

THE HORSE-RACETRACK INTERFACE: INFLUENCE OF TRACK SURFACE

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Musculoskeletal injuries are a substantial problem in racehorses. Lameness in racehorses is the leading cause of training failure, racehorse wastage, and turnover, with non-fatal musculoskeletal injuries occurring in 2.2-3.3 horses/per 1000 starts-this does not include injuries that occur during training.^{1,2} Fatal musculoskeletal injury (FMSI) rates of 1.2-1.7/1000 starts have been reported in Thoroughbred horses racing in North America^{1,3,4} and account for 70-80% of all deaths that occur at racetracks.⁵ Therefore, musculoskeletal injuries have a significant impact on the racing industry due to concerns over horse welfare, jockey safety, economic loss, and the negative impact that these injuries have on the public perception of the sport. Multiple epidemiological studies have been performed to identify risk factors for musculoskeletal injuries in racehorses, and as can be expected many of these studies have conflicting results. However, multiple studies have identified the following risk factors for developing FMSIs: horse characteristics (age > 4 years, males, pre-existing suspensory desmitis, toe grabs > 2mm high, under-run heels, having lameness detected on pre-race veterinary inspection); racing and training characteristics (increased race length, increased field size, claiming races, recent lay-up, and recent increase or decrease in training intensity); and track surface characteristics (firm footing, inconsistent footing, surface type).^{2,3,6-14}

When comparing racing surfaces worldwide, flat races run on turf have the lowest FMSI rates (0.38-0.57/1000 starts), followed by synthetic (aka "all-weather") surfaces (0.72-1.47/1000 starts), and then dirt surfaces (1.7-2.03/1000 starts).^{1,3,4,9,15-18} Though the actual numbers do vary, almost all studies have found this relationship of injury rate and surface type to be consistent. However, closer inspection of the results from different studies shows that while the FMSI rate of turf courses worldwide is fairly consistent, those of synthetic and dirt surfaces have more variation. It appears that synthetic surfaces have a very low FMSI rate for the first few years after their construction, with the FMSI rate decreasing by as much as 65% for the first meet after the change from dirt to a synthetic surface.^{17,18} However, as time goes on the FMSI rates on synthetic surfaces appears to increase, although they still remain below those of dirt surfaces. Recent data from the Jockey Club shows that overall, tracks that have changed from a dirt surface to a synthetic one have decreased the FMSI rate by 28%.¹⁷ This attrition has been suggested to be due to breakdown of the oils and waxes that are used to coat the synthetic surfaces, causing them to be less effective at draining water from the surface of the track down to the deeper layers of the surface. Additionally, breakdown of these substances also appears to make the synthetic surfaces more sensitive to changes in temperature. The FMSI rate of dirt surfaces also varies from track to track, which is proposed to be due to track maintenance issues such as providing adequate drainage and maintaining a consistent surface. And while it appears that synthetic surfaces are safer than dirt, it should be noted that when synthetic surfaces have replaced turf courses the FMSI rates have increased, again suggesting that overall turf courses appear to be the safest surface type.¹⁶

In addition to the differences in the FMSI rates between racing surfaces, the types of musculoskeletal injuries seen in horses training and racing on different surfaces also varies. Horses training on dirt tracks are at an increased risk of developing dorsal metacarpal disease when compared to those training on turf or wood chip tracks.¹⁹ Lateral condylar fractures of MC/MT3 are the most common type of FMSI seen in horses racing on dirt or turf tracks, whereas biaxial sesamoid fractures are the most common FMSI seen in horses racing on synthetic surfaces.^{11,15} Preliminary results of a study evaluating differences in scintigraphic findings in horses training on different surfaces suggests that horses training on synthetic surfaces have a decreased rate of stress fracture formation (Michael Ross, personal communication).

