

POSTMORTEM EXAMINATION PROGRAM

**Conducted for the California Horse Racing Board
January 1, 2000–December 31, 2000**

California Animal Health and Food Safety Laboratory System
School of Veterinary Medicine
University of California, Davis
October 2001

Postmortem

Examination

Program

California Animal Health and Food Safety Laboratory System

School of Veterinary Medicine
University of California, Davis

Davis, CA 95616

(916) 752-8700

October 2001

Equine Welfare and Racing Injury Prevention Committee

Bill Bell, DVM

Cherie Harter

Bud Johnston

Richard Mandella, Chair

Roy Minami

Skip Park, DVM

Alan Severinsen

Donald Smith, DVM

Lawson Williams

Steve Wood

Alex Ardans, DVM

TABLE OF CONTENTS

Introduction 3

Submissions 4

Table 1. Submissions by Activity

Table 2. Submissions by Breed and Month

Submissions by Breed and Age 5

Table 3. Breed of Submissions by Age

Figure 2. All Breed Submissions by Age

Figure 3. Thoroughbred Submissions by Age

Figure 4. Quarter Horse Submissions by Age

Injuries

Categories of Injury 6

Table 4. Category of Injury by Age

Table 5. Category of Injury by Breed

Category of Injury by Breed 7

Figure 5. Category of Injury: All Breeds

Figure 6. Category of Injury: Thoroughbreds

Figure 7. Category of Injury: Quarter Horses

Organ Systems Affected by Injuries 8

Table 6. Organ Systems Affected

Figure 8. Organ Systems Affected

Table 7. Musculoskeletal Injuries by Breed

Figure 9. Musculoskeletal Injuries

Table 8. Limbs Affected

Gastrointestinal System

Respiratory System

Central Nervous System

Cardiovascular System

Whole Body

Milestones 13

Publications, Awards, Abstracts

Research Support 14



POSTMORTEM EXAMINATION PROGRAM

Introduction

February of 2000 marked the 10th year of the California Horse Racing Board (CHRB) Postmortem Examination Program. The program was created in 1990 as a partnership between the California Animal Health and Food Safety Laboratory System (CAHFS) and CHRB to meet three primary objectives: 1) to determine the nature of injuries occurring in racehorses, 2) to determine the reasons for these injuries, and 3) to develop injury prevention strategies. To accomplish these objectives a broad, cooperative approach was devised involving the development of a contract with the CAHFS to perform a necropsy on every horse that died or was euthanized on racetracks or training facilities under the jurisdiction of the CHRB. This visionary partnership has become a national model for the racing industry in an effort to improve the safety and welfare of racehorses.

Pathologists at the Davis, Tulare and San Bernardino laboratories of the CAHFS conduct postmortem examinations and compile detailed information on each horse, which is then reported to the CHRB. A broad range of specimens are collected and shared with veterinary scientists in the School of Veterinary Medicine at the University of California, Davis (UC Davis). In-depth analyses of these specimens assist in determining with more precision the causes and risk factors that lead to catastrophic injuries in racehorses resulting in their death or euthanasia. Funding for the postmortem examinations is provided by the CHRB with transportation of the horses funded by racing associations. Additional studies are funded by the Center for Equine Health at UC Davis and through private sources.

Information from these tests and data gathered from the postmortem examinations are analyzed in efforts to elucidate the specific cause of catastrophic injuries. An advisory board, composed of horse owners, trainers, veterinarians, track maintenance personnel and CHRB officials, gives insight into injury investigations as well as sharing program findings and prevention strategies with the horseracing industry.

Studies demonstrating the role of previously undiagnosed stress fractures in catastrophic complete fractures of the pelvis, femur and humerus of Thor-

oughbred racehorses have prompted similar studies by the Equine Orthopedics Laboratory Group within the UC Davis School of Veterinary Medicine to focus on fractures of the lateral condyle of the cannon bone. Additional evidence is being gathered to determine the role the horseshoe toe grab height may have in contributing to catastrophic limb injuries. Previous information from the Postmortem Examination Program indicating that toe grab height is related to injury of the suspensory apparatus led trainers and racetrack practitioners to participate with Dr. Susan Stover, professor of Anatomy, Physiology and Cell Biology in the UC Davis School of Veterinary Medicine, in a clinical study of horses in race training at the racetracks.

