

Adams' Lameness in Horses

Ted S. Stashak

FOURTH EDITION

Adams' Lameness in Horses

TED S. STASHAK, DVM, MS

*Diplomate American College of Veterinary Surgeons;
Professor of Surgery, Department of Clinical Sciences,
College of Veterinary Medicine and Biomedical Sciences,
Colorado State University, Fort Collins, Colorado*

FOURTH EDITION



Williams & Wilkins

A WAVERLY COMPANY

BALTIMORE • PHILADELPHIA • LONDON • PARIS • BANGKOK
HONG KONG • MUNICH • SYDNEY • TOKYO • WROCLAW

Williams & Wilkins
Rose Tree Corporate Center, Building II
1400 North Providence Road, Suite 5025
Media, PA 19063-2043 USA

First Edition 1962
Reprinted 1962, 1963, 1965

Second Edition 1966
Reprinted 1967, 1969, 1972 (twice)

Third Edition 1974
Reprinted 1976

Library of Congress Cataloging in Publication Data

Adams, O. R. (Ora Robert)

Adams' Lameness in horses.

Bibliography: p.

Includes index.

1. Lameness in horses. 2. Horseshoeing. I. Stashak, Ted S. II. Title.

SF959.L25A3 1985 636.1'089758 85-5787
ISBN 0-8121-0980-5

Copyright © 1987 by Lea & Febiger. Copyright under the International Copyright Union. All Rights Reserved. This book is protected by copyright. No part of it may be reproduced in any manner or by any means without written permission of the Publisher.

PRINTED IN THE UNITED STATES OF AMERICA

Print Number: 5

Contributors

ROBERT A. KAINER, DVM, MS

Professor of Anatomy, Department of Anatomy, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, Colorado

JACK L. LEBEL, DVM, MS, PhD

Diplomate American College of Veterinary Radiology; Professor of Radiology, Department of Radiology and Radiation Biology, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, Colorado

LON D. LEWIS, DVM, PhD

Clinical Nutritionist, Mark Morris Associates, Topeka, Kansas

C. WAYNE McILWRAITH, BVSc, MS, PhD, MRCVS

Diplomate American College of Veterinary Surgeons; Professor of Surgery, Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, Colorado

ALAN J. NIXON, BVSc, MS

Diplomate American College of Veterinary Surgeons; Assistant Professor of Surgery, Department of Surgical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, Florida

RICHARD D. PARK, DVM, PhD

Diplomate American College of Radiology; Professor of Radiology, Department of Radiology and Radiation Biology; Head, Section of Radiology, Veterinary Teaching Hospital, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, Colorado

A. SIMON TURNER, BVSc, MS

Diplomate American College of Veterinary Surgeons; Professor of Surgery, Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, Colorado

DEDICATION

*To my wife Gloria, and my children Angela, Stephanie, and Ryan,
for their understanding and support.*

*To my parents for their inspiration
and
to the memory of DR. O. R. ADAMS*



O. R. ADAMS

In the absence of a modern textbook on the subject, Dr. O. R. Adams compiled his own *Veterinary Notes on Lameness and Shoeing of Horses* with the assistance of the class of 1957 of Colorado State University. This material provided a basis from which the equine lameness course was taught at Colorado State University. While Dr. Adams was on sabbatical leave in Kenya, copies of these notes were sent to colleagues in other universities for their comments. They were received favorably. Upon returning from Africa, Dr. Adams was encouraged by Lea & Febiger to develop the notes into a textbook.

The first edition of *Lameness in Horses* was published in 1962, even as new information and developments were appearing. Always seeking to improve the next edition, revisions were started as the previous one was sent to print.

Dr. Adams' love of horses and his pride in the veterinary profession continue to be apparent in this new revision capably edited by Dr. Ted Stashak.

—NANCY M. ADAMS

Preface

When I was contacted by Mr. George Mundorff, Executive Editor for Lea & Febiger, regarding the possibility of revising the third edition of "Lameness in Horses" by Dr. O. R. Adams, I was excited but naive to the task at hand. Dr. Adams had, in his previous three editions, established the state of the art of lameness diagnosis and treatment, presenting it in a unique manner that appealed to veterinarians, horse owners and trainers, and farriers. Without a doubt, he defined and directly influenced the course of this subject more than any other individual during this time. I was truly fortunate to train under him during my internship and surgical residency at Colorado State University. His never-ending thirst for knowledge, his humor, his friendship, and his love of the veterinary profession have inspired me throughout this endeavor. I only hope that I have served his memory well and that he would be proud of this fourth edition.

After considerable discussion with Lea & Febiger and the assurance of Mrs. Nancy Adams, Dr. Adams' widow, I embarked on the revision with some basic changes in format in mind. These included the addition of new authors, changes in chapter sequence and presentation, the addition of new chapters and deletion of some old ones, and the transition from a monograph to a reference text. Because I wanted the fourth edition to represent the school where Dr. Adams attended and taught, I selected mostly authors from our faculty on the basis of their expertise and their ability to provide a broad base of opinion for the reader.

