Equine calmers can enhance gait quality in dressage through improved engagement.

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Abstract

A relaxed, co-operative performance is important in the dressage horse. A number of equine calmers are commercially available to reduce anxiety in the horse. This study tested the use of the ProKalm supplement (Science Supplements Ltd., U.K.) to increase gait quality and therefore dressage performance in the competition horse, by increasing relaxation. Twenty one horses were tested ridden by their usual riders in two walks, four trots and one canter. Each movement was recorded three times in each direction, giving a minimum of fifteen strides. Subjects were assessed on three occasions each, once without intervention, once with a placebo and once with the calmer. The tests were filmed marker-free in three dimensions at high-speed for biomechanical analysis and simultaneously in two dimensions at 25Hz to allow dressage judges to remotely assess the performance. Results were compared across conditions using a multivariate repeated measures analysis. The placebo had a strong, positive effect on the horse and rider's performance and this was used to give a baseline of inter-trial variability. The calmer tested did not have a significant effect on the biomechanics of either of the walks tested ($P>0.05$). However it was shown to have significant effects on the stride length, metacarpo-phalangeal angles, tibio-tarsal angles and moments, and centre of gravity displacements (all $P<0.05$), and there was a significant increase in the judge's scores ($P<0.05$), above the inter-trial variability suggested by the placebo results. This implies that the horses were more engaged and in dressage terms performing better when taking the calmer supplement.

Introduction

Dressage is a sport where horses compete by performing athletic tasks under the influence of their riders aids. Judges score the performance of set movements, in terms of balance, straightness, impulsion, engagement, submission, accuracy and relaxation. Therefore in order to achieve the highest scores the horse must be relaxed and cooperative, working in harmony with the rider (FEI Handbook, 2012). Movements are scored individually out of ten, and then collective marks are given for the overall impression. These are totalled to give a percentage, with the highest subjective score determining the winner (Lawson and Marlin, in prep.).

Equine calmers are a group of oral supplements used by horse riders to calm the horses' temperament in the hope of increasing rideability and competition performance. These are competition legal, at both a U.K. national and an international level, and have met with varying degrees of success. Many appear to have little rigorous evidence supporting their effectiveness [ref]. One supplement that has been shown to have a significant effect in calming horses' reactions to novel items is ProKalm (Science Supplements Ltd., Newmarket, U.K., [ref]). It was has been assumed that in the case of this supplement, horses were actually more relaxed, both psychologically and at the muscular level. It was therefore hypothesised that horses may display a better quality of gait

when treated with this supplement, as they would engage their hind limbs more. In order to test this theory competitive dressage horses were assessed biomechanically and by two British Dressage Level One dressage judges, whilst on the calmer, whilst on a placebo, and with no intervention; in a double-blinded trial.

Methodology

Ethical approval for the study was given by OSU. Twenty-five competitive dressage horses and ponies (height range 142cm – 170cm, weight range 400-600kg) were volunteered for the trial with their usual riders, from the British Dressage Northern Region. For simplicity the term "horses" is used to refer to the entire horse and pony subject group. All gave informed consent. Horses were kept in their usual training regimes, and were currently competing at British Dressage levels from Novice to Advanced (Table 1). Two of of the riders were para equestrian dressage riders (upper limb amputees), and the remainder were able-bodied, however this was not thought to be relevant to the current study as it did not impact on performance or vary between testing days.

Horse and rider combinations were filmed with no intervention, and then having taken a placebo, and having taken ProKalm in a randomised order. The placebo and Prokalm were both taken for four days each at a dose of 64g/day (effective dosage range given in Table 1) split evenly between two feeds, and the horses were assessed on the fourth day. Each horse was then given sufficient time for the product to wear off before the next testing day. No real feedback was given to the participants and riders during the trial, other than to let them know that the data ad been collected successfully. The authors, judges and participants were blinded throughout the trial.

The assessment was the same on each of the three occasions for each horse and rider. Horses were assessed in their home environment on the same surface each time. They were asked to perform ridden, in this order, a medium walk, free walk, working, collected, medium and extended trot (where established), and a working canter. At each gait, horses were assessed along the long side of an arena for 20 metres three times on each rein. They were filmed with three high-speed cameras (Figure 1), each recording at 300Hz. No markers were attached in order not to interfere with the judging. A camera operating at 25 Hz placed ten metres away from the track on the E-B dissection of the arena, with a side-on view (perpendicular from the sagittal plane) was used to record the dressage judge's perspective.

