PILOT STUDY FOR VALIDATION *IN-VIVO* OF A SUPPORTING DEVICE LIMITING EXTENSION OF THE METACARPOPHALANGEAL JOINT IN SOUND HORSES

4° European College of Veterinary Sport Medicine and Rehabilitation (ECVSMR) Scientific Meeting
July 20-22, 2023, Maisons-Alfort

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BACKGROUND

The flexor tendons and the suspensory apparatus provide resistance to the metacarpophalangeal/ metatarsophalangeal joint during the stance phase of the stride. Injuries to the flexor tendons/ suspensory ligaments are extremely common in athletic horses. In case of severe injury to one of these structures it is extremely important to provide support to the damage structure during the rehabilitation process because damage tissues are less resistant. Therefore, it is essential to avoid overloading of the injured tendon/ ligament still providing reduced mechanical loading, an important stimulus during the reparative and remodelling phase of the healing. *In vitro* data have demonstrated that innovative carbon fiber composite support system (SS-*Fig. 1*) is effective in resisting the extension of the metacarpophalangeal joint. However, the exercise boot has not been validated *in vivo*.

Fig.1. Equestride® boot (https:// www.equestride.com/)

OBJECTIVE

The objective of this study is to evaluate the effect of SS in reducing the extension of the metacarpophalangeal joint (MCPJ) in walk and trot on straight line in sound horses

Fig.2 IMUs arrangement without the SS at baseline

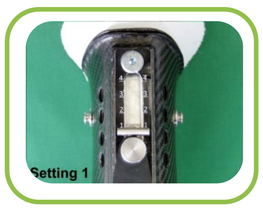


Fig.3 Setting 1 provides only support at full fetlock extension.

Fig.4 Setting 4 provides a significant level of support when the horse is standing

Fig.5 IMUs arrangement over the boot and contra-lateral

MATERIALS AND METHODS

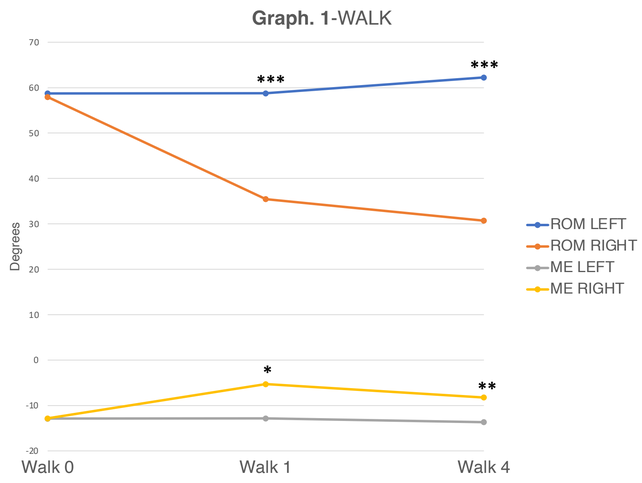
Five sound horses were enrolled in the study. Sagittal plane MCPJ patterns of forelimbs were recorded using 2 inertial sensor measurement units (IMUs) *per* limb (MOVIT system-previously validated with 2-d optical motion capture).
The sensors were placed on the dorsal aspect of the metacarpus and pastern of both front limbs (*Fig.2*) in order to record MCPJ relative angle and range of motion (ROM) without the SS (baseline) at walk and trot on straight line. The SS was applied on the right forelimb using 2 different grades of attenuation of MCPJ extension (1 'minimal'-*Fig. 3* and 4 'maximal'-*Fig. 4*) and IMU sensors put with the same disposition over the SS (*Fig. 5*). The left forelimb (L) was used as control.
A paired T-Test was used to compare L and R range of motion (ROM) and maximal extension (ME) of the MCPJ during 3 different conditions (without SS-baseline, with supporting device with setting 1, with supporting device with setting 3).

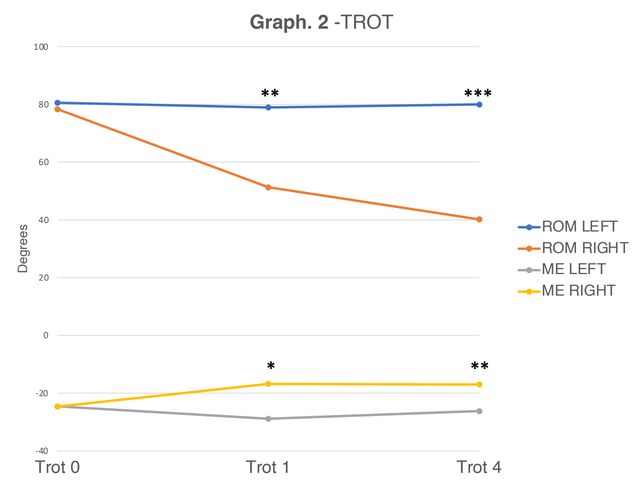
RESULTS

WALK	Baseline		Setting 1		Setting 4	
	L	R	L	R	L	R
ROM	58.7° ± 8.2°	57.9° ±9.1°	58.7 ± 8.8°	35.5±10.1°	62.3° ±6.8°	30.7± 9.9°
ME	-12.9° ±3.0°	12.8° ±2.3°	-12.8° ±4.5°	-5.3± 3.1°	-13.7° ± 3.6	-8.2° ± 4.5