In addition, the three-year equine protozoal encephalomyelitis (EPM) project is nearing completion. This project examined racehorses for exposure to a crippling parasite that can affect the brain and spinal cord of horses, leaving them unable to walk, much less run properly. The problem faced by the animal owners is that the diagnosis of this disease in the live horse is difficult using the present blood and spinal fluid tests. Many racetrack practitioners assisted with this project by sampling spinal fluid and blood from more than 200 horses submitted to the CAHFS for necropsy. Additional suspect horses submitted to CAHFS brought the total number of horses in the project to 372. The animals' brains and spinal cords were extensively examined microscopically for evidence of the parasite. The results of the microscopic examination were compared with the results of blood and spinal tests to give racetrack practitioners the best possible information on interpreting future test results on racehorses with ill-defined incoordination.

With detailed information on more than 2,800 racehorse injuries in the program database, a valuable resource is available to help develop preventive strategies on racehorse injuries. Other states have begun their own programs using the CAHFS Postmortem Examination Program as their model.



SUBMISSIONS

During the 2000 calendar year, 262 horses were submitted to CAHFS as part of the CHRB Postmortem Program. The Davis, Tulare and San Bernardino branches of the CAHFS performed the necropsies, with horses being brought directly to the closest CAHFS facility. At the time of submission, the CHRB official veterinarian categorized the activity of the horse when the injury occurred into one of four types (Table 1). The majority of catastrophic injuries, 44.3 percent, occurred during a race or immediately following a race. Closely following this, 30.9 percent of the fatal injuries occurred during or immediately following a training session. The third

most frequent category of fatalities, accounting for 21.8 percent of submissions, were horses in the non-exercise group. These were horses suffering primarily from colic or infectious diseases. The last group of injuries, accounting for only 3.0 percent of submissions, resulted from accidents. These were horses that suffered a fatal injury due to a mishap that was considered a one-of-a-kind event such as rearing or a collision.

The vast majority of submissions (84.0 percent) during 2000 were Thoroughbreds (Table 2, below). With fewer numbers of the other breeds racing, not enough data exists to allow comparison of injury rates among breeds for any predisposition to any particular type of injury.

The largest proportion of submissions (50.0 percent) were 3- or 4-year-old racehorses (Table 3, page 5). Only 21.4 percent of all racehorses submitted were 2-year-old horses. The number of horses submitted with catastrophic injuries dramatically drops after the fifth year of age. We cannot conclude if horses 6 years of age and greater are much less susceptible to the athletic injuries of racing, because the numbers of each age group racing and training on facilities controlled by CHRB are not known.



**Table 1.
Activity at Injury**

STATUS AT TIME OF INCIDENT

Accident	8
Non-exercise	57
Racing	116
Training	81
Total	262

Table 2. Submissions by Breed and Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Appaloosa	0	0	0	0	1	0	2	0	0	1	0	0	4
Arabian	0	0	0	0	1	0	0	1	0	0	0	0	2
Not Reported	0	0	0	0	1	1	1	0	0	0	0	1	4
Paint	0	0	1	0	0	0	0	0	0	0	0	1	2
Quarter Horse	0	0	0	2	1	3	5	0	2	5	1	5	24
Standardbred	1	0	1	1	1	0	0	0	0	0	1	0	5
Thoroughbred	21	19	18	12	14	20	21	15	23	23	19	15	220
Mix	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	22	19	20	15	19	24	29	16	25	30	21	22	262

