# EFFECTS OF CORRECTIVE SHOEINGS ON THE EQUINE SUPERFICIAL DIGITAL FLEXOR TENDON LOAD, EVALUATED BY A NON-INVASIVE ULTRASONIC TECHNIQUE

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## INTRODUCTION

Corrective shoeings are often recommended for tendinitis management, although their effects on tendon tension lack scientific evidence. Previous studies dealing with the quantification of the effects of corrective shoeings on equine tendon loads are indeed few [1,2], mainly because of the difficulty to obtain reliable in vivo data about tendon loads or strains, and because of the invasive nature of the techniques used so far (implanted transducers). A non invasive method to measure tendon loads has been developed [3]. This method is based on the measurement of the propagation velocity of ultrasound (US) in the tendon. It has been demonstrated that the speed of sound (SOS) changes in a logarithmic manner with the load applied to the tendon.

The objective of this paper is to report results of evaluation of the effects of 4 corrective shoes on the equine superficial digital flexor tendon (SDFT) load using this novel non-invasive technique.

## METHODS

Ultrasonic (US) measurements were performed on a group of 4 sound horses (8.5±4.0 years; 501±28 kg) using a dedicated device composed of an electronic battery-powered module (placed on the horse back by means of a saddle) and an ultrasonic probe. The probe is made of 6 transducer elements, one acting as an emitter and the others as receivers. The SOS was measured using the axial transmission method along the long axis of the tendon. Skin facing the right SDFT in the palmar metacarpal area was clipped. The probe was placed in contact with the skin by means of a gaiter.

After preliminary trimming, both front hooves of each horse were equipped with a support shoe (nailed). The standard and corrective shoes to be tested (6° toe and 6° heel elevation on hard ground, reverse shoe and wide toe-narrow branches shoe on soft ground) were successively screwed on the support shoes of both limbs. For each shoe test, a 10 minute habituation was performed then horses were led at the walk along a 30 m long track. Ultrasonic and accelerometric recordings (100 Hz) were repeated 3 times.

For each recording, a mean pattern of SOS was calculated after time normalization by averaging the SOS data over 10 successive strides. Finally, data from the 3 recordings of a shoe test were averaged.

The SOS values at the beginning, the 2 peaks and the end of the stance phase, as well as the corresponding temporal parameters (in % of stride duration) were considered for statistical analysis. An ANOVA was performed to test the effects ($P<0.05$) of the different shoes, each corrective shoe being compared both with the standard shoe and the opposite shoe, on a given ground (toe vs. heel elevation on hard ground, reverse shoe vs. wide toe-narrow branches shoe on soft ground).

## RESULTS AND DISCUSSION

Comparison of the SOS patterns demonstrated that heel elevation and reverse shoe induce a significant increase of both the intensity (about 0.2 to 0.3 N/kg of bodyweight, at the second peak), and the relative duration, of tendon loading during the stance phase (especially propulsion, i.e. second part of the stance), compared with standard shoe. The inverse effects were observed with toe elevation (about 0.2 N/kg of bodyweight load decrease) and, to a lesser extent, with wide toe shoe. In terms of loading intensity, the effects of toe vs. heel elevation on hard ground were more marked than those of wide toe vs. reverse shoes.

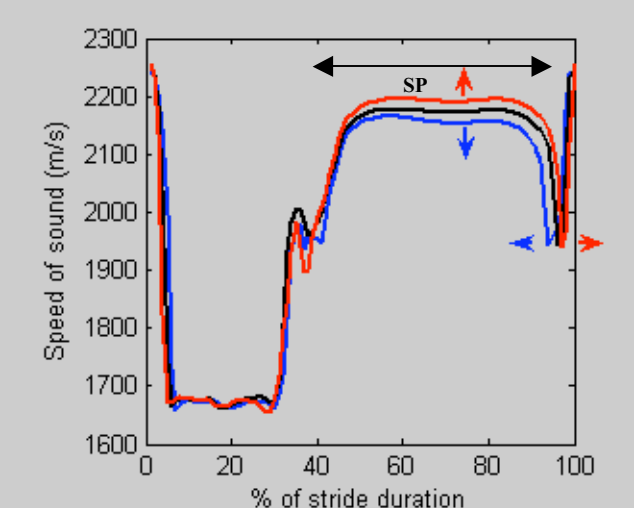


**Figure 1**: Effects of toe (blue) and heel (red) elevation, compared with a standard shoe (black), on the ultrasonic velocity pattern, at the walk on hard ground (SP = stance phase).

## CONCLUSIONS

This study confirms the results reported by the two previous studies [1,2] dealing with the effects of heel/toe elevation on the SDFT loading (increased / decreased tendon tension). It brings new information about reverse shoes and wide toe shoes, more recommended in practice, and tested on soft grounds as those used for training and competition. This study also revealed significant changes in tendon loading duration, induced by the corrective shoeings tested, on both ground surfaces.

## REFERENCES

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3. Pourcelot P, et al.. *J Biomech* in press.