Review of Safety of Turf Versus Non-Turf (Synthetic and Dirt) Racing Surfaces

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Turf, compared with non-turf (dirt and synthetic) surfaces, seems to have been largely overlooked in the search to improve the safety of racing. As societal and litigious pressures mount to improve the safety of racing for horses and jockeys alike, the inherent safety of turf compared with non-turf racing surfaces warrants greater consideration by racing administrators, veterinarians, and researchers, because the new generation of synthetic racing surfaces and the old generation of dirt racing surfaces have failed to match the safety performances of the best turf racing surfaces. Author's address: Equine Connections, 60 Regent Street, Belmont, Victoria 3216, Australia; e-mail: aclarke@equineconnections.com.au.

1. Introduction

Under headlines such as "Surface Wars," there has been vigorous debate in the international racing media and veterinary circles regarding the impact of a new wave of synthetic racetrack surfaces on the incidence of musculoskeletal injuries and rates of fatalities for horses competing on these surfaces. Early results from North America indicate that the new synthetic surfaces are safer than dirt racing surfaces. However, the most recent results continue to show that neither dirt nor synthetic surfaces are as safe as turf.

The "inherent safety"[1] of the turf racing surface seems to have been overlooked with the recent focus on synthetic and all-weather racing surfaces. Furthermore, the synthetic or all-weather surfaces have been described as a "double-edged sword," because there is evidence that new, different, and equally life-threatening injuries occur with horses that race and train on synthetic surfaces. These new and different injuries are reflected in different patterns of fractures and injuries seen with horses racing on non-turf compared with turf surfaces. In addition, there are indications that training on a synthetic surface and subsequently racing on a turf surface may have an impact on the injuries sustained.

The aim of this paper is to compare the safety of turf versus non-turf racing, to highlight the inherent safety properties of turf racing surfaces, and to address the need to focus more emphasis on the impact of training and racing surfaces, because training surfaces seem to have an impact on the race-day safety of racehorses.

2. Turf Versus Non-Turf Racing Surfaces

One of the most comprehensive comparative studies of the impact of racing surfaces on fatal racing injuries was published in 2004 by Parkin et al.[1] The paper is entitled "Risk of fatal distal limb fractures among Thoroughbreds involved in the five types of racing in the United Kingdom."[1] The types of fractures were assessed using radiographic and postmortem examinations, and the incidence and types of fractures were examined in relation to the differ-

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ent types of racing and racing surfaces. There were several key findings of this study.

- In flat racing, the risk of fatal injury on turf (0.38 per 1000 starters) was about one-half of that on all-weather racing surface (0.72 per 1000 starters).
- A different pattern of fractures was seen with horseracing on turf compared with those racing on all-weather surfaces. The relative risk of biaxial sesamoid fractures on all-weather surfaces was 9.89 times higher than the risk on turf. A similar pattern of injuries and an increased risk of injuries associated with non-turf (dirt and synthetic surfaces) surfaces have been previously reported in North America.[2,3]
- It is possible "that the all-weather courses in the UK have become less safe."[1] The rates of overall fatalities reported when two all-weather racing surfaces were relatively new in 1989 showed the all-weather surfaces had a lower fatality rate compared with turf; however, a similar study carried out ~10 yr later found all-weather surfaces to be less safe than turf.[1]
- The results suggested that factors such as the way the hoof interacts with the ground during racing are critical in understanding the different incidence and different patterns seen with turf compared with non-turf racing surfaces. Parkin et al.[1] summarized the hoof/ground interaction as follows: "when impacting on a non-turf track, the hoof slides further before stopping, increasing the degree of fetlock extension as the leg becomes the predominant weight-bearing limb, placing greater strain on the suspensory apparatus."[1]

