# The effect of GROUND and RAISED trot poles on hind limb JOINT RANGE OF MOTION in the RIDDEN horse.

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## INTRODUCTION:

Musculoskeletal conditions, affecting joints and muscles of equine athletes, have. Been seen to shorten successful competitive careers. In the unridden horse, ground and raised trot poles have been observed to improve balance and muscular control, and strengthen flexor and core stabilising musculature, as well as increasing limb joint ranges of motion (ROM) (Brown *et al*., 2015). Addition of a rider increases ground reaction forces on the horse's limbs and has an overall extending effect on the back and dorsal muscle chain (De Cocq *et al.*, 2009). Therefore, the aim of this study was to evaluate the kinematics of the femorotibial, tarsus and metatarsophalangeal joints of ridden horses trotting over no poles, ground poles and raised poles.

## METHOD:

Nine horse (mean ± standard deviation; age 9 ± 2 years; height 166cm ± 10cm) and rider partnerships were recruited from the student livery population at Hartpury University. All horses were confirmed sound to be ridden over poles by a veterinarian and ridden by their usual rider. Skin fixed markers were placed on relevant anatomical sites to mark out the femorotibial joint, tarsal joint and metatarsophalangeal joint (Figure 1). Horses were required to trot over no poles (NP), ground poles (GP) and raised poles (RP; 20cm to bottom of pole) in a randomly assigned order to collect 3 clean repetitions. Before starting data collection, horses were warmed up for 10 minutes in walk, trot and canter following their normal routine. Poles were placed at 1.20m ± 0.10m apart in an indoor arena within a marked lane, 25 metres in length and 2 metres wide. Optimum distances between poles were individualised for each participant and confirmed in a practice trial. Two cameras were set up perpendicular, 7.5m from the centre of the lanes to capture strides at 120Hz; see figures 2 and 3. A related-samples Friedman's two-way analysis of variance by ranks test was used to identify significant differences, pairwise Wilcoxon comparisons were also used to explore and locate any significant differences between the range of motion of each joint throughout the 3 exercise conditions.

