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Original Research

Assessment of Saddle Fit in Racehorses Using Infrared Thermography

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ABSTRACT

The aim of this study was to assess the influence of horse, saddle, and rider on saddle fit in racehorses by detecting pressure distribution using infrared thermography. In this study, 22 saddles used on 65 racing horses ridden by 21 riders were used. Data from horses including gender, breed, age, training intensity, and level of performance were collected. Type and mass of the saddle were also obtained, along with information about the rider's body mass and riding skills. Thermographic images of the saddle's panels were captured immediately after untacking the horse at each thermographic examination. On each thermographic image of the saddle panels, six regions of interest (ROIs) were marked, with mean temperature calculated within each ROI to indicate pressure distribution. Saddle fit was evaluated for right/left panel pressure, bridging/rocking pressure, and front/back pressure according to horse's: gender, breed, age, training intensity, level of conditioning, rider's skills, and load (saddle plus rider mass). There were statistically significant relationships ($P < .05$) between left/right asymmetry and age, training, intensity and load. In front/back pressure, there was a statistically significant relationship ($P < .05$) for load. No statistically significant relationships were observed between bridging/rocking pressure and the rest of the aforementioned variables. The study indicated that load, horse age, and training intensity influence pressure distribution in racing saddles. Therefore, animal age and load have to be considered in saddle fit. Infrared thermography has been confirmed as a useful tool in the evaluation of saddle fit in racing horses.

1. Introduction

Back pain is one of the most common clinical problems encountered in performance horses [1]. Back pathologies are mainly associated with soft tissue injuries or spinal stress fractures [2]. It has been reported in many studies that a contributing factor to back pain in horses is a badly fitting saddle [3–5].

An ill-fitting saddle can contribute to pain on palpation, direct and compensatory overt lameness, gait alterations [6,7], and behavioral changes [4]. Therefore, it is important that objective scientific studies be carried out to identify variables that could impact on saddle fit.

Some preliminary studies have used pressure-sensing mats for the objective measurement of saddle fit [8–10]. These devices have been validated for both accuracy and reliability of their force-sensing technology [1,11,12]. An alternative method for determining the pressure distribution across the saddle can be obtained through the use of infrared thermography (IRT) on the saddle panels [13,14].

Infrared thermography is a noninvasive imaging method that enables superficial heat emission to be detected, indicating the surface temperature [15]. Potential equine veterinary applications of IRT have been described [16–18], including the study of back injuries. Infrared thermography has been used in detecting disease

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of the thoracolumbar region, muscular pathologies [19], and spinous process inflammation of the thoracic vertebrae [20].

Application of IRT in the evaluation of saddle fit offers a rapid and easy method which is more practical than other measurement methods available. Infrared thermography examination in saddle fit indicates the temperature distribution, and thus the interaction between the saddle and the surface of the back. In a correctly fitted saddle, pressure distribution should be even on both sides of the spine and back [13]. Locally warmer areas on the back can be detected by IRT with at least 10 times more sensitivity than palpation by the human hand and indicate regions of higher saddle pressure. As a result, pressure points can be easily identified and localized. According to Turner et al. [13], the most commonly identified problems are bridging and rocking of the saddle. In the study presented by Arruda et al. [14], IRT proved to be a useful imaging technique to assess saddle fit used on jumpers. However, no research to date has presented quantitative analysis of the observed pressure distribution on saddle panels. The aim of this study was to assess the influence of horse, saddle, and rider on saddle fit in racehorses by detecting pressure distribution using IRT.

2. Materials and Methods

2.1. Data Collection

Sixty-five clinically healthy racehorses (49 Thoroughbreds and 16 Arabians) of mixed gender (32 mares, 29 stallions, and four geldings), aged between 2 and 6 years were studied, with a total of 22 saddles used. Horses had varying levels of fitness (high, moderate, and low condition) which was determined by the trainer of each stable. Horses were trained for flat racing at Partynice Racecourse (Poland) during the 2016 season. The horses were housed at three different racing stables with varied training intensity (stable A—28 horses, stable B—8 horses, and stable C—19 horses). Horses had similar management regimes but were trained at different intensity levels depending on their trainer, on the same racetrack, in a clockwise direction.

