Aetiology and Epidemiology of Racing Injuries An Australian Perspective

By John Kohnke BVSc RDA
Sydney, Australia

Introduction

Over recent years, there has been much more concern on the influence of track design and surfaces which can influence the numbers and types of injury in racing greyhounds. Extensive reviews of the incidence and types of racetrack injuries in America were carried out by the late Dr Mark Bloomberg of the University of Florida between 1984 to 1990. In Australia, the NCA and the major race clubs which administer greyhound racing, reviewed injury rates in the early 1990s of greyhounds racing on both grass and sand tracks in each state. Many of these surveys were prompted by trainers concerned that racing greyhounds suffer higher than acceptable numbers of serious musculo-skeletal injuries which may be related to track geometry, surface type and weather conditions. The aim of these reviews was to reduce race injuries as a result of improved track design and surface condition.

Evaluating Injury Rates

Studies of the types and incidence of injuries on race tracks indicate that only a very small percentage of injuries which occur on the race track are actually recognised and diagnosed on the day or evening of the race. Many of the injuries listed in the stewards' reports are serious injuries, where they have either caused a form reversal in a consistent performer, as a result of examination of animals involved in a collision or track fall, or where the greyhound has obviously been injured, such as a fractured hock or a severe muscle tear which results in immediate lameness and loss of speed. It is only usually these groups of animals which are examined by the veterinarian at the racetrack.

Direct comparison of different tracks with regard to track injury rates, types and degree of severity is also subject to variation due to different veterinary opinions from track to track.

The late Dr Mark Bloomberg, of the University of Florida, carried out a study assessing race injury rates reported to the track veterinarian in 47,323 races in the period 1984 to 1990.[1.] This included over one quarter of a million race starts (only six dogs run in a race in America as compared to eight in Australia) and a total of 761 injuries (or one injury per 62.2 races) were reported. This represented an injury rate of only 1.6% which was notified or diagnosed at the race track flowing racing. By comparison, follow up of greyhound injury records from a large Sydney veterinary practice in the early 1990s, indicated that up to 50% of the greyhounds running in any one race sustained some type of minor injury.[3.] These ranged from a sand toe or broken nail, to more serious muscle injuries which were only evident the morning following a race once the animal cooled down.

Dr Bloomberg carried out a similar survey from 1990 – 1992 at the same USA tracks.[2.] When the results of the earlier study were compared with the more recent study, there was found to be a shift in the type of injuries. Dr Bloomberg and co-workers found that the number of hock injuries, for instance, decreased from 52.2% to 48.7% of the total number of injuries on some tracks, but the number of metacarpal shin bone and metatarsal injuries increased from 8.3% to 20%. It was concluded that the increase in lower limb and toe injuries could be a result of the increased banking of the turns and the fast or firmer racing surfaces of the tracks which were designed to improve speed, but increased concussion by reducing the surface cushioning effect.

Injury Focus

In this large survey, it was also shown that 90% of muscle or bone related serious injuries which required veterinary attention immediately after a race or the following morning, occurred on the first bend of the racetrack. Dr Bloomberg and his co-workers considered that the increased risk of injuries on the first bend was a result of either the increased speed, competitive spirit, or the higher risk of physical contact between greyhounds cornering at speed. However, more recent studies on the theory and geometry of racetrack design, backed up by video replays of greyhounds performing on poorly designed tracks, contradicts this view. Replay of race videos indicated that there was a sudden increase in centrifugal forces on the second stride into a corner as the animal enters the bend during the acceleration phase in the first fifty metres of a race. Tracks with a minimum distance from the boxes to the first bend had a higher risk of injury because greyhounds were more likely to be grouped together entering the first bend with increased risk of interference. Some tracks are designed to spread the field at the first bend by having a lower cross fall for a given radius. Certainly, bone and joint injuries are more common on the turns of a track, rather than on the straights. Unfortunately, only serious joint injuries are reported because the animal is showing obvious lameness or pain, with only 6.2% of muscle related injuries actually diagnosed trackside after a race. Many greyhounds with muscle injuries, as noted above, would be taken off the track and returned to the home kennels before being examined and diagnosed the following morning by a veterinarian or a trainer.

Greyhound Injuries-Summary

Important considerations:

- 50% sustain one or more minor injuries.
- Only 16% of major injuries diagnosed at track (1.6%).
- Injury type and rate varies between tracks.
- Injury type changes relative to track geometry/track surface/grade of dog.
- Only 6.2% of muscle injuries diagnosed at track when animals are hot after racing.
- Injury comparison between tracks is difficult – variation in veterinary diagnosis.