With the idea of approaching the discussion of lameness as one would approach a lameness examination itself, I changed the sequence of presentation. Using the newest accepted nomenclature, Chapter 1 deals with the functional anatomy of the equine locomotor system and represents a complete revision of Chapter 2 in the previous edition. Dr. Kainer starts with the forelimb, advancing from the foot up the limb, describing the regional anatomy of each site. The hindlimb is covered in similar fashion. The

nomenclature may be confusing initially to older graduates of American veterinary schools, but recent graduates as well as foreign veterinarians will be well versed in this terminology. We felt it was time to make this transition since the new nomenclature has been in use for at least 4 years. (Older terms are included parenthetically.)

Following a format similar to the previous edition, Chapter 2 deals with the relationship between conformation and lameness. I have eliminated "The Examination for Soundness," which was Chapter 3 in the previous edition, because it discussed many topics unrelated to lameness and, simply, because the subject of soundness is so comprehensive it could be covered in a separate text. The present Chapter 3 deals with the diagnosis of lameness. After defining lameness and establishing how to determine which limb is lame, the description of the physical examination begins at the foot of the forelimb and proceeds upward. Emphasis is placed on recognition of problems peculiar to the region examined. Following this is a description and illustration of perineural and intrasynovial anesthesia.

The next logical step in the diagnosis of lameness is radiology, which is discussed in Chapter 4. This chapter is comprehensive; nothing like it has been published elsewhere. The format of the text and illustrations should answer any question the reader may have regarding the techniques for taking radiographs and interpreting them. The artwork beautifully illustrates the different structures seen on various radiographic views, and the illustrations are labeled so that anatomic sites are easily identified.

Chapters 5 through 7 are new. Discussing the role of nutrition in musculoskeletal development and disease, Chapter 5 illustrates a unique approach not used elsewhere. Dr. Lewis provides a comprehensive review of specific nutritional disorders, their causes, and their treatment for all phases of growth and development in the foal, during pregnancy and lactation in the mare, and during maintenance of the working horse. This information will benefit both

the horseman and the veterinarian. Chapter 6, by Dr. Turner, starts with a brief review of endochondral ossification and then discusses the diseases associated with bones and muscles and their treatment. In Chapter 7, Dr. McIlwraith describes the developmental anatomy of joints and related structures, disease processes, clinical signs, and treatments. Both of these chapters present in-depth reviews, with major emphasis on the pathogenesis and pathobiology of the diseases. They are heavily referenced, and will be of major interest to the veterinary profession.

Representing a complete revision of Chapter 8, "Lameness" updates the reader on new diseases as well as new findings and treatment for previously recognized entities. Unlike past editions, this material is heavily referenced. Information regarding the prevalence of the disease within various breeds according to sex and age introduces each subject. The format of the chapter has been changed to start with diseases relating to the foot region and then proceeding upward anatomically, consistent with the way most equine practitioners approach a systematic examination. Specific diseases of each region are discussed separately. This chapter, though referenced heavily and written technically, should be of interest to the horseman as well as the veterinary profession. I am particularly grateful to Dr. Allen Nixon for his thorough and comprehensive review of the diagnosis and treatment of the "wobbler's syndrome" in horses. His presentation is clear and well illustrated, giving the reader the confidence to differentiate among the diseases that cause this syndrome.

Chapters 9 through 12 were written primarily for the horseman and farrier, though they will also be of interest to the veterinarian, particularly the equine practitioner. I have updated these chapters with new information, as well as listing what the horseman should look for when the horse is properly trimmed and shod. Chapter 13, "Natural and Artificial Gaits," is essentially unchanged. Chapter 14, "Methods of Therapy," has been updated, and includes an extensive revision of different methods of external coaptation. This chapter is primarily directed toward the veterinary profession, though the horse owner will obtain insight into why different treatments are selected.

With the explosion of literature pertaining to musculoskeletal disease in the horse and the demands put on authors and editors alike, it became obvious that a transition from a monograph to a reference text was timely. To this end the authors have attempted to provide the latest information. As with any large text, however, authors and editors alike

feel somewhat frustrated because at the time of publication some of this information will be out of date. With few exceptions, we stopped referencing material published in 1985. Occasionally publications in 1985 changed the presentation of the materials so much that it could not be denied and therefore was included.

I am grateful to Dr. Robert Kainer, Professor of Anatomy and author of the first chapter, for taking the time to review and advise me on the nomenclature used in this book. A special thanks is extended to Dr. A. S. Turner for his review and comments on Chapter 8. The fine contributions of all the authors is sincerely appreciated. I want to thank Dr. Robert Perce (California) and Mr. Richard Klemish (farrier, Colorado) for their advice on the chapters dealing with trimming and shoeing horses.

The addition of many new illustrations and photographs represents a tremendous time commitment and effort on behalf of the Office of Biomedical Media at Colorado State University. For the illustrations, I am indebted to Mr. Tom McCracken and Mr. John Dougherty for their expertise and the cooperation they have given me. For the photographs I am grateful to Mr. Al Kilminster and Mr. David Clack, for their expertise, cooperation, and commitment to excellence. For the design of the book cover I thank Mr. Dave Carlson.

Most of the manuscript was typed by Mrs. Helen Acevedo. Her cooperation and patience with the many revisions necessary to complete this text are gratefully appreciated.

