

POLYURETHANE HORSESHOES MODIFY HOOF-GROUND INTERACTION.

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Introduction

Lameness is the most important cause of wasting in sport horses. Joint injury and joint diseases are the most common causes of lameness, and together they represent a major part of the caseload for equine clinicians. Immediately after initial ground contact, vertical landing forces rapidly decelerate the hoof and horizontal braking forces reduce the speed of the limb to zero. This phase is called the impact phase, which is considered to be the most critical part of the stance phase for developing injuries of the musculoskeletal system. Even under normal physiological conditions, repetitive impact loading may lead to articular cartilage degeneration and even later to development of osteoarthritis. The vibrations generated in the horse's limb during each impact are attenuated while they are transmitted proximally. The relative contribution of the different structures in the horse's lower limb to the damping of impact vibrations has not yet been clarified. Special shoeing types are thought to dampen these vibrations and horses with signs of pain in the distal portion of the forelimb and shod with orthopaedic damping shoes appear to trot more comfortably. Polyurethane shoes are also believed to dampen impact vibrations, although experiments to assess the effects of orthopaedic shoeing on impact vibrations have only been described in individual horses. The purpose of this study was to quantitatively compare hoof impact of the forelimb in a group of horses under different shoeing conditions.

Materials and methods

Twelve sound warmblood horses were trotted by hand on an asphalt track at a mean speed of 3.5m/s under three shoeing conditions (unshod, traditional steel shoes and polyurethane shoes (Hippoflex®) in a latin square design. A tri-axial accelerometer was fixed on the lateral hoof wall of the left forelimb (Fig. 1) to record hoof acceleration/ deceleration at impact in three directions at a sampling frequency of 10kHz. The maximum amplitude of vertical and horizontal forward/ backward acceleration at hoof impact was calculated from the acceleration-time curves and was statistically compared under the different shoeing conditions at a significance level of $p < 0.05$.



Results

The variability of the maximum deceleration between horses and also in subsequent stride and trials was large. Mean maximum deceleration amplitude (\pm s.d.) in vertical direction for unshod, steel shod and polyurethane shod condition was 504 ± 219 , 688 ± 293 and 343 ± 251 m/s^2 and in the forward/backward direction 202 ± 124 , 206 ± 77 and 105 ± 63 m/s^2 respectively. The maximum amplitude in vertical- and forward/backward-direction of the polyurethane shoe was significantly lower compared to the other two conditions ($p < 0.05$). Differences between steel shod and unshod condition were not significant. The vibration duration was significantly shorter in the unshod condition (72 ± 40 ms) compared to the steel shod (135 ± 70 ms) and Hippoflex[®] shod (140 ± 67 ms) condition ($p < 0.05$).

Conclusion

Horses shod with HippoflexR shoes experience lower vertical impact peak vibrations, with less friction than in the steel shod and unshod condition. In fact, HippoflexR shoes show more damping in the vertical and more sliding in the horizontal direction. Steel shod condition comes close to the natural unshod condition. Attenuation of vibrations is better in the unshod condition compared with the other two conditions. What the long-term effects of polyurethane shoes are and whether modification of impact by orthopaedic shoeing prevents osteoarthritis needs further investigation.

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