Track Design

The type of injuries sustained on a certain track can be related to the track geometry, slope of the cross fall, radius of the bends, position from the traps to the first bend, as well as the type of surface, moisture content, compaction and maintenance of the straights and bends. When tracks are redesigned and surfaces renovated, then all these factors should be taken into account, so that the incidence of injury decreases. However, it appears that most injuries still involve bones and joints whilst the greyhound is cornering. The type of surface and slope of crossfall on the corners are the most important factors which need further investigation and research into racetrack design.

A comprehensive review of rack track biomechanics and design was published by Mr Bede Ireland, a Sydney based civil engineer, who designed a number of 'high speed' tracks for harness horses and racing greyhounds.[4.]

Influencing Factors

Track Design/Geometry on Bends

- Radius of end circle.
- Banking or crossfall.
- Transition rate from straight to banking.
- Angle of lean and speed of greyhound.
  1. The transition rate from straight to banking is the **ramp** effect as the track starts to turn to the left – a smooth transition "curve" or "ramp" is essential to prevent "run off" or falls at speed.[4.]
  2. The angle at which a greyhound "leans" into the corner is proportional to the **speed** and **radius** of the track corner.[4.]
  3. A racing greyhound needs to lean and balance itself when cornering – ideally it should remain perpendicular to the track surface if the banking or crossfall of the track is high enough to counteract the sideways or outward centrifugal force.[4.]

Banking on the corners, with a smooth transition "ramp" or "curve" enables a greyhound to **run faster** and **maintain its direction** around the corner more easily.
Consider a **velodrome** for racing bicycles – high banking and smooth transition curves help to maintain balance and speed. As a living and highly responsive athlete, a greyhound can maintain some balance around curves by moving its limbs to prevent itself falling or running off – but this can increases stress on the wrists, pasterns and toes.[4.]

Nutritional Influences

Interestingly, the Florida reviews by Bloomberg,[1,2.] illustrated an increased incidence of injuries in the higher grades of races. It was suggested that this increase could be due to the fact that greyhounds are selected, bred and fed in an effort to improve their overall speed and performance. The incidence of joint and bone injuries could reflect a weakness in the skeletal structure of the greyhound particularly those on high meat diets with relatively deficient levels of calcium. A review of clinical cases presented at a large greyhound practice in Sydney in 1993, with investigation into the diet and supplement balance, indicated that many greyhounds were deficient in calcium relative to the amount of meat being fed. When the levels of calcium were calculated in the diet and increased to balance the phosphorus content of the meat, including supplementary vitamin D, the incidence of bone and joint injuries decreased by 15% within a three month period.[5.]

Although ligament injuries accounted for the majority of hock ('popped hocks') injuries, the incidence of hock bone fractures and fracture of the inside metacarpal (or shin) bones reduced dramatically once additional calcium and vitamin D was added to the diet in kennelled greyhounds. A similar study was also carried out in racehorses in Hong Kong some years ago where up to a 60% decrease in joint and bone injuries was reported after horses on high grain diets were supplemented with calcium and vitamin D to the required NRC (1974) levels. It my own experience, the incidence of metacarpal bone soreness and fracture also decreases when schooling and training programs in young greyhounds are planned so as to increase the loading on the metacarpal in a step-wise manner over 4-6 weeks. This is normally achieved by galloping the young greyhound over short distances starting half way around corners from the third to fourth week into the first training and education period. This helps to increase the loading progressively and thus allow the immature bones to adapt to the stresses from centrifugal, gravitational and frictional forces imposed as the young immature greyhound leans into the corner when galloping. In the USA, runs in a number of Kansas rearing farms are designed with banked curves in the run to help stimulate bone modelling of the metacarpals as young greyhounds grow and develop to 12 months of age.[6.]