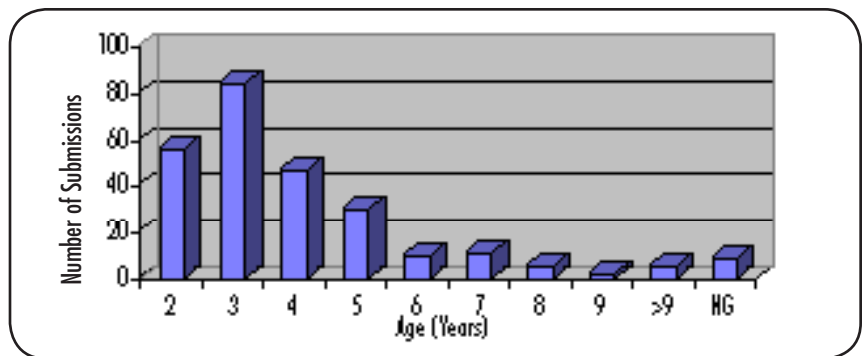


SUBMISSIONS BY BREED AND AGE

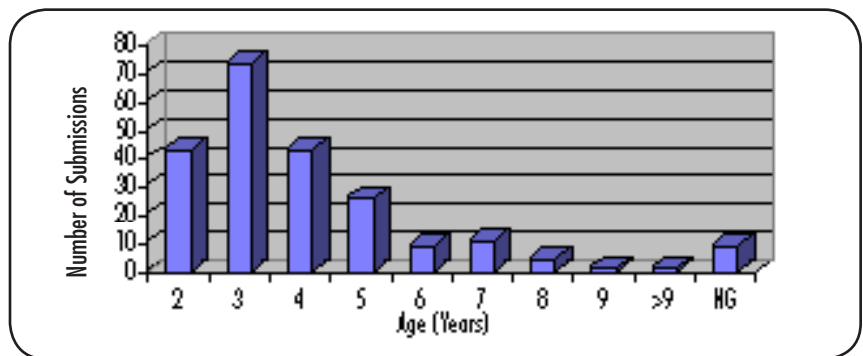
Table 3. Breed of Submissions by Age

Age (years)	≤2	3	4	5	6	7	8	9	>9	NG*	Total
Appaloosa	2	0	1	0	0	0	0	0	1	0	4
Arabian	0	2	0	0	0	0	0	0	0	0	2
Not Reported	0	0	1	1	0	0	1	0	0	0	3
Paint	1	0	0	0	0	0	0	0	1	0	2
Quarter Horse	9	8	2	2	1	0	0	0	2	0	24
Standardbred	1	0	1	1	0	0	1	0	1	0	5
Thoroughbred	43	74	43	26	9	11	4	1	1	9	221
Welsh Pony	0	0	0	0	0	0	0	1	0	0	1
Total	56	84	48	30	10	11	6	2	6	9	262

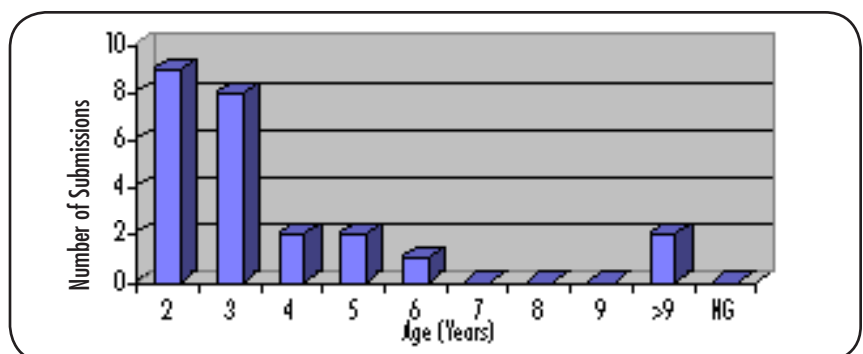
**Figure 2
All Breed
Submissions by Age**



**Figure 3
Thoroughbred
Submissions by Age**



**Figure 4
Quarter Horse
Submissions by Age**



INJURIES

As mentioned earlier, the categories of injury represent the activity of the horse or circumstances at the time of the fatal or catastrophic injury. The largest cluster of fatal injuries, 39.3 percent, occurred during racing and training in 3- and 4-year-old racehorses (Table 4). The 2-year-old horses had an equal number of fatalities during training, racing and from natural diseases. As in 1999, the 2-year-old group had the highest proportional number (35.2 percent) of fatalities due to disease.

As seen in previous years, Thoroughbred horses suffered almost equal numbers of catastrophic injuries while training as in racing (Table 5). Typical of previous years, the Quarter Horse rarely suffers a catastrophic injury during a training session. Approximately 80.2 percent of the fatal injuries are due to musculoskeletal problems (Table 6, page 8). Of

this group, 83.8 percent of injuries involve problems affecting the front or rear legs (Table 7, page 9). These injuries are more likely to occur during racing or training. Because these injuries are by far the most common, most of the investigative efforts at the University of California, Davis, have focused on causes and prevention of limb injuries.