I am also grateful to my many colleagues who took the time to personally reveal their thoughts regarding certain topics. A special thanks is extended to the following: Dr. Joerg Auer (Texas), Dr. Peter Haynes (Louisiana), Dr. Larry Bramalage (Ohio), Dr. Joe Foerner (Illinois), Dr. Dallas Goble (Tennessee), Dr. Robert Baker (Southern California), Dr. Robert Copelan (Kentucky) and Dr. Scott Leith (deceased, Southern California).

Mr. Christian C. Febiger Spahr Jr., Veterinary Editor, Mr. George Mundorff, Executive Editor, Mr. Tom Colaiezzi, Production Manager, Ms. Constance Marino, and Mrs. Dorothy Di Rienzi, Manager of Copy Editors, and the entire staff at Lea & Febiger have been most helpful in the preparation of this book. I am grateful for their support and guidance.

I hope this book will be useful to all who read it. I hope to receive your cooperation in making corrections and suggested additions for further revisions.

Fort Collins, Colorado

TED S. STASHAK

Contents

Chapter 1. Functional Anatomy of Equine Locomotor Organs

ROBERT A. KAINER

Anatomic Nomenclature and Usage	1
Thoracic Limb	1
Digit and Fetlock	1
Metacarpus	18
Carpus	21
Antebrachium	24
Cubital (Elbow) Joint	31
Arm and Shoulder	31
Lymphatic Drainage	37
Stay Apparatus of the Thoracic Limb	37
Growth Plate Closure	38
Pelvic Limb	38
Digit and Fetlock	38
Metatarsus	42
Tarsus (Hock)	43
Crus (Leg or Gaskin)	51
Stifle (Genu)	56
Thigh and Hip	60
Lymphatic Drainage	68
Stay Apparatus of the Pelvic Limb	68
Growth Plate Closure	68
Axial Contributors to Locomotion	70

Chapter 2. The Relationship between Conformation and Lameness

TED S. STASHAK

Conformation of the Body	72
Balance	72
Center of Gravity	74
Conformation of the Limbs	75
The Forelimbs	75
Faults in Conformation of the Forelimbs	77
The Hindlimbs	88
Faults in Conformation of the Hindlimbs	88

Evaluation of Limb Conformation for Judging Purposes	90
Conformation of the Foot	91
Foot Axis and Pastern Axis	91
Foot Level	93
Effect of Foot Conformation on Stride and Way of Going	93
The Forefoot	94
The Hind Foot	95
Abnormal Conformation of the Foot	95

Chapter 3. Diagnosis of Lameness

TED S. STASHAK

Definition of Lameness	100
Classification of Lameness	100
Character of the Stride	101
Anamnesis	102
Procedures for Examination	103
Visual Examination	103
Examination by Palpation and Manipulation	107
Special Considerations	133
Local Anesthesia	134
Radiography	151
Additional Methods of Examination	151

Chapter 4. Equine Radiology

RICHARD D. PARK AND JACK L. LABEL

Equipment	157
X-ray Machines	157
Accessory X-ray Equipment	159
Darkroom Equipment	166
Radiation Safety	168
Technique Charts	169
Special Radiographic Examinations	170
Draining Tract Injections (Sinus Tract and Fistula)	170
Arthrography	171
Tendonography	172
Myelography	174
Additional Imaging Techniques	174

Xeroradiography	174
Thermography	175
Ultrasound	175
Nuclear Medicine (Scintigraphy)	176
Principles of Radiographic Interpretation	176
Radiology of Soft Tissue Structures	177
Radiology of Bone	178
Radiology of Synovial Joints	182
Normal Radiographic Anatomy for Equine Lameness Examinations	187

Chapter 5. The Role of Nutrition in Musculoskeletal Development and Disease LON D. LEWIS

In the Mare and Foal	271
Inadequate Feed Intake	271
Excess Feed Intake	271
Protein Imbalances	272
Effects on the Nursing Foal	272
Mineral Imbalances	273
Vitamin Deficiencies	276
In the Growing Horse	276
Causes of Alterations in Endochondral Ossification	276
Nutritional Management of Alterations in Endochondral Ossification	280
In the Mature Horse for Maintenance or Work	280
Water, Electrolyte, and Energy Deficits	281
Nutritional Secondary	
Hyperparathyroidism	284
Vitamin D Imbalances	285
Vitamin A Imbalances	286
Selenium Toxicity	287
Fluorosis	289

Chapter 6. Diseases of Bones and Related Structures SIMON TURNER

Postnatal Development and Growth of the Musculoskeletal System	293
Morphology of the Growth Plate (Physis)	294
Biomechanical Aspects of the Growth Plate (Physis)	296
Cessation of Growth	297
The Effect of Physical Force on the Epiphysis: Epiphyseal Injuries	297
Bone Healing and Fracture Repair: Clinical Aspects	299
Fractures as a Cause of Lameness	299
Fracture Healing in Horses	300
Local and Systemic Diseases of Bone	304
Infectious Osteitis and Osteomyelitis	304
Other Diseases	308