In order to better understand the differences seen in FMSI rates and injury types between different racing surfaces, and to hopefully help prevent these injuries from occurring, studies evaluating the horse-racetrack interface are being undertaken with increasing frequency. These studies generally measure either the force (N) or acceleration (gs) the foot experiences when hitting a specific surface at the trot, gallop, or breeze. Ground reaction force (GRF), classically measured with force plates, can now be measured in a real-world setting using a 3-dimensional dynamometric horseshoe. Acceleration is measured using accelerometers mounted onto the dorsal hoof wall and can be used to calculate peak acceleration at each phase of the stride, temporal stride parameters, and impact injury scores. Most of these types of studies are in the preliminary phase, with low numbers (n = 3 or 4) of horses being tested in each trial, with the largest study of this type testing 11 horses.²⁰ However, some trends with regards to track surface are becoming apparent. Using a triaxial accelerometer, Ryan et al. found that the highest impact acceleration experienced while breezing on a turf surface occurred at the initial impact of the foot with the ground, and this peak impact lasted for a relatively short period of time.²¹ Conversely, they found that the highest impact acceleration experienced while breezing on a dirt surface occurred at takeoff, and lasted for a relatively longer period of time. When comparing a synthetic surface to a sand track in French trotters at a fast trot, Chateau et al. found that a lower GRF and peak acceleration on the foot, and lower force on the superficial digital flexor tendon was seen with the synthetic surface.²²⁻²⁴ That study also showed that trotting on a synthetic surface decreased the stride length, which led the authors to conclude that synthetic surfaces had a dampening effect on the foot, which could be responsible for their apparent safety; however, this also appears to make them a somewhat inefficient surface. Setterbo et al. showed similar results when comparing all 3 surfaces; the lowest accelerations, GRFs, and loading rates were seen in horses cantering on a synthetic surface.²⁵ Studies of this type show great promise for helping understand differences between track surfaces; however, a much larger number of horses need to undergo such tests in order to definitively determine what these differences are and how they affect the development of FMSIs.

We are currently performing a study using a wireless data acquisition system (WDAS) containing a triaxial accelerometer and gyroscope (to measure angular velocity) to investigate differences in acceleration profiles and impact injury scores generated in Thoroughbred racehorses exercising at high speeds over various types of racing surfaces.²¹ The WDAS is a lightweight (~150 g) device that is glued onto the left front dorsal hoof wall. Thoroughbred horses in active race training are used. Horses are breezed over a dirt track, a synthetic surface, and a turf surface sequentially in a randomized fashion. Speed is monitored by use of a radar gun, and 10 seconds of data is recorded for each surface using a remotely controlled trigger. Variables measured include peak acceleration at impact, break-over, and take-off; temporal stride parameters, and angular velocity. This study is ongoing, but preliminary results suggest that track surface does appear to affect the peak accelerations experienced as well as temporal stride parameters of horses at a breeze.

References:

- Peloso JG, Mundy GD, Cohen ND, et al: Prevalence of, and factors associated with, musculoskeletal racing injuries of Thoroughbreds. *J Am Vet Med Assoc* 204:620-626, 1994.
- Cohen ND, Dresser BT, Peloso JG, et al: Frequency of musculoskeletal injuries and risk factors associated with injuries incurred in Quarter Horses during races. *J Am Vet Med Assoc* 215:662-669, 1999.
- Hernandez J, Hawkins DL, Scollay MC. Race-start characteristics and risk of catastrophic musculoskeletal injury in Thoroughbred racehorses. *J Am Vet Med Assoc* 218:83-86, 2001.
- Estberg L, Stover SM, Gardner IA, et al. Relationship between race start characteristics and risk of catastrophic injury in Thoroughbreds: 798 cases (1992). *J Am Vet Med Assoc* 212:544-549, 1998.
- Johnson BJ, Stover SM, Daft BM, et al: Causes of death in racehorses over a 2 year period. *Equine Vet J* 26:327-330, 1994.
- Parkin TDH, Clegg PD, French NP, et al. Horse-level risk factors for fatal distal limb fracture in racing Thoroughbreds in the UK. *Equine Vet J* 36:513-519, 2004.
- Parkin TDH, Clegg PD, French NP, et al. Race- and course-level risk factors for fatal distal limb fracture in racing Thoroughbreds. *Equine Vet J* 36:521-526, 2004.
- Hill AE, Stover SM, Gardner IA, et al. Risk factors for and outcomes of noncatastrophic suspensory apparatus injury in Thoroughbred racehorses. *J Am Vet Med Assoc* 218:1136-1144, 2001.