Table 8 (page 10) compares catastrophic injury rates between limbs for injuries occurring during racing or training. Slightly, but non-statistically fewer left front injuries occur during racing, but there were significantly more left front limb injuries during training. Although the numbers were small, there were significantly more right rear leg injuries than left rear.



Table 4. Category of Injury by Age

Age (Years)	2	3	4	5	6	7	8	9	>9	NG*	Total
Accident	2	4	0	0	0	0	0	0	1	1	8
Non-exercise	18	15	11	2	2	1	3	1	3	1	57
Racing	17	36	19	21	8	9	1	1	2	2	116
Training	17	30	18	7	0	1	3	0	0	5	81
Total	54	85	48	30	10	11	7	2	6	9	262

Table 5. Category of Injury by Breed

	Accident	Non-exercise	Racing	Training	Total
Appaloosa	2	1	1	0	4
Arabian	0	2	0	0	2
Not Reported	1	1	0	2	4
Paint	0	1	1	0	2
Quarter Horse	0	5	18	1	24
Standardbred	0	2	2	1	5
Thoroughbred	5	44	94	77	220
Welsh Pony	0	1	0	0	1
Total	8	57	116	81	262



CATEGORY OF INJURY BY BREED

Figure 5
Category of Injury:
All Breeds

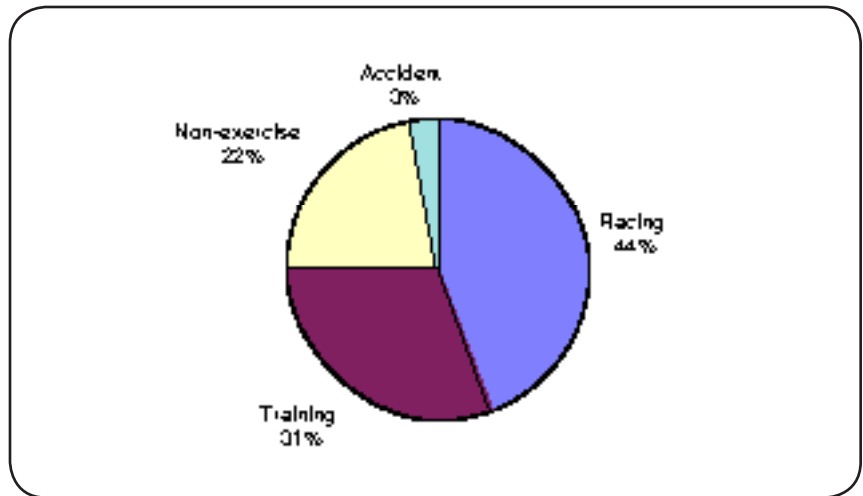


Figure 6
Category of Injury:
Thoroughbreds

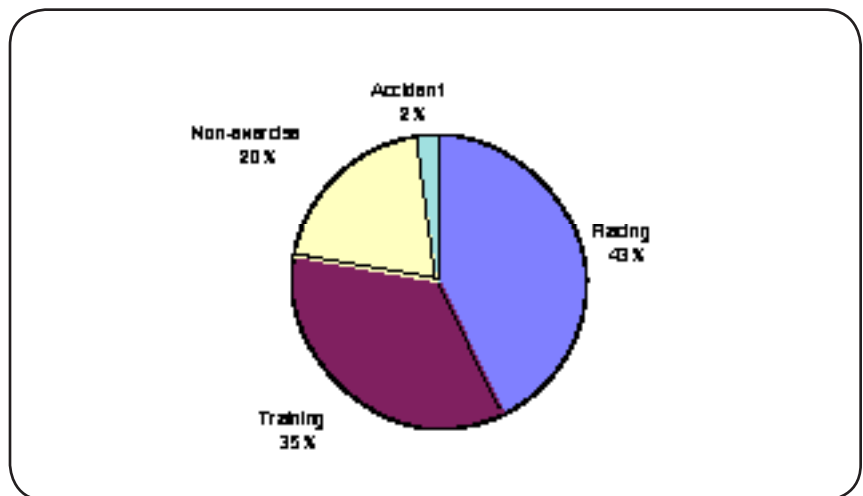
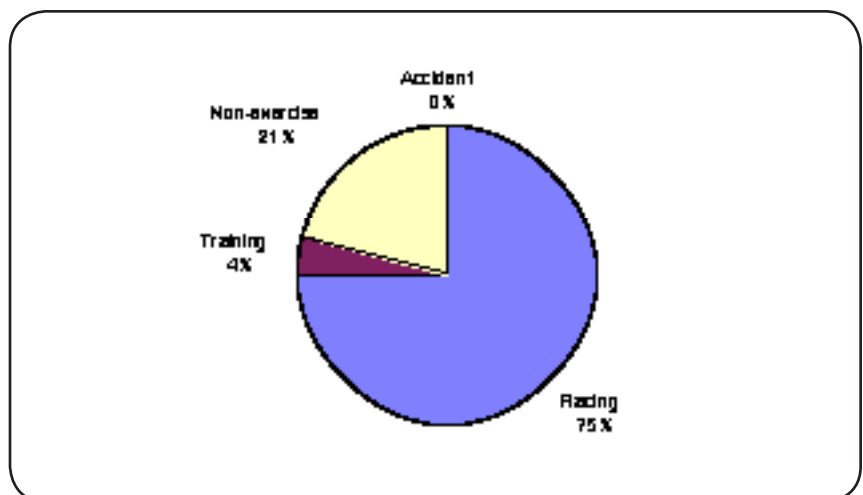