Diseases of Muscle	324
Introduction	324
Muscle Response to Injury	325
Diagnosis of Muscle Diseases in the Horse	330
Systemic Diseases of Muscle	331
Other Myopathies	334

Chapter 7. Diseases of Joints, Tendons, Ligaments, and Related Structures C. WAYNE MCILWRAITH

Diseases of Joints	339
Anatomy and Physiology of Joints	339
Pathobiology of Joints and Their Reaction to Insult and Injury	345
Diagnosis of Joint Disease	347
Specific Diseases of Joints	357
Idiopathic Synovitis (Bog Spavin and Articular Windpuffs)	357
Traumatic Arthritis	360
Osteochondrosis	396
Incomplete or Defective Ossification of Carpal or Tarsal Bones	419
Synovial Osteochondromatosis	422
Infectious Arthritis	423
Synovial Hernia, Ganglion, and Synovial Fistula	433
Immune-mediated Joint Disease	435
Congenital Joint Anomalies	435
Tumors	437
Diseases and Problems of Tendons, Ligaments, and Tendon Sheaths	447
Anatomy	447
Developmental Problems in Tendons and Ligaments	450
Traumatic Problems of Tendons and Ligaments	463
Diseases of Bursae and Other Periarticular Tissues	481

Chapter 8. Lameness TED S. STASHAK

The Foot	486
Laminitis	486
Navicular Disease (Podotrochleosis)	499
Fractures of the Navicular Bone	514
Sheared Heels	515
Pedal Osteitis	517
Subchondral Bone Cysts of the Distal (Third) Phalanx	519
Fractures of the Distal (Third) Phalanx (Pedal Bone, Os Pedis, Coffin Bone)	521
Extensor Process Fractures of the Distal (Third) Phalanx	526

- Pyramidal Disease (Buttress Foot) 528
- Penetrating Wounds of the Foot 529
- Quittor (Necrosis of the Collateral Cartilage) 532
- Puncture Wounds of the White Line (Gravel) 534
- Sidebones 537
- Corns and Bruised Soles 538
- Canker 540
- Thrush 540
- Keratoma 541
- Selenium Toxicosis 541
- Avulsion of the Hoof Wall at the Heel (Heel Crack or Heel Avulsion) 543
- Toe Cracks, Quarter Cracks, Heel Cracks (Sand Cracks) 544
- Vertical Tears of the Hoof Wall 551
- The Pastern 551
 - Ringbone (Phalangeal Exostosis) 551
 - Luxation and Subluxation of the Pastern Joint 558
 - Fractures of the Middle (Second) Phalanx (P-2) 560
 - Longitudinal and Comminuted Fractures of the Proximal (First) Phalanx (P-1) 563
 - Desmitis of the Distal Sesamoidean Ligaments 566
 - Rachitic Ringbone 568
- The Fetlock 568
 - Chip Fractures of the Proximal (First) Phalanx in the Metacarpophalangeal or Metatarsophalangeal (Fetlock) Joint 568
 - Fractures of the Proximal Sesamoid Bones 573
 - Sesamoiditis 582
 - Traumatic Arthritis of the Metacarpophalangeal (Fetlock) Joint (Osselets) 584
 - Traumatic Rupture of the Suspensory Apparatus 584
 - Lateral and Medial Luxation of the Metacarpophalangeal and Metatarsophalangeal Joints (Fetlock Luxation) 587
 - Angular Limb Deformities Associated With the Metacarpophalangeal and Metatarsophalangeal Joints (Fetlock Deviation) 590
 - Constriction of or by the Palmar (Volar) or Plantar Anular Ligament 593
- The Metacarpus and Metatarsus 596
 - Periostitis and Fracture of the Dorsal Metacarpus (Bucked Shins, Shin Splints, and Stress Fracture) 596
 - Fractures of the Condyles of the Third Metacarpal and Metatarsal Bones (Condylar Fractures, Longitudinal Articular Fractures) 601
 - Fractures of the Third Metacarpal or Metatarsal (Cannon) Bone 606
 - Angular Limb Deformities Associated with the Diaphysis of the Third Metacarpal and Metatarsal Bones (Cannon Bone) 610
 - "Splints" 612
 - Fractures of the Small Metacarpal and Metatarsal (Splint) Bones 615
 - Lameness Associated with the Origin of the Suspensory Ligament 622
- The Carpus 624
 - Angular Limb Deformities Associated with the Carpus (Carpus Valgus and Carpus Varus, Medial Deviation of the Carpus and Lateral Deviation of the Carpus) 624
 - Dorsal (Anterior) Deviation of the Carpal Joints (Bucked Knees, Knee Sprung, Goat Knees, and Flexion Deformity of the Carpus) 641
 - Rupture of the Extensor Carpi Radialis Tendon 643
 - Rupture of the Common Digital Extensor Tendon 643
 - Hygroma of the Carpus 645
 - Intraarticular Fractures of the Carpus 647
 - Luxations of the Carpal Joints 657
 - Carpal Canal (Tunnel) Syndrome 659
 - Fractures of the Accessory Carpal Bone 661
- The Forearm (Antebrachium) 663
 - Osteochondroma Formation at the Distal Radius (Supracarpal Exostoses) 663
 - Sprain of the Accessory Ligament (Radial or Superior Check Ligament) of the Superficial Digital Flexor Tendon 665
 - Fractures of the Radius 667
- The Elbow 670
 - Fractures of the Ulna 670
 - Rupture of the Medial Collateral Ligament of the Humeroradial (Elbow) Joint 674
 - Bursitis at the Point of the Elbow (Olecranon Bursitis, Shoe Boil, Capped Elbow) 675
- The Humerus 675
 - Fractures of the Humerus 675
 - Paralysis of the Radial Nerve 678
- The Shoulder 679
 - Inflammation of the Bicipital Bursa (Bursa Intertubercularis, Bicipital Bursitis) 679
 - Ossification of the Tendon of the Biceps Brachii Muscle 681
 - Inflammation of the Infraspinatus Bursa 683