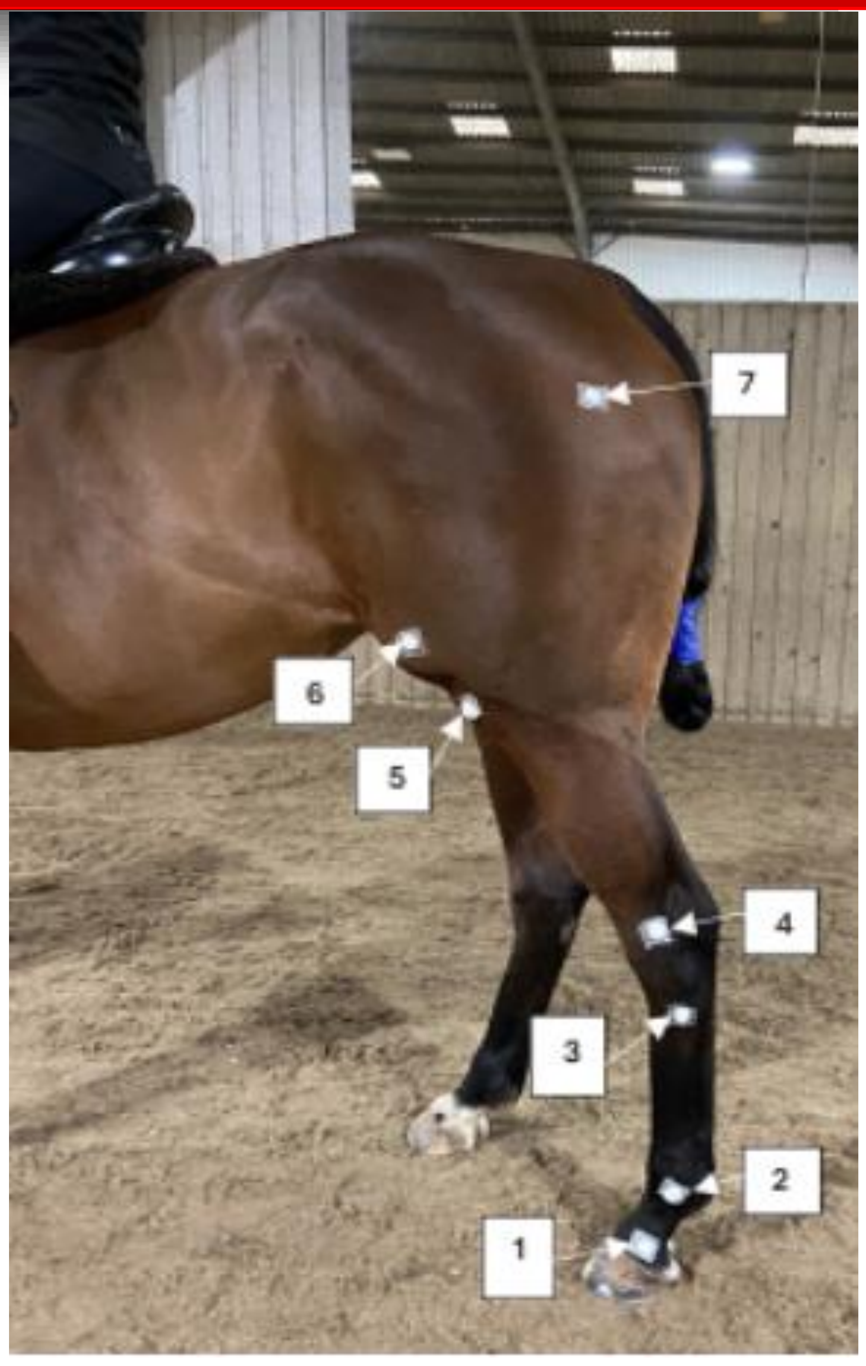


*Figure 1 highlights the skin fixed markers and their placement on the horse.*
*1= lateral collateral ligament of the distal interphalangeal joint (designated coronary band), 2= distal aspect of the third metatarsal bone over the collateral ligament of the metatarsophalangeal joint, 3= proximal aspect of the third metatarsal bone at the junction with the base od the 4th metatarsal bone, 4= mid talus, 5=. Proximal aspect of the fibula, 6. = medial epicondyle of the distal femur, 7 = proximal aspect of the greater trochanter of the femur (placements taken from the Walker et al. paper in 2022.*

*Figure 2 pole and camera distancing*

*Figure 3 shoes lane set up for ground and raised poles*

## RESULTS:

All joints produced a range of motion which significantly increased over GP and RP compared to NP. There was overall a significant ($p<0.05$) but asymmetrical response to the exercise conditions in the ROM of the left and right femorotibial joints based on *post hoc* testing; see Figure 4. The metatarsophalangeal and tarsal joints similarly show significant stepwise increases in ROM between the three conditions across both limbs (p= <0.001; p= <0.001).

*Table 4 shows the mean and standard deviations for the range of. motion for the femorotibial, tarsus and metatarsophalangeal for both the left and right limbs*

| | No poles | | Ground poles | | Raised poles | |
|---|---|---|---|---|---|---|
| | Mean° | Standard deviation | Mean | Standard deviation | Mean | Standard deviation |
| Stifle, left limb | 11.849° | 5.237 | 16.500° | 3.839 | 19.044° | 6.794 |
| Stifle, right limb | 12.956° | 9.973 | 17.978° | 6.199 | 22.078° | 5.327 |
| Tarsus, left limb | 54.967° | 8.368 | 88.056° | 14.277 | 111.122° | 8.163 |
| Tarsus, right limb | 54.044° | 4.705 | 88.078° | 12.490 | 110.978° | 6.339 |
| Metatarsophalangeal, left limb | 48.730° | 10.609 | 58.726° | 10.914 | 71.356° | 12.144 |
| Metatarsophalangeal, right limb | 46.207° | 15.644 | 54.859° | 18.648 | 69.248° | 10.882 |