TROT	Baseline		Setting 1		Setting 4	
	L	R	L	R	L	R
ROM	80.6.° ±8.6°	78.4.° ±9.9°	78.9.° ±12.5	51.3° ± 14.4	80° ± 9.1°	40.2 ± 5.3°
ME	-24.6° ±6.2°	-24.7° ±2.0°	-28.9.° ±7.2	-16.8° ± 7.3	-26.2 ± 5.9°	-17 ± 4.4°

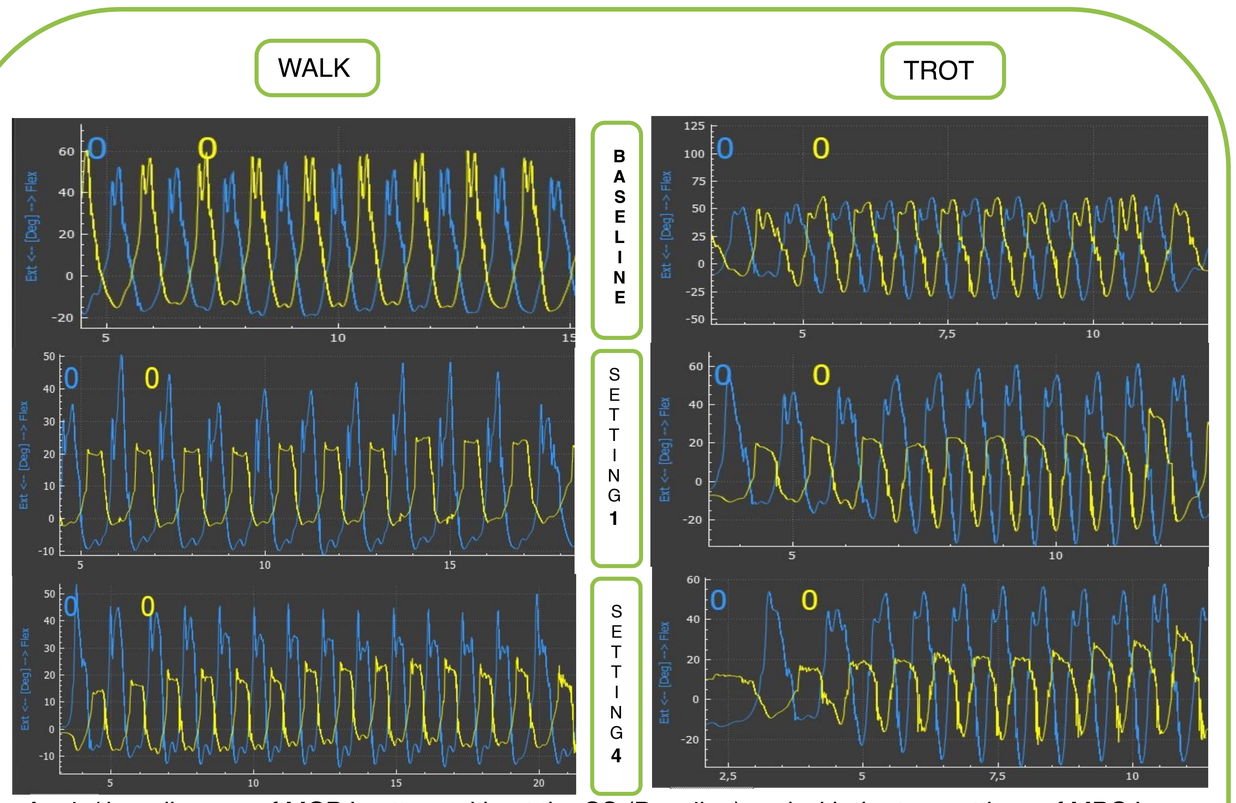
No statistically difference between L and R ROM and ME at trot and walk without the SS was found. **A significant difference was observed in walk for setting 1 for ROM (p<0.001***) and ME reduction (p<0.05*) and setting 4 (ROM p<0.001***; ME p<0.01**) (Graph. 1). Reduction was also significant in trot for setting 1 (ROM p<0.05**; ME p<0.05*) and setting 4 (ROM p<0.001***; ME p<0.05**) (Graph 2).**





DISCUSSION

The preliminary results of this study demonstrated that the SS was effective to limit in-vivo range of motion and extension of the metacarpophalangeal joint in horses moving at walk and trot in straight line.



Angle/time diagram of MCPJ pattern without the SS (Baseline) and with the two settings of MPCJ attenuation on ten consecutive strides. Positive values of angles (°) represent flexion and negative values extension of the MCPJ. MCP joint pattern of the left front is displayed in blue- MCP joint pattern of the right front is displayed in yellow.

REFERENCES

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