Osteochondrosis of the Scapulohumeral (Shoulder) Joint	683	Distal Luxation of the Patella	741
Arthritis of the Shoulder Joint (Omarthritis)	687	Patellar Subluxation and Luxation (Patellar Ectopia)	741
Luxation of the Scapulohumeral (Shoulder) Joint	688	Fracture of the Patella	743
Paralysis of the Suprascapular Nerve (Atrophy of the Supraspinatus and Infraspinatus Muscles [Sweeny])	689	The Femur	744
Fractures of the Scapula	691	Fractures	744
Fractures of the Supraglenoid Tubercle (Tuber Scapulae)	692	Femoral Nerve Paralysis (Crural Paralysis)	746
Rupture of the Serratus Ventralis Muscles	693	Trochanteric Bursitis (Trochanteric Lameness, Whorlbone Lameness)	747
The Tarsus	694	The Coxofemoral Joint	748
Bone Spavin (Osteoarthritis or Degenerative Joint Disease of the Distal Tarsal Joints)	694	Rupture of the Round Ligament of the Coxofemoral Joint	748
Cunean Tendinitis and Bursitis (Distal Tarsitis Syndrome of Harness Race Horses)	704	Coxofemoral Luxation (Dislocation of the Hip Joint)	748
Bog Spavin (Idiopathic Synovitis Tarsocrural Effusion)	706	The Pelvis	750
Blood Spavin	708	Thrombosis of the Caudal Aorta or Iliac Arteries	750
Occult Spavin (Blind Spavin)	708	Fractures of the Pelvis	752
Osteochondritis Dissecans of the Tarsocrural (Tibiotalar) Joint	709	Subluxation of the Sacroiliac Joint (Sacroiliac Strain)	753
Slab Fractures of the Central and Third Tarsal Bones	710	The Thoracolumbar Spine	757
Interarticular Fractures in the Tarsocrural (Tibiotalar) Joint	711	Associated Back Problems	757
Fractures of the Fibular Tarsal Bone (Calcaneus)	713	Overlapping of Thoracic and/or Lumbar Dorsal Spinous Processes	760
Luxations of the Tarsal Joints	715	Muscle Problems	761
Curb	715	Myositis of the Psoas and Longissimus Dorsi Muscles	761
Dislocation of the Superficial Digital Flexor Tendon off the Calcaneal Tuber (Luxation of the Superficial Digital Flexor)	718	Muscular Dystrophy	762
Rupture of the Peroneus Tertius	720	Tendons	762
Restriction by the Peroneus Tertius Muscle	721	Traumatic Division of the Digital Extensor Tendons of the Fore- and Hindlimb	764
Rupture of the Achilles Tendon	722	Traumatic Division of the Digital Flexor Tendons of the Fore- and Hindlimb	764
Rupture of the Gastrocnemius Tendon	722	Idiopathic Synovitis	767
Stringhalt	723	(Windpuffs, Windgalls)	767
Shivering	725	Wounds	767
The Tibia	726	The Wobbler Syndrome (A. J. Nixon)	772
Fractures	726	Cervical Vertebral Malformation	772
Osteochondrosis (Avulsion Fracture) of the Tibial Tuberosity	729	Equine Protozoal Myeloencephalitis	778
Fracture of the Fibula (Discontinuous Fibula)	730	Equine Degenerative Myeloencephalopathy	778
Fibrotic and Ossifying Myopathy	730	Equine Herpes Virus-1	778
The Stifle	733	Sorghum SP Toxicosis (Sudan Grass)	779
Lamenesses of the Stifle Joint (Gonitis)	733	Vertebral Osteomyelitis and Epidural Empyema	779
Upward Fixation of the Patella	737	Spinal Nematodiasis	779
Chondromalacia of the Patella	741	Vertebral Fractures	779
		<i>Chapter 9. Classification of Horseshoes and Horseshoe Nails</i>	
		TED S. STASHAK	
		Horseshoes	786
		Horseshoe Nails	787

Effects of Shoe Weights	788
Corrective Shoes	788
Shoe Pads	793

Chapter 10. Trimming and Shoeing the Normal Foot TED S. STASHAK

Trimming the Normal Foot	796
Shoeing the Normal Foot	799
After the Horse Has Been Shod	803
Foot Balance and Axis	803
Shoeing	803
Removing Horseshoes	804

