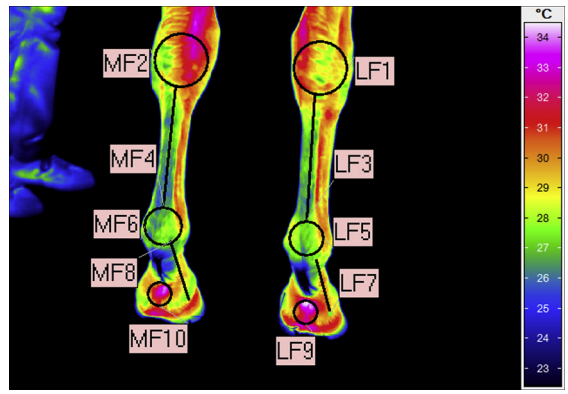

Fig. 2. Thermogram of right lateral and left medial aspects of distal part of the forelimbs. Measured regions of interest: LF1—right carpal joint, lateral aspect; MF2—left carpal joint, medial aspect; LF3—right third metacarpal bone, lateral aspect; MF4—left third metacarpal bone, medial aspect; LF5—right fetlock joint, lateral aspect; MF6—left fetlock joint, medial aspect; LF7—right short pastern bone, lateral aspect; MF8—left short pastern bone, medial aspect; LF9—right heel, lateral aspect; and MF10—left heel, medial aspect.

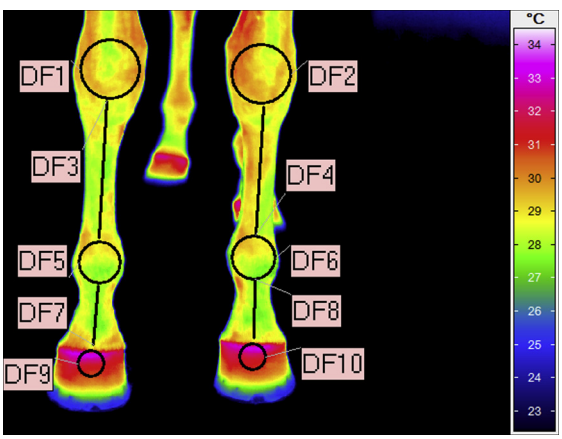

Fig. 1. Thermogram of dorsal aspect of distal part of forelimbs. Measured regions of interest: DF1—right carpal joint, dorsal aspect; DF2—left carpal joint, dorsal aspect; DF3—right third metacarpal bone, dorsal aspect; DF4—left third metacarpal bone, dorsal aspect; DF5—right fetlock joint, dorsal aspect; DF6—left fetlock joint, dorsal aspect; DF7—right short pastern bone, dorsal aspect; DF8—left short pastern bone, dorsal aspect; DF9—right hoof, dorsal aspect; and DF10—left hoof, dorsal aspect.

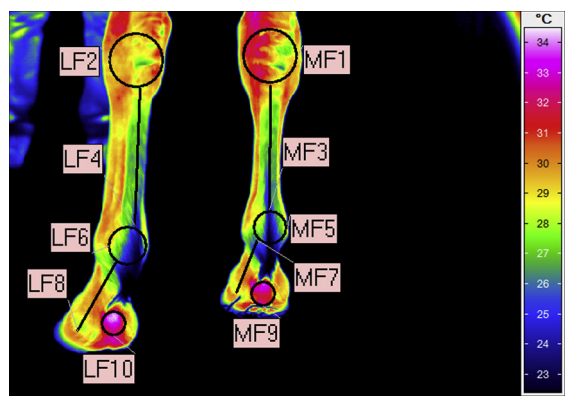

Fig. 3. Thermogram of left lateral and right medial aspects of distal part of the forelimbs. Measured regions of interest: MF1—right carpal joint, medial aspect; LF2—left carpal joint, lateral aspect; MF3—right third metacarpal bone, medial aspect; LF4—left third metacarpal bone, lateral aspect; MF5—right fetlock joint, medial aspect; LF6—left fetlock joint, lateral aspect; MF7—right short pastern bone, medial aspect; LF8—left short pastern bone, lateral aspect; MF9—right heel, medial aspect; and LF10—left heel, lateral aspect.

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