The improved safety of turf compared with non-turf surfaces has also been reported in Hong Kong-based studies where the fracture and breakdown rate during racing on the all-weather racing surface is almost double that seen on the natural turf surface.[4] An American case-controlled study carried out in New York reported a decreased risk of injury with racing on turf surfaces compared with non-turf surfaces.[5] A study of 15 yr of statistics from horse racing in Victoria, Australia, where turf was the only racing surface available, also reported fatality rates considerably lower than those in jurisdictions such as in North America where non-turf surfaces are more commonly in use.[2,6–9] In these studies, the reported fatality rate was 0.44 horses per 1000 starters on turf tracks in Australia compared with rates of between 1.4 and 1.7 fatalities per 1000 starters in the United States where the primary racing surfaces are not turf.[2,6–9]

A further insight into the comparative safety of turf and synthetic tracks has been provided with the introduction of synthetic racing surfaces in Australia. There has been one such track commissioned in the state of Victoria, in the city of Geelong, in 2007. The overall rates of fatality of horses racing on this track have been significantly higher than those previously observed on turf tracks in the state. A review of stewards' reports and racing results from this new synthetic track shows a fatality rate of 2.0 fatalities per 1000 starters. Citing concerns related to the deterioration of performance and apparent increased risk of fatalities on the synthetic racing surface, Racing Victoria, the body charged with governing racing in the state, placed a 2-yr hold on planned installation of additional new synthetic tracks in the state effective as of April 2009. In May 2009, Racing Victoria announced that while training would continue on the present synthetic track, there would be no further racing held on the track for ~1 yr until significant maintenance and upgrades were completed. Declines in the safety of several synthetic tracks with increases in injuries and fatalities have also been reported in North America. The exact reason for this problem is not clear, but it seems that the problems start as the fiber and/or wax deteriorates and can also involve drainage. These unforeseen maintenance requirements have lead to increases in operating costs and decreases in safety of horses and riders that have not been previously considered in the cost-benefit analyses of synthetic tracks. Much remains to be learned regarding the maintenance and management of synthetic tracks.

Although the increased rate of fatalities as reported on the synthetic track in Victoria is preliminary and requires further investigation, it is consistent with the most recently reported fatality rates for North American tracks: 1.47 fatalities per 1000 starts for synthetic surfaces and 2.03 fatalities per 1000 starts for dirt tracks.[3] Based on these figures, it can be seen that the move from dirt to synthetic tracks improves safety in North America, whereas the move from turf to synthetic tracks in Victoria decreases the safety for horses and jockeys alike.

Turf racing surfaces are not necessarily a panacea to lower the risks of injury and fatality in their own right. There has been one North American study that showed turf racing to be less safe than non-turf racing.[7] The quality of turf surfaces seems to be critical in this context and can affect the injury rate. For example, one study from Singapore reported a one-third decrease in total injury rate when racing moved from a turf track that consisted of "cow grass grown on a layer of fine sand which was, in turn, on top of yellow earth" to a new natural engineered profile turf (EPT)[a] track.[10]

3. Engineered Profile Turf

The engineered profile turf (EPT) natural turf track is a long-life, all-weather, low-maintenance, turf technology that incorporates mesh elements into the growing medium. The EPT technology has been in use for 18 yr in racing jurisdictions in Australia,

Hong Kong, and Singapore. Today, these tracks have some of the lowest rates of race-day fatalities and injuries of horses in the world.[4,6,10,11]

The rate of fatalities on the EPT track in Hong Kong is approximately one-half that observed on the non-turf, all-weather surface.[4,12] Fatality rates reported in Hong Kong like those in Australia where the EPT system is in use are also lower than those recorded in other jurisdictions such as in North America where racing takes place on dirt and non-EPT turf tracks.[2]

The incorporation of mesh elements[b] into the growing medium of the EPT system creates a hard-wearing, durable surface that has hosted up to 65 all-turf meetings in 1 yr. The drainage allows for the provision of optimal racing surfaces in the widest range of weather conditions. Loss of drainage capacity as the root zone compacts is one of the main factors that limits the longevity of turf tracks. In the case of traditional turf tracks, the lifespan of the track is between 7 and 15 yr, whereas, in the case of the EPT system tracks, the lifespan has been projected out to 30 yr. Currently, the EPT track in Victoria is 14 yr of age, and the track in Hong Kong is 18 yr of age. Variations in compaction and drainage also create inconsistencies in track surface, which are especially disliked by the wagering public whose funds are required to generate the revenue that drives the industry.