Chapter 11. The Effects of Improper Trimming and Shoeing

TED S. STASHAK

Lateral and Medial Balance	807
Foot-Pastern Axis and Slope	808
Improper Shoeing	810

Chapter 12. Methods of Corrective Trimming and Shoeing

TED S. STASHAK

Fundamentals of Correcting Faults in Gaits	813
Corrective Trimming	815
Corrective Shoes	816
Square-Toe or Roller-Toe Shoes	816
Bar Shoes	816
Placement of the Shoe in Reverse Fashion	816
Clips	817
Trailers	817
Elevated Heels	817
Wide-Web Shoes	817
Concaved Solar Surface	818
Glue-On Shoes	818
Changing the Usable Ground Surface of the Foot	818
Conditions that Require Corrective Trimming and Shoeing	819
Base-Wide, Toe-Out in Front (Splay-Footed, Toe-Wide)	819
Base-Narrow, Toe-Out, Landing on Outside Wall in the Forefeet	822
Base-Narrow, Toe-In (Pigeon-Toed) (Toe Narrow)	823
Base-Wide, Toe-in, Landing on the Inside Wall of the Forefeet	824
Long Toes and Underrun Heels	824
Contracted Heels	825

Ringbone	827
Sidebones	827
Navicular Disease	827
Cow Hocks	827
Bone Spavin	828
Cross-firing	828
Forging and Overreaching	829
Elbow Hitting	830
Interfering	830
Corns	831
Toe and Quarter Cracks	831
Wire Cuts in the Coronary Band	831
Flexor Tendinitis or Injury	831
Flat Feet	832
Dropped Sole or "Pumiced Foot"	832

Chapter 13. Natural and Artificial Gaits O. R. ADAMS

The Walk	834
The Flat-Foot Walk	834
The Running Walk	834
The Trot	834
The Gallop or Run	836
The Canter	837
The Pace	838
The "Slow Gaits" (Running Walk, Fox Trot, or Amble)	838
Backing	839

Chapter 14. Methods of Therapy

TED S. STASHAK

Physical Therapy	840
Cold	840
Heat (Thermotherapy)	840
Massage	842
Faradic Current	842
Exercise	842
Other Methods of Therapy	843
Immobilization	843
Immobilization of a Part	844
Application of Counterirritation	856
Cryotherapy	863
Radiation Therapy	863
X-Irradiation	864
Acupuncture	864
Laser Therapy	864
Electrostimulation (ES), Pulsing	
Electromagnetic Fields (PEM) and Magnetic Therapy (MT)	864
Poultices or Cataplasms	866
The Use of Anti-inflammatory Agents	866

Index 879

Functional Anatomy of Equine Locomotor Organs

ROBERT A. KAINER

Anatomic Nomenclature and Usage

Through the efforts of nomenclature committees, informative and logical names for parts of the horse's body, as well as positional and directional terms, have evolved (*Nomina Anatomica Veterinaria*).¹⁵ Some older terminology is still acceptable. For example, while thoracic limb and pelvic limb are preferred anatomic designations, forelimb and hindlimb are commonly used. Navicular bone for distal sesamoid bone, coffin joint for distal interphalangeal joint, and fetlock joint for metacarpophalangeal joint, are acceptable synonyms. It behooves one to be familiar with many of the older terms. But some have become archaic and even add to the confusion in communicating structural concepts. These terms should be avoided. In this book acceptable synonyms will be indicated parenthetically, and the two terms may be used interchangeably.

In Figure 1-1 note that positional adjectives end in -al. When the terms are used as positional adverbs, the suffix -ally is added. When used as directional adverbs, those indicating direction from a given point, the suffix -ad is added. For example, a structure is located distally; another structure extends or courses distad. With the exception of the eye, the terms anterior and posterior are not applicable to quadrupeds. Cranial and caudal apply to the limbs proximal to the antebrachicarpal (radiocarpal) joint and the tarsocrural (tibiotarsal) joint. Distal to these joints, dorsal and palmar (on the forelimb) or plantar (on the hindlimb) are the correct terms. The adjective, solar, is used to designate structures on the palmar (plantar) surface of the distal phalanx and the ground surface of the hoof.

Thoracic Limb

Digit and Fetlock

The foot and pastern comprise the equine digit, a region including the distal (third), middle (second),

and proximal (first) phalanges and associated structures (Fig. 1-2). The fetlock consists of the metacarpophalangeal (fetlock) joint and the structures surrounding it.

Foot

The foot consists of the epidermal hoof and all it encloses: the connective tissue corium (dermis), digital cushion, distal phalanx (coffin bone, since it is enclosed as in a coffin), most of the lateral (collateral) cartilages of the distal phalanx, distal interphalangeal (coffin) joint, distal extremity of the middle phalanx (short pastern bone), distal sesamoid (navicular) bone, bursa podotrochlearis (navicular bursa), several ligaments, tendons of insertion of the common digital extensor and deep digital flexor muscles, blood vessels, and nerves.

The hoof is continuous with the epidermis at the coronet. Here the dermis of the skin is continuous with the dermis (corium or pododerm) subjacent to the hoof. Regions of the corium correspond to the parts of the hoof under which they are located: perioplic corium, coronary corium, laminar (lamellar) corium, corium of the frog, and corium of the sole.

