INFRARED VIDEO-THERMOGRAPHY TECHNIQUE ON SPORT HORSES

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The reduction of performance in sport horses often leads to a severe economic loss. Despite this, mechanisms of performance reduction in sport horses are often poorly understood. Although single thermographic images have already been used in veterinary medicine as a diagnostic method for lameness and inflammation in horses, to the authors' knowledge, thermographic videos have never been taken on horses affected by a reduction of performance. Our aim was to verify the possibility of recording properly thermographic videos on sport horses tested on a high-speed treadmill and investigate whether they could be considered promising biomarkers in horses affected by performance reduction. We have been successful in creating a digital video thermography on two horses using a thermocamera AVIO TVS 500. The results obtained in this study are promising in order to optimize video-thermography technique for training and performance of sport horses .

Introduction

The reduction of performance in sport horses often leads to a severe economic loss. Despite this, mechanisms of performance reduction and chronic maladaptation in sport horses are still poorly understood.
It is possible that horses suffering from sub-clinical diseases or not properly trained, respond with a higher muscular, cardiac and respiratory effort, than well-trained subjects, when tested for physical work.
Moreover, due to the same physical condition and training, it is possible that particularly nervous or stressed subjects may have lower performances than the other ones.
The term 'poor performance syndrome' is used to describe a combination of symptoms that do not have a single specific aetiology and therefore it is a condition with a difficult clinical management.
In order to define a diagnosis of subjects in which the detection of reactivity and performances is desirable, it is very important that animals are not disturbed by invasive instruments, to avoid changes in their behavioural and physiological responses. Thermographic technique, as a non invasive method, meets these requirements.
Single thermographic images have already been used in veterinary medicine as a diagnostic method in sport horses for lameness and inflammations (Turner, 2001 - Yanmaz et al., 2007); for muscle disorders (Turner, 2001); for spinal problems (Fonseca et al., 2006); for "poor performance" syndromes (Kowalik et al., 2002).
In all these cases, thermography has been used successfully as a support to the diagnostic procedure. Information obtained about skin temperature evolution during physical efforts may be very useful to optimize training and performance of sport horses; indeed, it would objectively allow one to recognise when a horse is in the range of a good condition. Also, they allow a better understanding of changes in muscle blood flow and thermoregulation, as well as an early identification of inflammation related to

musculoskeletal disorders. However, to the authors' knowledge, thermographic videos have never been taken on horses running on a high speed treadmill.
Our aim was to verify the possibility of recording properly thermographic videos of sport horses tested on a treadmill and investigate whether they could be considered promising biomarkers in horses affected by performance reduction.

Material and Methods

In this study we used two thermocamera AVIO TVS 500, which is a rugged and portable instrument with a VOX microbolometric sensor of 320x240 pixel, operated in the radiation wavelength between 8 μm and 14 μm, with thermal resolution better than 0.1 ° C and acquisition frequency of 60 Hz .
Tests have been carried out during winter 2008 and summer 2009 at the Clinical Hospital of the Milan Veterinary Faculty, in a controlled treadmill room where environmental temperature, humidity and ventilation were kept under constant conditions.
The horses were 7 clinically sound standardbred trotters in training, both male and female and named as in the following table :

HORSE	N°OF TRIALS
La Valentina (A)	1
Fortunato (B)	1
2709	2
2909	2
2809	1
3709	2
5609	1

Table 1. Subjects that entered the study

The animals underwent the same type of test, except for A and 2909 second trial, for the same duration, with the treadmill speed increased according to the different gaits requested. The test was divided in four phases: walk, trot, gallop and recovery at walk. Each test session lasted twenty minutes.
The horse A underwent a longer test, including additional trot and recovery phases. The horse 2909 faced a second trial during which it galloped for 10 min longer than the other horses. The two thermocamera were mounted on stands at a distance of about 4 meters from the animals. Each instrument was connected to a personal computer with a USB cable in order to remotely control the camera and record the obtained files.
Videos were taken for the entire duration of the test when the horse were working on the treadmill, from both lateral right side and a dorsal position (Fig. 1, Fig.2). The frame rate was set t30 fps. More videos were taken some minutes before and after the test, in order to record the resting condition.
Files obtained were stored on a computer and analysed with a dedicated software. Temperature and relative humidity inside the test room were recorded continuously during tests.