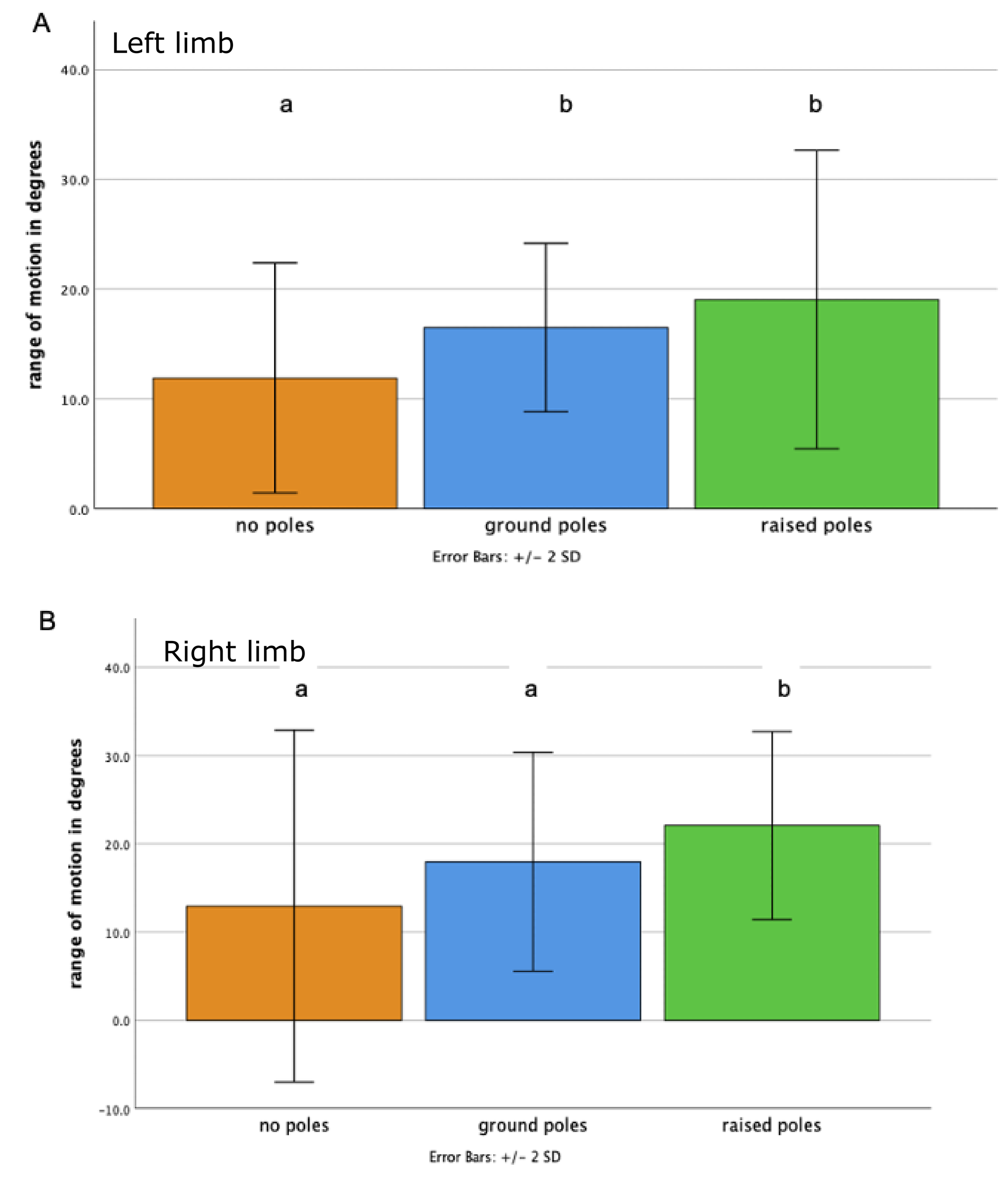


*Figure 4 shows the mean range of motion in degrees, with error bars to determine standard deviation, of the stifle in the left (a) and right (b) limbs over no poles, ground poles and raised poles. Differing letters above the bars denote significant differences at p<0.05.*

## DISCUSSION & CONCLUSIONS:

All results were compared to similar studies in both walk and trot without a rider; as to the authors knowledge to date this is the first study to incorporate the inclusion of a rider. Comparisons indicated that although the trot gait followed the pattern of GP and RP increasing the ROM of the joints compared to NP, the walk gait highlighted higher mean ROM of the femorotibial and metatarsophalangeal joints suggesting that walking over GP and RP is better for improving ROM of those joints. The tarsus joints ROM was seen to be improved more when trotting over the 3 conditions. The results across the two limbs regarding the tarsus and metatarsophalangeal were symmetrical however an asymmetry was identified across the two limbs at the femorotibial joint, this could be linked to the factor that riders completed the trial in rising trot. All 3 joints increase over GP and RP compared to over NP even with the inclusion of the rider; when comparing to other studies conducted in hand in either walk or trot the femorotibial and metatarsophalangeal joint highlight results that show the inclusion of the rider does not improve the ROM of the joints. There is no evidence to suggest that the inclusion of the rider causes a negative impact towards the horse. These results express the safety and efficacy of trot poles during rehabilitation processes for restoring the full ROM of the femorotibial, tarsus and metatarsophalangeal joints even with the inclusion of the rider as the horses approaches to the poles were similar to the unridden horses (Brown et al, 2015; Walker et al, 2022). Future research should make direct comparison of limb kinematics of the ridden and unridden horse over poles and investigate the impact of varied rider weight on joint ROM over poles.

## REFERENCES:

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