Grossly definitive parts of the hoof protect underlying structures of the foot and initiate dissipation of concussive forces when the hoof strikes the ground. Examination of the ground surface of the hoof reveals the sole, frog, heels, bars, and ground surface of the wall (Fig. 1-3). The ground surface of the forefoot is wider than that of the hindfoot, reflecting the shape of the distal surface of the enclosed distal phalanx (coffin bone).

The hoof wall extends from the ground proximad to the coronary border where the soft white horn of the periople joins the epidermis of the skin at the coronet. Regions of the wall are the dorsal toe, the medial and lateral quarters, and the rounded heels continuing palmarad from the quarters (see Fig. 1-3;

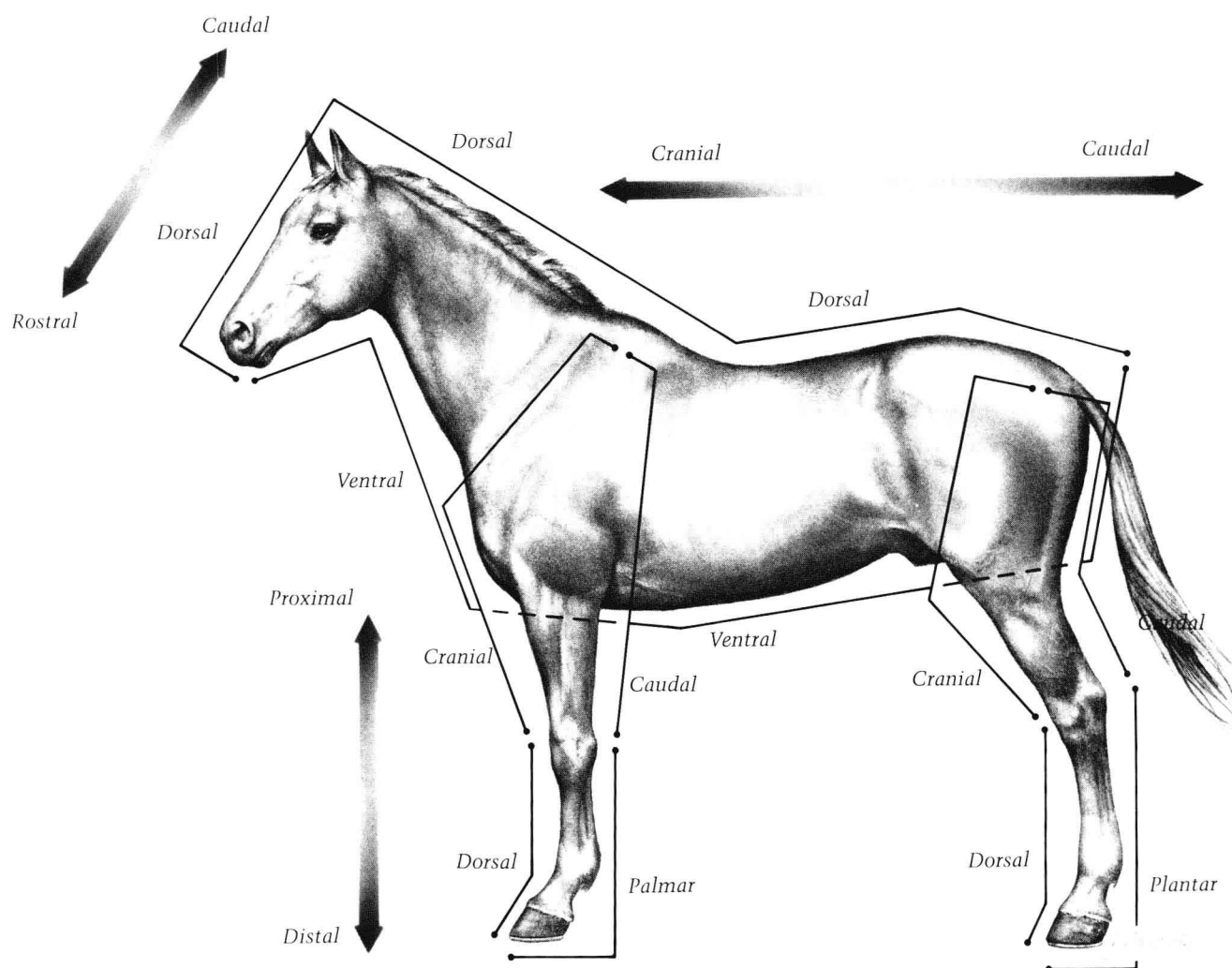


FIG. 1-1. Topographical and directional terms.

1-4). From the thick toe the wall becomes progressively thinner and more elastic toward the heels where it thickens again at the junction of the bars (the "buttress" of the hoof). The wall usually curves more widely on the lateral side, and the lateral angle is less steep than the medial angle. The angle of the toe between the dorsal surface and the ground surface is 48 to 60° in the forefoot.²⁶

Fine, proximodistal, parallel lines visible on the smooth surface of the wall are due to the orientation of the horn's tubules (Fig. 1-5). Differential growth rates of the wall from the coronary border toward the ground account for the smooth ridges parallel to the coronary border.