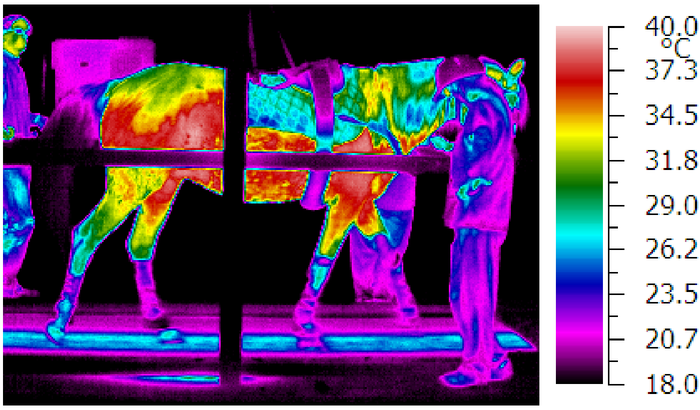

Fig. 1. Thermographic image of horse 1 on the high speed treadmill from a lateral position

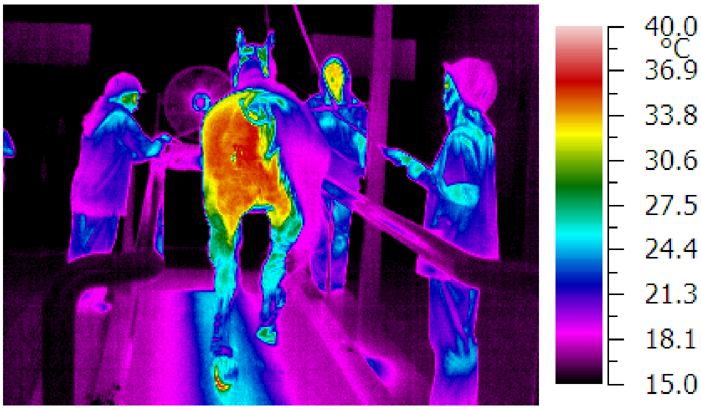

Fig. 2. Thermographic image of horse 2 on the high speed treadmill from a dorsal position

Results

We obtained 10 thermographic videos of 7 standard bread horses during the tests and it was possible to evaluate the heating process of the horses' different skin regions, according to the different gaits.
As expected, for all the considered subjects, the areas more affected by temperature changes were initially shoulders and then the back and rear limbs.
The following graph shows the patterns of max and mean skin temperatures recorded by the thermocamera positioned laterally during one trial.