Figure 7
Category of Injury:
Quarter Horses



ORGAN SYSTEMS AFFECTED IN INJURIES

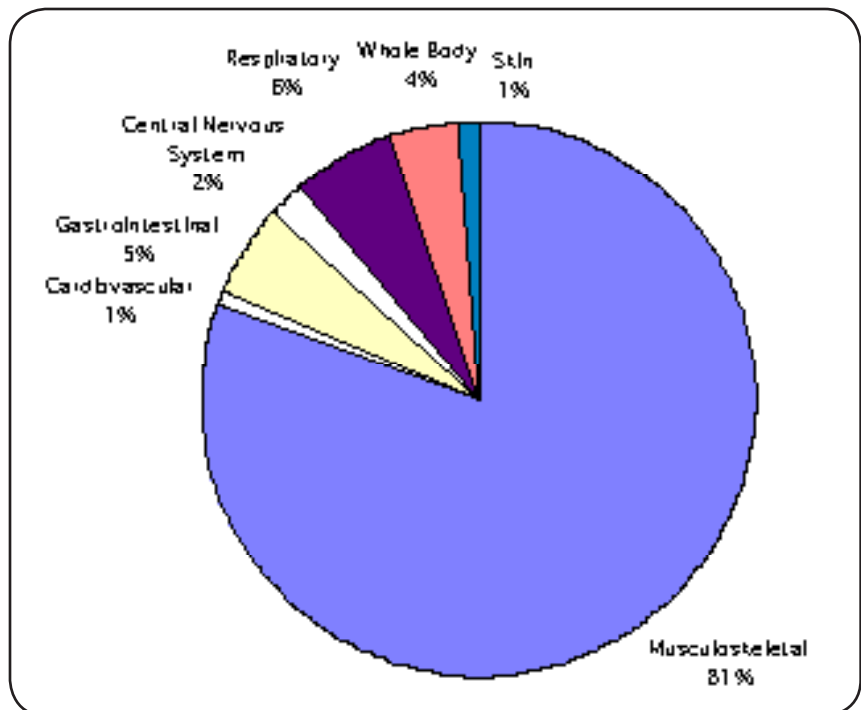
The majority of injuries for all breeds occur to the musculoskeletal system. Most additional investigative studies beyond the Postmortem Examination Program are focused on the musculoskeletal system in an effort to develop prevention strategies.

