Effect of surface and predominant direction of training and racing on movement symmetry and hoof shape in racing Thoroughbreds

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Racehorses regularly perform under conditions that put their body under high loads: forces of up to 2.5 times their own body weight need to be supported by each forelimb during maximum speed gallop. When running around curves, as performed regularly during training and racing, even higher forces are produced to negotiate the bends; this has been linked to horses sustaining injuries.

Measuring force during high-speed exercise is difficult and prohibitively time consuming in large numbers of horses. Small accelerometers, similar to what is found in modern SmartPhones, can provide insights into which limb(s) produce(s) increased/decreased force. We propose to use these sensors – attached to head, withers and pelvis – for studying movement asymmetries (and hence force imbalances) in horses predominantly training/racing in a particular direction. The measured parameters document force imbalances between the two fore- and/or the two hind limbs and also indicate whether force imbalances are related to supporting the body weight ("impact") or to pushing the body off the ground ("pushoff"), two fundamental limb functions repetitively undertaken by each limb during each stride cycle.

Preliminary data from two cohorts of Thoroughbred racehorses training/racing predominantly in one direction (clockwise: The Hong Kong Jockey Club; anti-clockwise: Singapore Turf Club) indicates direction-specific movement adaptations. Here, we propose to make use of: 1) published relationships between movement symmetries of different anatomical landmarks, 2) published relationships between specific movement parameters and weight bearing/pushoff imbalances on different surfaces and 3) changes in hoof shape between inside/outside limbs to provide insights into limb loading difference experienced during curve-running between the inside/outside limbs, crucial information for optimizing performance while minimizing load differences between pairs of limbs.

First, we will gather additional evidence about movement symmetry in Thoroughbred racehorses training/racing in a specific direction. Second, we will document hoof shape differences between pairs of limbs. Third, we will link specific hoof shape differences to movement symmetries (and force imbalances) during circular movement and on different surfaces. To achieve this, movement symmetry will be assessed during straight-line and circular movement on different surfaces with accelerometers attached to head, withers and pelvis. Hoof shape will be measured with a camera-based method (SmartPhone). Links between hoof shape and movement asymmetry will be compared between different surfaces which are known to alter impact/pushoff force allowing us to understand the biomechanical relevance of changes in hoof shape and their role for balancing the forces between the inside and outside limbs.

The study, in particular the link between hoof shape and movement (and hence force) asymmetry between inside and outside limbs, is essential for understanding the biomechanics of horse predominantly exercising in a specific curve direction. Hoof shape provides an insight into the natural, 'medium to long term' adaptations of these horses. Understanding these will provide practically relevant information for devising optimized trimming and shoeing regimens for horses exercising in a specific direction, balancing the loads between the limbs. Future studies can then investigate the influence of these regimens on injury rates and performance.