Cruz AM, Poljak Z, Filejski C, et al. Epidemiologic characteristics of catastrophic musculoskeletal injuries in Thoroughbred racehorses. *Am J Vet Res* 68:1370-1375, 2007.

Boden LA, Anderson GA, Charles JA, et al. Risk factors for Thoroughbred racehorse fatality in flat starts in Victoria, Australia (1989-2004). *Equine Vet J* 39:430-437, 2007.

Stover SM. The epidemiology of Thoroughbred racehorse injuries. *Clin Tech Equine Pract* 2:312-322, 2003.

Williams RB, Harkins LS, Hammond CJ, et al. Racehorse injuries, clinical problems and fatalities recorded on British racecourses from flat racing and National Hunt racing during 1996, 1997 and 1998. *Equine Vet J* 33:478-486, 2001.

Cohen ND, Mundy GD, Peloso JG, et al: Results of physical inspection before races and race-related characteristics and their association with musculoskeletal injuries in Thoroughbreds during races. *J Am Vet Med Assoc* 215:654-661, 1999.

Balch OK, Helman RG, Collier MA: Underrun heels and toe-grab length as possible risk factors for catastrophic musculoskeletal injuries in Oklahoma racehorses. *Am Assoc Equine Pract* 47:334-338, 2002.

Parkin TDH, Clegg PD, French NP, et al. Risk of fatal distal limb fractures among Thoroughbreds involved in the five types of racing in the United Kingdom. *Vet Rec* 154:493-497.

Carke AF. Review of safety of turf versus non-turf (synthetic and dirt) racing surfaces. *Am Assoc Equine Pract* 55:183-186, 2009.

Anon. Welfare and safety summit on track injury statistics revised. HYPERLINK "<http://www.graysonjockeyclub.org/aboutDisplay.asp?section=12&story=327>" <http://www.graysonjockeyclub.org/aboutDisplay.asp?section=12&story=327>. Accessed on April 27, 2010.

Finley B. Ground control. The (real) truth about synthetic surfaces. *Thoroughbred Daily News Magazine* Winter 2010.

Moyer W, Spencer PA, Kallish M. Relative incidence of dorsal metacarpal disease in young Thoroughbred racehorses training on two different surfaces. *Equine Vet J* 23:166-168, 1991.

Cruz AM, Thomason J, Bignell. Effect of exercise surface on the hoof-track interaction in Thoroughbred racehorses. *Proc 2007 American College of Veterinary Surgeons Forum, Chicago, IL*, pp 7.

Ryan CT, Dallap Schaer BL, Nunamaker DM. A novel wireless data acquisition system for the measurement of hoof accelerations in the exercising horse. *Equine Vet J* 38:671-674, 2006.

Chateau H, Robin D, Falala S, et al. Effects of a synthetic all-weather waxed track versus a crushed sand track on 3D acceleration of the front hoof in three horses trotting at high speed. *Equine Vet J* 41:247-251, 2009.

Robin D, Chateau H, Pacquet L, et al. Use of a 3D dynamometric horseshoe to assess the effects of an all-weather waxed track and a crushed sand track at high speed trot: Preliminary study. *Equine Vet J* 41:253-256, 2009.

Crevier-Denoix N, Pourcelot P, Ravary B, et al. Influence of track surface on the equine superficial digital flexor tendon loading in two horses at high speed trot. *Equine Vet J* 41:257-261, 2009.

Setterbo JJ, Garcia TC, Campbell IP, et al. Hoof accelerations and ground reaction forces of Thoroughbred racehorses measured on dirt, synthetic, and turf track surfaces. *Am J Vet Res* 70:1220-1229, 2009.