Table 6. Organ Systems Affected

	MS	CV	GI	Skin	CNS	Res	WB	Total
Appaloosa	2	0	0	10	0	0	0	4
Arabian	1	0	1	0	0	0	0	2
Not Reported	3	0	0	0	0	1	0	4
Paint	2	0	0	0	0	0	0	2
Quarter Horse	18	1	2	1	1	0	1	24
Standardbred	1	0	1	0	0	3	0	5
Thoroughbred	183	1	10	2	5	10	9	220
Welsh Pony	1	0	0	0	0	0	0	1
Total	211	2	14	3	6	15	11	262

MS=Musculoskeletal System, CV=Cardiovascular System, GI=Gastrointestinal System, CNS=Central Nervous System, Res=Respiratory System, WB=Whole Body

**Figure 8
Organ Systems Affected**



MUSCULOSKELETAL INJURIES

Musculoskeletal injuries include those occurring to all muscles, tendons, ligaments and bones. For the sake of continuity, the laminitis or founder cases are listed with the musculoskeletal system rather than the integumentary (skin) system. Several of the horses in Table 7, below, had more than one injury to a part of the musculoskeletal system. In these instances, the injury was categorized according to the damage that most likely occurred first. This premise has been used consistently for every year of the program so the previous year's studies can be compared.

Table 7. Musculoskeletal System Injuries by Breed

	Arabian	Appaloosa	Not Reported	Paint	Quarter Horse	Standardbred	Thoroughbred	Welsh Poly	Total
Fracture, Carpal	0	1	0	0	2	0	7	0	10
Fracture, Femur	0	0	0	0	0	0	1	0	1
Fracture, Humerus	0	0	1	0	1	0	16	0	18
Fracture, Metacarpal	0	0	0	0	2	0	27	0	29
Fracture, Metatarsal	0	0	0	0	0	0	7	0	7
Fracture, P1	0	0	0	0	0	0	7	0	7
Fracture, P2	0	0	0	0	0	0	1	0	1
Fracture, P3	0	0	0	0	0	0	1	0	1
Fracture, Pelvis	0	0	0	0	1	0	4	0	5
Fracture, Radius	0	0	0	0	0	0	1	0	1
Fracture, Scapula	0	0	0	0	1	0	4	0	5
Fracture, Sesamoid(s)	0	0	2	1	8	0	67	0	78
Fracture, Skull	0	1	0	0	1	0	3	0	5
Fracture, Tibia	0	0	0	0	0	0	5	0	5
Fracture, Ulna	0	0	0	0	0	0	2	0	2
Fracture, Vertebrae	0	0	0	0	0	0	4	0	4
Joint Luxation	0	0	0	0	0	0	2	0	2
Laminitis	1	0	0	0	1	0	5	1	8
Ligament Rupture	0	0	0	0	1	1	11	0	13
Other	0	0	0	1	0	0	7	0	8
Total	1	2	3	2	18	1	182	1	210



Location and Number of Injuries

Figure 9
Musculoskeletal Injuries

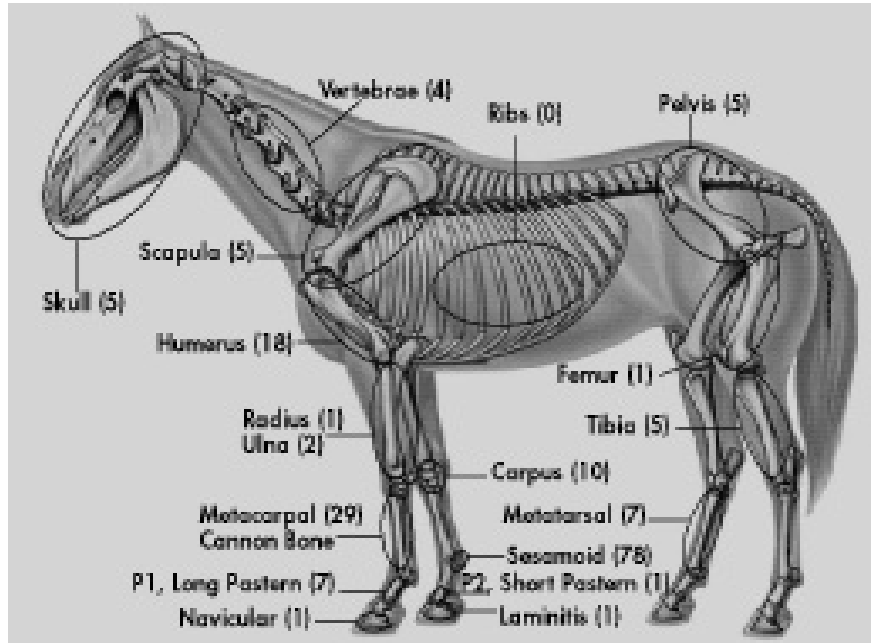


Table 8. Limbs Affected

Racing	Training	Total	
Front Limbs			
Right:	51	20	71
Left:	44	39	83
Rear Limbs			
Right:	6	8	14
Left:	0	4	4
Bilateral			
Front:	3	1	4
Rear:	0	0	0

LIMBS AFFECTED

Table 8 lists the injured limbs of the horses submitted that suffered fatal musculoskeletal injuries during racing or race training exercises.