The films were imported into Matlab where a proprietary automated marker-free tracking code (Addis and Lawson, 2011) used kinematic fitting (Lu and O'Connor, 1999) to calculate skeletal motion. Briefly the following assumptions were used: the edge of the horse's legs can be detected as a gradient change in pixel intensity, movement is essentially biological (i.e. acceleration is smooth) and bones do not change length and joints do not dislocate. Therefore for any set of frames the skeletal position can be deduced from the remaining set of solutions by minimising the total errors at each joint. This technique has been shown to produce high accuracy and resolution results on horses, making it suitable for this type of comparison study (Warlow and Lawson, 2012).

Once the skeletal motion had been calculated, a musculo-skeletal model based on that of Lawson et al., (2007ab) was used to calculate joint angles, stride lengths, tempo and rhythm. As the equine metacarpo-phalangeal joint is passive it is possible to infer internal forces directly without the use of a force plate (McGuigan et al., 2001), allowing the joint moments to also be included. These results were tested against the null hypothesis that the use of the ProKalm supplement did not significantly enhance performance when compared to the placebo, using a multivariate repeated measures analysis (MANOVA), which considered each gait separately.

Where it was considered potentially advisable to do to prevent injury, exercise bandages were permitted on the horse's legs. These however had to be worn or not worn consistently on all three testing days.

Results

Of the 25 participants' 75 testing days, 8 were lost irreparably through cancellations due to injury, ill health and weather conditions. This left 21 participants with complete data sets. Each horse's performance was also scored by two dressage judges, who reported a significant improvement in both the placebo and ProKalm cases, and these results are reported in Lawson and Marlin (in prep a). The effect of the placebo is reported more fully in Lawson and Marlin (in prep b). Sample trial videos are shown in the supplementary materials.

The direction of travel of the horse (left and right reins) did not prove to be significantly different in terms of the effect of the calmer or placebo so these results were pooled. Results for the gaits examined are given in Table 2 and Figures 2-6. The presence of bandages did not significantly increase the variability of the joint angles calculated, implying that they did not affect the measurements taken.

As significant placebo effects were seen in some cases, these data could not be pooled with the non-intervention data. Consistency values were calculated for each horse, by comparing its non-intervention trial with its placebo trial. These were then used to judge whether the effects of the ProKalm had exceeded this horse's normal inter-trial variability. The placebo effect seen was correlated with the horses' training levels, with more novice horses being more susceptible, and as a result a larger ProKalm effect was needed for these horses to show significance beyond their established inter-trial variability.

Straightness and symmetry at the walk and canter was found to be an issue in a number of horses, however this was not significantly affected by the calmer at the population level.

In medium walk and free walk no significant effect of the calmer was found when compared to the variability produced by the placebo. However significant effects were seen at the trots and the canter (Tables 2 and 3). As a secondary check, sample type (ProKalm, placebo or non-intervention) was compared to testing day order for its influence on the data. Testing day was also found to have a significant effect on the horse's performance; however this was mild in comparison to the effect of sample type.

Hind-limb engagement was taken as peak tibio-tarsal angle and hind-limb protraction angle. These were compared across all trots in the three test conditions and peak tibio-tarsal angle was seen to significantly increase in the case of the Placebo (4% ±2%, p=0.04) and the ProKalm (8%±3%, p=0.03). The ProKalm had a significant effect above that of the inter-trial variability suggested by the placebo case in the peak tibio-tarsal angle in the collected trot only. Whilst hindlimb protaction angle did appear to vary between trials, this was not significantly different on the population level (p=0.2). Figure X shows mean hock angle for the collected, working, medium and extended trots, for the three different test conditions for the population as a whole. Figures Ya,b, c, and d show metatarsophalangeal angle profiles for a typical subject for the three test conditions at the four trots.

Metacarpo-phalangeal joint peak angle mildly but significantly increased during stance in the case of the ProKalm condition in the collected (2% ± 2%, p=0.05) and working trots (3%±1%, p=0.03). No significant differences were seen in timing or smoothness of movement of this joint.

Tibio-tarsal joint moments showed that a significantly higher joint moment was being generated at the collected (10% ± 3%, p=0.03) and working trots (9%±3%, p=0.02) and at the canter (6%± 3%) under the ProKalm condition. The horses' centre of gravity displacement also significantly increased in these cases.

As would be expected, stride length varied greatly between subjects, and indeed between testing days, however it was highly consistent intra-trial within an individual pace. For each type of trot, around fifteen strides were analysed and intra-trial variability for peak joint angles was found to be less than three degrees. Stride length was shown to significantly increase in working (7%±2%) and extended trots (9%±4%), and in canter (7%±4%), but not in collected trot. Although some horses showed a significant increase in stride length in medium trot, this was not statistically significant in the population (Figure Z). Speed did not vary significantly between testing days for each pace tested, however tempo (strides/ minute) did change significantly, as this is the corollary of stride length. Variability in tempo decreased with both the placebo and the ProKalm.