Two types of racing saddle were used during the study: 16 were hard with a tree at the seat and back of the saddle, and six were soft without a tree (stable A—nine saddles, stable B—6 saddles, and stable C—seven saddles). The mass of the saddles (including stirrups and girth) was between 4 kg and 6 kg. Twenty-one riders participated in the study. Each stable had their own riders (stable A—nine riders, stable B—six riders, and stable C—six riders), with mean body mass: 59.5 kg, SD = 8.2 kg, Min = 50.0 kg, and Max = 80.0 kg. Riders were classified by trainers according to their riding skills: very good, good, and average.

Thermographic measurement of the saddle was conducted on each horse in duplicate (2 weeks apart). On both days, horses were tacked up in the same way using a single numnah and underwent training comprising of warm-up (walk and trot) for 10 minutes and then canter at a distance of 2,200 m for 20 minutes. Horses were ridden in the same way: rising trot and two point seat in canter. After training, they were untacked in the stable and cooled down on an automatic horse walker for approximately 20 minutes. On the second examination day, each horse was ridden by a different rider and was fitted with a different saddle.

2.2. Infrared Thermography

Thermographic images were captured using a VarioCAM hr Resolution infrared camera (uncooled microbolometer focal plane array, focal plane sensor array: 640 × 480 pixels, spectral range 7.5–14 μm, accuracy ±1°C, sensitivity 0.02°C, InfraTec, Dresden, Germany). The protocol for thermography examination was as previously described by Van Hoogmoed et al. [21] and Soroko et al. [22]. To minimize the effect of environmental factors, thermography was always performed within an enclosed stable (in the horse's box) to avoid sun radiation and air drafts.

Thermographic measurements of the saddle were captured, 2–3 seconds after untacking the horse (Fig. 1).

The distance of the saddle from the camera was fixed for all imaging at 1 m, and the emissivity (ε) was set to 1 for all readings as per the protocol of Arruda et al. [14]. All thermographic imaging was performed by the same operator (M.S.).

2.3. Data Analysis

On each thermographic image of the saddle panels, six regions of interest (ROIs) were marked as shown in Fig. 1, and the mean temperature within each ROI was defined and calculated as follows:

X1 = the average temperature in the region ROI1 (right side—front of the saddle)
X2 = the average temperature in the region ROI2 (right side—middle of the saddle)
X3 = the average temperature in the region ROI3 (right side—back of the saddle)
X4 = the average temperature in the region ROI4 (left side—front of the saddle)
X5 = the average temperature in the region ROI5 (left side—middle of the saddle)
X6 = the average temperature in the region ROI6 (left side—back of the saddle)

The mean temperature was calculated using IRBIS 3 Professional software (InfraTec).

2.4. Statistical Analysis

Saddle fit was evaluated according to the following:

- Horse's: gender, breed, age, training intensity, and conditioning.
- Rider's skills.
- Type of saddle.
- Loading (saddle mass plus rider's body mass).

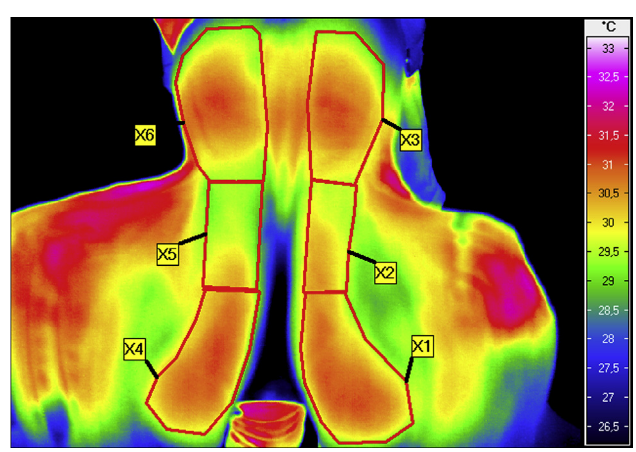

Fig. 1. Example thermographic image of saddle panels taken immediately after untacking the horse, with the six regions of interest (ROIs) indicated: right front of the saddle (X1), right middle of the saddle (X2), right back of the saddle (X3), left front of the saddle (X4), left middle of the saddle (X5), and left back of the saddle (X6).