The critical factors for those involved in the selection of track surfaces and types are proven track records for performance and measurable criteria to assess this performance. In this context, the following performance specifications are provided for EPT system tracks, and they can be used as a template for the objective assessment of track performance (the following list is reproduced with permission of StrathAyr Pty Ltd.).

1. The system profile shall maintain a drainage rate (hydraulic conductivity) exceeding 100 mm/h in the field as measured by using a double-ring infiltrometer.
2. The surface shall maintain its resiliency, yet be firm under all conditions over the entire track as measured by using a 2.25-kg (4.96 lb) Clegg Hammer dropped from a 450-mm height. The system profile shall maintain its capability to register a 2.25 kg (4.96 lb) Clegg Hammer range between 50 and 100 gravities under all weather conditions.
3. The system below the grass turf shall not exhibit degradation under usage, subject to appropriate and necessary maintenance practices.
4. The root-zone profile of the system shall maintain a field capacity moisture content (when tested 1.5 h after irrigation) of between 15% and 20% at the sand surface over the whole track.
5. The system shall maintain an observed resistance to divots and rapid recovery from divoting relative to the performance of a standard United States Golf Association (USGA) sand profile. Divot recovery shall be at least 15–50% quicker (depending on time of year) than the standard USGA profile.
6. The system shall withstand the passage of heavy vehicles and the placement of special events equipment and structures, and it will successfully recover without rutting into the surface over the whole track. The system shall retain sufficient resiliency to absorb and recover after impact from sports players, machinery, or vehicles. Recovery from loading up to 250 kPa should be >50% in accordance with a plate-load test.

Where relevant, all measurements are in accordance with procedures supplied in a monitoring performance document.

4. Track Condition

Hardness is also a factor that is critical in the installation and management of both turf and non-turf racing surfaces. Internationally, track condition has been shown to be a significant risk factor of fatality or injury of racehorses during races.[11,13–17] Two British studies have shown that the rate of injury of racing horses increases as the track surfaces become harder.[1,17] It has been proposed that the greater risk of injury on a firm track is most likely caused by the greater ground resistance and the increased stress being placed on limb bones during repetitive loading.[15] Variations in the drainage and hardness exist between different turf tracks, and with tracks with high drainage rates, it can be difficult to produce a good racing surface even when irrigation is available.

5. Impact of Training Surfaces

As the research focus on race-day injuries is broadened, training regimens and training surfaces are being subject to increased scrutiny. The impact of training tracks on race-day safety is exemplified in the results published by Osborne et al.[4] The study found that turf racing was safer than all-weather racing; however, the injuries observed were predominantly sesamoid fractures, which probably reflected the "intensive use of the all-weather track for training, and less so for racing."[4] This observation adds weight to the potential importance of continuity of surfaces used for racing and training. At the very least, it highlights that advancements in the safety of racing require close scrutiny of both the racing and training surfaces and the potential interaction(s) between both.

6. Summary

In summary, turf racing surfaces have historically provided the benchmark in terms of being the safest

racing surface for horses and jockeys alike. The initial results attained with the new generation of synthetic tracks indicate that these surfaces are in general terms less safe than a turf surface. The safety of turf racing can be impacted by the quality and hardness of the turf surface. Maintenance issues and deterioration of non-turf surfaces are emerging issues for the new generation of synthetic racing surfaces. Additional research is required to examine risk factors for race-day injuries associated with training surfaces in their own right and the interactions between the different types of training and racing surfaces. At the end of the day, the challenge for those developing the new generation of synthetic surfaces is to perfect a surface that matches the safety performance of the best of natural turf surfaces. It remains to be seen if this challenge can be achieved. Likewise, those charged with the administration of racing and the selection and installation of racing surfaces will need to look more closely at the inherent safety of turf versus non-turf racing surfaces, taking into account the increasing societal and litigious pressures for safer racing for horses and jockeys alike.

References and Footnotes

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[b]Reflex Mesh, StrathAyr Pty Ltd., 70 Tea Tree Road, Richmond, Tasmania 7025 Australia.