Rider position changed significantly between testing days in the total population. There was a mild but significant effect in the trials where a sample (placebo or ProKalm) were used, however there was no difference in the ProKalm testing days as a whole when compared to the existing variation. The minor difference seen appeared to be correlated with the order of the testing days (and was seen between the first and second testing day) and not with the sample used. The judges' scores detected no significant change between rider position and effectiveness on any of the testing days, but a wide difference between riders.

Discussion

The design of this study was in some ways unusual in that all the horses received both the calmer and a placebo, and was also tested without intervention. This allowed the placebo effect to be more thoroughly accounted for, and had the advantage that each subject was being compared only with themselves. This allowed a variety of horses to be tested, without increasing the variability of the

measurements as each horse is compared to its own baseline data. It also meant that any errors that occurred in the overall accuracy of any measurements or calculations were not as influential as the resolution and repeatability of the data. The repeatability of the calculations, and therefore its sensitivity to errors, was shown to be very robust, and is more fully discussed in the paper on the placebo effect seen (Lawson and Marlin, in prep a). The stride lengths, joint angles and moments calculated were in keeping with those previously published for the gaits examined (Clayton, 1999; 2001, Holmstrom et al., 1995).

Significant results were seen for the effect of the calmer at trot and canter, although the effects were the most pronounced at the trots than the canter, possibly partly due to the relative consistency of these paces. The increased peak forelimb metacarpo-phalangeal angle, and rate of flexion seen in the ProKalm case, would imply a more athletic movement as this is a predominantly passive joint. This is directly linked with centre of gravity displacement, which showed the horses displaced their centres of gravity more during the ProKalm trials, literally having more “bounce” to their stride. This may also be a direct result of the increased hind limb engagement suggested by the higher peak hindlimb tibio-tarsal joint angles, which would create more impulsion in the stride.

All the horse-rider combinations in this study were self-selected volunteers for a calmer trial, and hence it is likely that the riders all suspected that their horses had issues with anxiety or a lack of relaxation. The most significant results in stride length change were seen at the extended trot, and it is likely that this is due to this pace requiring increased relaxation and ground cover, making it more likely for tension to affect performance and balance. The largest differences at medium trot were seen in the horses that did not have an established extended trot. This would suggest that the horses benefitted more noticeably from the calmer when tested nearer the boundaries of their current training and abilities. This would also fit with the finding that the novice horses showed a more pronounced effect from the ProKalm than the advanced horses, despite also being more susceptible to the placebo effect (and therefore needing a larger difference to show significance over the existing variability).

The lack of a significant effect at the free walk was surprising. It was assumed that the increased ground cover and relaxation that this requires would make it the most revealing of the movements tested. However it was also the most variable of the movements and seemed to be the most susceptible to inter-trial variability.

A large range of equine sizes, abilities and temperaments were used, along with a range of rider experience and ability. This was not thought to be a large limitation as the study is comparative, with each horse or pony being compared only with itself. However this does mean that each horse experienced a different effective dosage of the supplement, and each horse had a different starting level of tension which will have increased the variability of the results.

It would be interesting to return to the subjects in future to test the intra-subject repeatability of the effects seen. Whilst this was not explicitly tested, in those subjects that did not experience a strong placebo effect, the data was highly consistent from the no-intervention testing day to the placebo testing day. The criteria “subjects that did not experience a placebo effect” of course introduces a selection bias of those subjects that were consistent, however it is notable that this

consistency was correlated with the sample taken (placebo versus ProKalm) and not with testing day order. This is particularly surprising given that the data were mainly collected shortly before the U.K. national championships and as a result many horses were under an intense training schedule. Similarly, whether through nerves or training, testing day order did appear to have a mild but significant effect on the riders' positions.

In this study we have shown that equine calmers may assist in dressage training, and further many have a performance enhancing quality. Currently the National and International federations have no objections to the use of the substance tested as psychological aid for potential nervousness in the horse. Only one calmer has been tested here, and without knowing the contents of the product it is not possible to extrapolate the results or to estimate whether other products are likely to produce a similar effect on gait quality in nervous horses. The horses used were all fit for competition, and the effect of the calmer tested on injuries or muscle tension due to secondary compensation have not been examined. It is, however, likely that the increased engagement suggested by the results here would be equally beneficial in other equine sports such as show-jumping.

Competing Interests

This study was partly funded by Science Supplements Ltd.