Track Maintenance

The 1990 and 1993 American surveys also raise issues not only about the design of racetracks, but also on aspects of regular maintenance. Studies indicated that even though geometrically designed tracks can reduce the risk of injury, poor maintenance can reduce this beneficial effect leading to an increased risk of injury. Data Collected by Dr Robert Gillette of Kansas State University indicated that injuries on the corners were minimised by ensuring that the moisture content on sand tracks was maintained between races, particularly in the later races in a meeting.[7] Sprinklers on the inside of the rail, or water trucks can be used to dampen the surface, prior to light harrowing and conditioning after every race, particularly when the weather was hot. Dr Bloomberg and co-workers indicated that whilst the rate of injuries decreased on the initial redesign of a racetrack, over a two year period, where maintenance of the track surface was not carried out to a high standard, the risk of bone and joint injuries significantly increased.[2] Although there was a halving of the injury rate of redesign of the bends, this advantage was whittled away to the original rate due to poor surface maintenance with migration and compaction of the surface inwards to the rail, which eventually produced a lower slope on the bends compared to the original geometrically designed track. This problem was also discussed by Ireland.[4] Under both wet conditions with surface runoff to the inside of the track, and dry conditions with drift down the crossfall, coupled with poor maintenance and conditioning procedures, much of the track surface will migrate to the lowest area along the running rail, reducing the crossfall or slope on the bends. Bad erosion and surface drift results in a flattening of the slope in the running rail area, with a sudden increase in the slope to the outside of the track due to centrifugal outwards 'flinging' of sand by greyhounds as they corner at speed in a pack on the rail.

Influencing Factors

Track Surfaces

• Climate	-	rainfall	-	frequency
			-	intensity
	-	drainage	-	run off on crossfall to rail
			-	soakage and subsoil drainage
	-	location	-	shade (grandstand, shadows of trees)
			-	windblown – long, open straights
• Frequency of Racing			-	durability
			-	maintenance
• Availability and cost of materials				
• Reduction of "cup out" when galloping[4]			-	damage to track surface by pads and toe nails during acceleration and cornering.

1. The type of track surface material also has to be chosen to suit the climate, frequency of racing and the availability of materials.[4]
2. Grass tracks are the traditional racing surface, but they are often unable to withstand regular racing, particularly on bends or corners, and are hard to maintain in safe condition.[4]
3. Newer types of synthetic surfaces are suitable as safe alternatives to grass surfaces, particularly for the jumping pad in front of the starting traps.

Geometrical Design

Mr Blade Ireland, an Australian civil engineer, carried out extensive engineering studies to investigate and understand the centrifugal and other forces generated when a greyhound gallops around a circle track.[4]

Geometrical Design *(cont.)*

The overall outcome of redesign and correct maintenance of track surfaces not only decreases the risk and the rate of injury, but also increases the speed and performance of the animal and thus the interest in wagering on a well-designed and maintained racetrack.

Tracks at Southport in QLD and Maitland in NSW were redesigned and reconstructed in an effort to ensure more suitable racing surfaces using a specially prepared loam and sand mixture.[4, 8, 9.] Subsequent surveys revealed a significant decrease in stress related injuries at these locations. Modification of track geometry on corners to match banking and installation of transition curves proportional to the radius of the track, can improve speed and performance. Additionally, the improved track and performances increased the interest in greyhound racing and the overall prize money bet on the TAB. In fact, at the Maitland track, the amount of turnover increased by 64% over a four year period, as compared with an average of 18.5% expansion in betting investment at all other tracks in NSW.[8.] A similar result has been obtained wherever tracks have been redesigned. A more even spread of wins from all starting traps was also reported.

SPEED CONTROL

Practical Benefits

<u>Original Track – Maitland NSW</u>

457 metes	25.73 seconds
Serious injury rate	1 in 320 starts

<u>Redesigned 1987</u> - radius - crossfall
- loam surface - better maintenance

457 metres	25.29 seconds
Serious injury rate	1 in 1880 starts

Betting turnover increased 64% in 4 seasons to 1990 (NSW State average 18.5%)

Source:- Bede Ireland, 1994.[10.]

A similar trend was also found in a study in Florida, where significant upgrades of the major tracks were carried out. The newer tracks resulted in improved performance, and a lower risk of injuries, and drew the punting crowds. In turn, this significantly reduced the betting turnover and 'handle' (prize money poor) at the other tracks which were not upgraded in a similar way and a couple of tracks had to close due to poor gate attendance. Unfortunately, there is a lot of political influence on decisions to redesign racetracks at club or authority level.

The results of the American, and some of the leading Australian racetrack redesigns, have shown that the redesign of a track requires careful evaluation to create accurate and easily maintained transition curves and crossfall linked to the radius of the track, for best results.