ORGAN SYSTEMS AFFECTED BY INJURIES

Gastrointestinal System	Colic	8
	Colitis	5
	Oral	1

Four cases of colic resulted from impaction or torsion of the stomach or intestines, and one case was due to post surgical complications. Three of the cases of colic were due to severe intestinal edema and bloat of unknown cause. A single case of gastric bloat was due to grain overload. Of the five cases of colitis, one was due to *Clostridium difficile*, two were due to other *Clostridium sp.*, and two had no identifiable cause. The single oral lesion was an abscess at the base of the tongue resulting in weight loss and systemic illness.

Respiratory System	Pneumonia	10
	Pulmonary Hemorrhage	4
	Retropharyngeal hemorrhage	1

Several cases of pneumonia, often with a severe pleuritis occurred in 2000. Typical of previous years, *Streptococcus zooepidemicus* was the primary cause, responsible for six cases. A mixture of bacterial species were responsible for four of the cases. The horses dying from pulmonary hemorrhage and pharyngeal hemorrhage were severe “bleeder” cases.

Central Nervous System	Neurological disorder	4
	Equine Protozoal Myelitis	2

The horses with neurological disorders resulted from a variety of dif-

ferent causes. These included one case each of a brain contusion due to accidental trauma, encephalitis due to herpesvirus, bacterial meningitis and neurological disease of unknown cause. Two cases of neurological disease were identified in which the protozoan *Sarcocystis neurona* was present. In one case records indicated a prior diagnosis of the disease with chronic signs related to the infection, while the other horse had an active infection with the organism resulting in neurological signs.

Cardiovascular	Aortic rupture	1
	Cardiac failure	1

Few cardiac diseases resulted in death during 2000. One horse, which died suddenly while warming up, was found to have suffered a ruptured aorta. Evidence of cardiac disease and acute heart failure was found in a second horse that collapsed following an episode of unsteadiness.

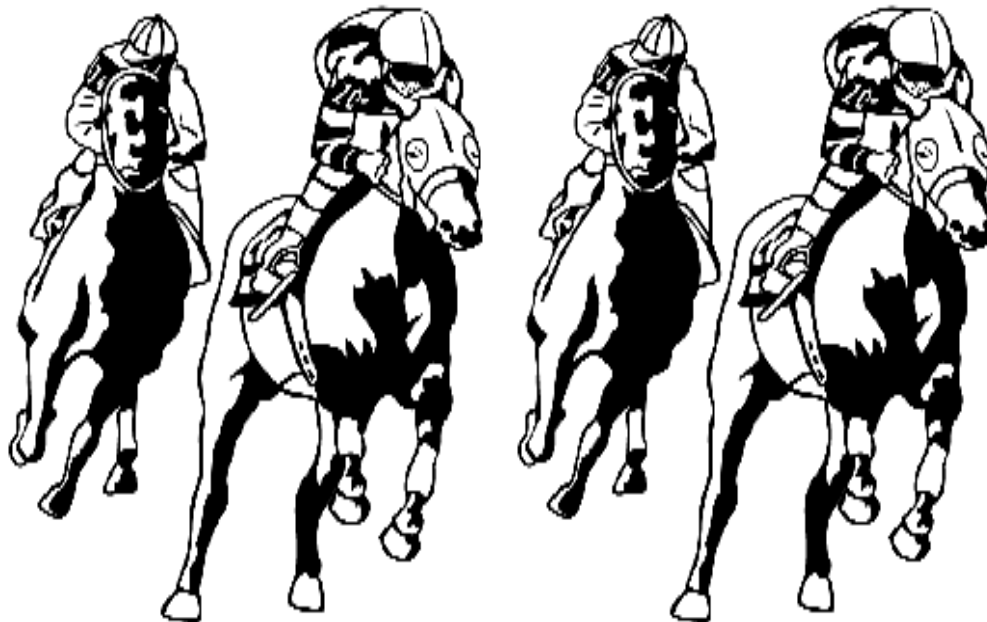
Two of the sudden deaths were related to surgery under anesthesia, while five deaths had no identifiable cause. No commonality was indi-



