Title: An investigation into the relationship between asymmetrical loading of the stirrups by the rider and hind-limb kinematics of the horse during rising trot.

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Introduction: Asymmetric load upon the horse's back has been identified as a possible cause of back pain and lameness (Gomez Alvarez *et al* 2008). Whilst force measurements under the saddle have been well researched, other force contact point measures, such as the stirrups, have been considered briefly using a strain gauge between the iron and the leather (Van Beek *et al* 2012). Knowledge of the effect of interactive forces between horse and rider on equine movement patterns may provide further understanding of the horse-saddle-rider interaction. The objective of this study is to measure rider asymmetry in stirrup loading during rising trot, and to identify concurrent effects on horse hind-limb kinematics.

Material and methods: A controlled, randomised study using 20 clinically sound horses with single horse/rider combinations capable of achieving satisfactory (6/10) in a Prelim dressage test; thus able to achieve a balanced working trot in unison. Rider stirrup force (SF) was assessed at rising trot on a riding simulator using riders' own saddles, with custom stirrups incorporating a force sensor. Force data (kg) was directly transcribed to a hardwired laptop. Horses were trotted up and ridden during a seperate session in a controlled environment. Skin markers were applied to the dorsolateral hoof of both hind-limbs of the horse. 2D video analysis recorded three trials of trot step cycles in each direction in ridden (R), unridden with tack (UT) and unridden without tack (U) conditions. Peak flight arc (PFA) was assessed using Kinovea software. Symmetry indices (SI) were calculated from means. Data was tested for normality by Kolmogorov-Smirnov test. Pearson's correlation coefficient and two-factor ANOVA tested for interaction between PFA SI and rider SF SI, and differences between SF/PFA measurements.

Results: There were no significant differences between left and right mean, minimum or maximum SF. There were significant differences in PFA between left and right hind-limbs for all three conditions ($p=0.01$), but there was no significant difference between conditions. Most horses (85% (R), 90% (UT) and 75% (U)) achieved a consistently greater left hind-limb PFA. There was a positive correlation between horse PFA SI and rider SF SI ($r=0.5$; $p<0.05$).

Discussion and conclusion: Horses with an increased asymmetry in hindlimb PFA correlated with a greater rider SF asymmetry. As PFA does not change when ridden or unridden, it may be suggested that the horse has some influence on the rider rather than the other way around. Furthermore, the consistently greater left PFA could be highlighting the occurrence of lateral dominance in horses. Additional research is recommended to investigate these mechanisms of asymmetry.

References: Gomez Alvarez, C.B., L.ami, J.J., Moffatt, D., Back, W. and van Weeran, P.R. (2008). Effect of chiropractic manipulations on the kinematics of back and limbs in horses with clinically diagnosed back problems. *Equine Veterinary Journal,* 40(2), pp. 153-156.

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