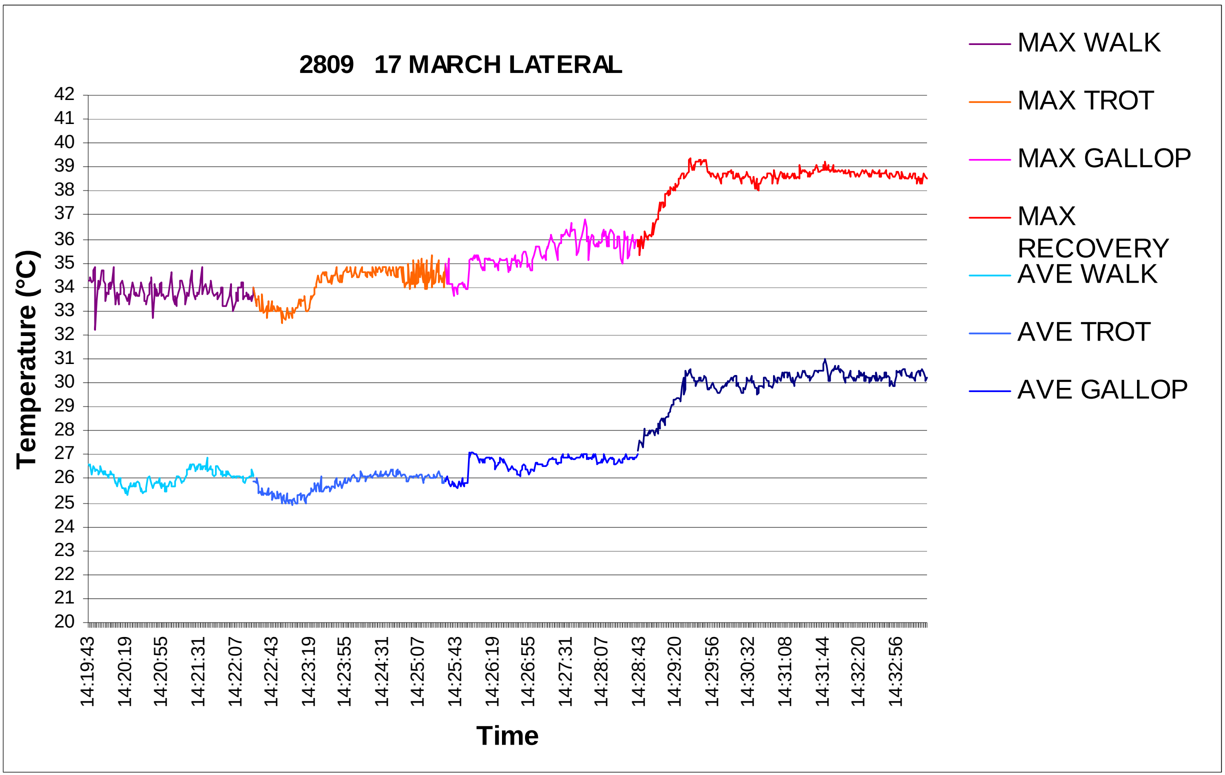

Fig.3. Visual representation of thermographic patterns during one trial

The thermal trend is represented by subsequent steps differently colored, each of them reflecting a different speed. When walking or trotting, all the horses presented similar thermal values, higher temperatures were recorded at gallop and maximal temperatures were found during the final recovery phase at walk.
The cooling effect of the fan might be responsible also of the initial temperature decrease always recorded when horses started trotting.

Horse	**Walk**	**Trot**	**Gallop**	**Recovery**	**Trot after first recovery**	**Final recovery**	**Day**	**Environment. Temp.**
A	33.2	33.6		37.9	36.6	37.9	1	13.1
B	32.6	31.2	34.7	38.7			1	12.6
5609	33.1	32.9	33.5	39.1			5	16.5
3709		34.0	34.1	36.7			2	17.7
3709	36.1	34.2	34.9	37.7			2	19.8
2909	33.8	34.8	36.0	37.8			2	20.4
2809	33.8	34.1	34.0	35.4			2	18.0
2909	34.1	34.9	36.8	40.1			3	19.3
2709	35.1	35.0	35.1	37.7			2	18.0
2709	34.6	34.6	35.8	38.9			4	20.9

Table 2 Average max temperatures recorded in different subjects (°C)

Thermal differences between average max temperatures during each phase and the walk phase were calculated and results are shown in Table 3.

Walk	**Trot**	**Gallop**	**Recovery**	**Trot after first recovery**	**Final recovery**	**Horse**	**Environment. Temp.**
33.2	0.4		4.7	3.3	4.6	**A**	13.1
32.6	-1.3	2.1	6.1			**B**	12.6
33.1	-0.1	0.4	6.0			**5609**	16.5
						3709	17.7
36.1	-1.9	-1.2	1.6			**3709**	19.8
33.8	1.0	2.2	4.0			**2909**	20.4
33.8	0.3	0.2	1.6			**2809**	18.0
34.1	0.8	2.7	6.1			**2909**	19.3
35.1	-0.1	0.0	2.6			**2709**	18.0
34.6	0.0	1.2	4.4			**2709**	20.9

Table 3. Thermal differences between average max temperatures during each phase and the walk phase

Results indicate that the horses presenting higher thermal increases were B, 5609 and 2909 during the longer trial. The two final graphs highlight that environmental temperature influences not only the initial skin temperature of horses but it is also inversely associated to the max temperature recorded during the recovery phase.

Conclusions

Our aim was to verify the possibility of recording properly thermographic videos of sport horses tested on a treadmill and investigate their significance.

We have been successful in creating digital videos thermography of horses on treadmill, using two thermocamera AVIO TVS 500 which is a very sensitive and portable instrument. Videos were taken for the entire duration of tests, from a lateral position and from a dorsal one, and it was possible to evaluate the different skin heating process according to the horse's different gaits.

Next step will be to optimize and standardize the video-thermography technique and study ranges of variation in a larger sample of normal subjects, sound and well trained. The contemporary use of other physiological correlates (such as heart rate variability, blood parameters, echographic images) will allow us to find possible explanations for the thermal anomalies detected.

References

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