INJURIES • continued

Whole Body	Sudden Death	7
	Anaphylaxis	3
	Disseminated hemorrhage	1

cated in the circumstances prior to death with one horse dying during a race, one during training and three in non-race related situations. One was a Quarter Horse, one an Appaloosa and the others Thoroughbreds. One horse died from disseminated intravascular coagulation, a complex disease resulting from the activation of platelets within the blood vessels and small blood clots being formed. In this case, the inciting cause was not determined.



MILESTONES

- Publications** McDuffee, L.A., Stover, S.M., Bach, J.M., Taylor, K.T. An in vitro biomechanical investigation of an equine interlocking nail. *Veterinary Surgery*, 29(1):38-47.
- Hassel, D.M., Stover, S.M., Yarbrough, T.B., Drake, C.M., Taylor, K.T. Palmar-plantar axial sesamoidean approach to the digital flexor tendon sheath in horses. *Journal of the American Veterinary Medical Association*, 217(9):1343-1347.
- McDuffee, L.A., Stover, S.M., Taylor, K.T. In vitro cyclic biomechanical properties of an interlocking equine tibial nail. *Veterinary Surgery*, 29(2):163-172.
- Galuppo, L.D., Stover, S.M., Willits, N.H. A biomechanical comparison of double-plate and Y-plate fixation for comminuted equine second phalangeal fractures. *Veterinary Surgery*, 29(2):152-162.
- McDuffee, L.A., Stover, S.M., Coleman, K. Limb loading activity of adult horses confined to box stalls in an equine hospital barn. *American Journal of Veterinary Research*, 61(3):234-237.
- Daft, B., Barr, B., Ardans, A., Read, D.H., Bell, W., Hird, D., St. Ledger, J., Cornish, C., Kinde, H., Johnson, B.J., Woods, L., Anderson, M., Hietala, S., Adaska, J., Hurley, J. Equine Protozoal Myeloencephalitis: A comparison of western blot results for serum and cerebral spinal fluid with postmortem finding in normal and neurologic horses. Proceedings of the annual American Association of Equine Practitioners meeting, 46:264-265.

- Current Projects**
- Computer modeling of the racehorse forelimb for the study of race-track surface characteristics and tendon and suspensory ligament injuries.
 - The effects of horseshoe characteristics on lay-ups and fatal injuries in racing Thoroughbred horses.
 - Relationship of suspensory ligament injury and cannon bone condylar fracture.
 - Instrumented horseshoe for measuring ground reaction forces in racing Thoroughbred horses.
 - Studies of the causes and development of palmar osteochondrosis of the cannon bone.
 - Evaluation of proximal sesamoid bone fractures
 - Compressive and tensile fracture mechanics of equine cannon bone specimens

RESEARCH SUPPORT

- Sponsors**
- Center for Equine Health, with funds provided by:
 - Oak Tree Racing Association
 - State of California Satellite Wagering Fund
 - Southern California Equine Foundation
 - private donors
 - Dolly Green Foundation
 - Grayson-Jockey Club Research Foundation, Inc.
 - Niarchos Foundation
 - USDA

Researchers

Mark Anderson
Lucy Anthenill
Alex Ardans
Bradd Barr
Patricia Blanchard
James Case
Tim Carpenter
Barbara Daft
Larry Galuppo
Ian Gardner
Jeff Gibeling
Diane Gross
Diane Hassel
Dave Hawkins
Ashley Hill
Mont Hubbard
B.J. Johnson
Hailu Kinde
Sarah Lejeune
Melinda MacDonald
Bruce Martin
Laurie McDuffee
Janet Moore
Bob Norrdin
Cathy Prater
Deryck Read
Susan Stover
Mike Swanstrom
Leslie Woods
Neil Willits
Pink Hong Yeh





**California Animal Health and
Food Safety Laboratory System**

School of Veterinary Medicine
University of California, Davis
West Health Sciences Drive
Davis, California 95616