INFLUENCING FACTORS

Speed of Greyhound

Track geometry interrelationships[4.]

$$cf = \frac{MV^2}{r}$$

$$\text{Centrifugal Force} \quad - \quad \frac{\text{Weight of Greyhound x Speed}^2}{\text{Radius of End circle}}$$

INFLUENCING FACTORS *(cont.)*

Greyhounds Slow up When Cornering.
Source:- Bede Ireland. 1994

This equation points out the influence of
- a greyhound's weight)
- speed (squared)) in creating centrifugal forces
- corner radius)

Higher weight or
Heavier Greyhounds x Fastest Greyhounds^2 = Greater Centrifugal Force[4.]
Running Around a Tight Circle (lower radius)

Note: This is the speed/centrifugal loading aetiology which is the cause of metacarpal periostitis (shin soreness) in racing horses and greyhounds trained too fast, too early on tightly curved, poorly banked rack tracks.

SPEED CONTROL

- The upper limit of lean controls the speed of the greyhound.
- Centrifugal force imposed on shoulders at second stride into bend.
- Soreness – dog slows.
- Off balance – dog slows.

1. As a greyhound enters the corner on the track, centrifugal force on the circle is imposed onto the left shoulder at about second stride into the bend.[4.]
2. If the greyhound is sore in the left shoulder: it will feel pain – and will slow up, then run towards the rail. Should it become off balance – it will run to the outside of the track in order to slow down by increasing the radius of the bend and thus interfere with other dogs in the race, resulting in collisions.

Note: See diagram attached at the end of this document. – Figure1: Speed and Angle of Lean Relationships to Track Crossfall (Aetiology of Metacarpal Periostitis in Young Greyhounds.

The attached graph illustrates the speed increase with large track end circle radius and degree of lean into corners.

Highest speeds are possible on large tracks with banks which minimise inward lean on cornering.
Source:- B Ireland. 1998.[4.]

SPEED CONTROL

- Maintain speed – dog increases radius by running out wide halfway through bend.
- Centrifugal free crossfall – 30% to 50% (1 in 3 slopes to 1 in 2 slopes).
  - surface scouring in rain
  - surface drifts inwards to rail.

Source:- Bede Ireland. 1989,[9.] 1998.[4.]

1. On poorly banked, tight circle bends, greyhounds have to slow down to run around the bend smoothly at a set distance from the rail – if the greyhound maintains straight gallop speed, it has to run out wide to maintain speed without falling.
2. The bank has to slope 30 – 50% to give centrifugal free crossfall (i.e. like a cement velodrome for bicycles).
3. Track surfaces cannot be maintained on a greater than 23% slope on most tracks in wet weather without risk of surface damage.

<u>Track Geometry</u>

	- Radius
	- Crossfall
Minimum radius approx.	- 49 metres
Minimum crossfall	- Straight 4%
	- Bends 8%
Optimum crossfall	- Bends 11 – 12%

Crossfall must be linked to radius.
Source:- Bloomberg. 1993.[2.] Ireland. 1994.[8.] 1998.[4.]

Questions to ponder?
How many tracks are designed with:

1. Smooth transition "curves" or "ramps".
2. Optimum crossfall to radius.
3. Proper surface maintenance.

All deficiencies = increased injury rates.

RACETRACK GEOMETRY
Radius and Crossfall Matched

- Smooth transition curves – no sudden centrifugal forces.
- Angular lean minimised – dog corners with minimal lean to tack surface.
- Stress reduced or inside railing limbs.
- Speed increase – track records.

These are advantages of carefully engineered track design to minimise angular lean and stress limbs.

<u>EXAMPLES OF GEOMETRY/SURFACE USA STATISTICS</u>

INFLUENCE OF GEOMETRY
Number of Race Falls

Track 1
Crossfall 5.6% — 1 fall per 115 starts
Track 2
Crossfall 11% — 1 fall per 589 starts

Track 1 redesigned and renovated.
Crossfall elevated to 11% falls uncommon.
Source:- G Pratt. Massachusetts. USA 1989.[11.]

INFLUENCE OF GEOMETRY/TRACK SURFACE
Six Tracks

Hock and Shin Injuries
Crossfall less than 8%

Hocks	52.0%
Shins	8.3%

Crossfall greater than 8% compacted track

Hocks	47.8%
Shins	20.0%

Source:- M Bloomberg. Florida, USA 1990-92.[2.]

INFLUENCE OF GEOMETRY/TRACK SURFACE
One Track – Loam Surface

Total Number of Injuries

<u>Old Track</u>
1 injury per 40 starts

<u>Redesigned Track Geometry</u> – Crossfall 8 – 12% on bends
1 injury per 84 starts

<u>Poor Surface Maintenance</u> – too dry, crossfall reduced
1 injury per 48 starts

Source: M Bloomberg. Florida USA 1984-89.[1.]

AUSTRALIAN STATISTICS

INFLUENCE OF TRACK SURFACE
Sprung and Broken Toes

<u>Old Track Grass Surface</u>
1 in 272 starts

<u>Old Track Grass Surface – Redesigned Crossfall</u>
1 in 2160 starts

<u>New Track Loam Surface – Redesigned Transition Curve</u>
1 in 2400 starts

Source:- Wentworth Park, NSW 1994.[11.]

RACE TRACK COMPARISONS
SAND SURFACES
% of Total Injuries

		Albion Park QLD ***52 Meetings (160 injuries)***	**Wentworth Park NSW** ***100 Meetings (188 injuries)***
Shoulder	Left	10.6	16.5
	Right	19.4	14.4
Wrist	Left	3.8	8.5
	Right	8.8	2.1
Thigh/Hip	Left	11.2	10.6
	Right	22.5	19.7
Broken Hock		3.8	3.2
Chest		6.3	9.0
Split Webbing		6.3	2.7
Toes		6.3	4.3

RACE TRACK COMPARISONS *(cont.)*

	Albion Park QLD *52 Meetings* *(160 injuries)*	Wentworth Park NSW *100 Meetings* *(188 injuries)*
520 metres	29.81 seconds	30.13
710 metres	41.88 seconds	42.58 (720m)

Source:- R J Lambert. Albion Park 1994.[11.]
P J Bell. NSW NCA 1994.[11.]

RACE TRACK SURFACES

RACE TRACK SURFACES

The surface of this track was changed from grass to loam without any change in design or track geometry.

		Mandurah WA Grass *22 Meetings* *(157 Injuries)*	% of Total Injuries Sand *31 Meetings* *(124 Injuries)*
Shoulder	Left	9.5	5.6
	Right	29.0	27.0
Wrist	Left	5.0	8.0
	Right	10.0	7.3
Thigh	Left	4.5	14.0
	Right	2.5	8.0
Hock	Left	0.0	0.0
	Right	1.2 (2#)	3.2(3#)
Neck		7.0	10.5
Toes		9.0	0.0

No change in geometry - fractures Bends 1 in 12 (8.5%) crossfall.

Source:- Dr S Read. Mandurah 1994.[12.]

	Mandurah WA Grass	Statistics Sand
Injuries/meeting	7.1	4.0
Fractures/meeting	0.27	0.09
Track Record		
410m	23.56	24.24
530m	30.56	31.76

No change in geometry bends 1 in 12 (8.5%) crossfall

Source:- D S Read. Mandurah 1994.[12.]

RACE TRACK GEOMETRY/SURFACE

		Wentworth Park Grass *104 Meetings (219 injuries)*	**% of Total Injuries – Sand** *100 Meetings (188 injuries)*
Shoulder	Left	20.1	16.5
	Right	22.4	14.4
Wrist	Left	1.8	8.5
	Right	3.6	2.1
Thigh/hip	Left	11.4	10.6
	Right	11.8	19.7
Broken Hock		0.9	3.2
Chest		1.4	9
Split Webbing		5.9	2.7
Toes		13.2	4.3
Crossfall	Straights	1/18 (5.5%)	1/25 (4%)
	Bends	1/8 (12.5%)	1/12 (8.3%)

Source:- P J Bell. NSW NCA 1994.[11.]

RACE TRACK SURFACES *(cont.)*

RACE TRACK SURFACE
SAND SURFACES
% of Total Injuries

	Wentworth Park Grass	**Statistics Sand**
Injuries Per Meeting	*2.1*	*1.9*
Trace Records	Old Grass Track	
530m	30.62	
722m	42.5	
Revamped Grass Track with Camber		
520m	29.5	
720m	42.05	
Sand Track (at present)		
520m	30.13	
720m	42.58	

Source:- B Crawford. NSW NCA 1994.[11.]

Note: Please refer to Injury Location Chart located at the end of this report. (Injury Location Chart[13.])

SUMMARY

1. Carefully designed tracks can increase speed and reduce injury rates.
2. 90% of injuries occur on the bends.
3. 1.6% of serious injuries diagnosed at track.
4. Better designed tracks.
   - Greater punter satisfaction.
   - Higher betting turnover.
   - More return to industry.
   - Happier owners and trainers of greyhounds.

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