The fibrous connective tissue corium contains blood vessels and nerves. It provides nourishment as well as attachment for the overlying germinal layer (stratum germinativum) of the stratified squamous epithelium comprising the ungual epidermis (L. ungula, hoof). The basal layer (stratum basale) of the stratum germinativum is a single layer of prolif-

erating cylindrical cells. One to a few layers of polyhedral cells in the process of keratinization (formation of horn) make up the stratum spinosum.¹¹ The rest of the ungual epidermis is a stratum corneum of anucleate squamous cells containing hard keratin of the cutaneous epidermis. Cells of the ungual epidermis form horn tubules, intertubular horn or lamellae (sheets), corresponding to the configuration of the underlying corium. Most of the ungual epidermis, the horny stratum corneum, is devoid of nerve endings; it is the "insensitive" part of the foot. A few sensory nerve endings from the corium penetrate between cells of the germinal layer of the epidermis. In addition to many sensory nerve endings, the corium contains motor sympathetic endings to blood vessels.

Three layers comprise the hoof wall: the stratum externum (stratum tectorium), stratum medium, and stratum internum (stratum lamellatum)¹¹ (see Fig. 1-5). The superficial stratum externum is a thin

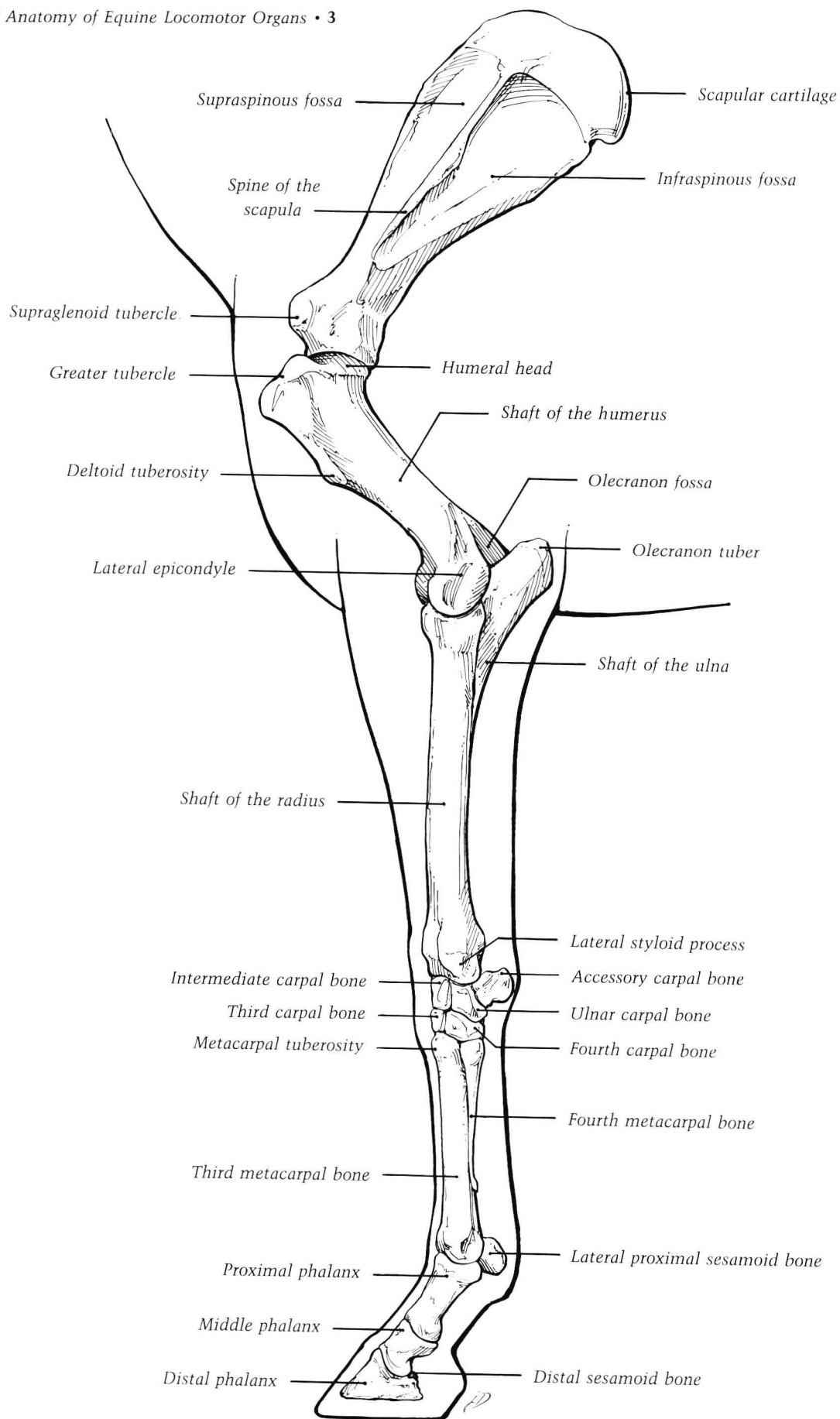


FIG. 1–2. Bones of the equine thoracic limb; lateral view.

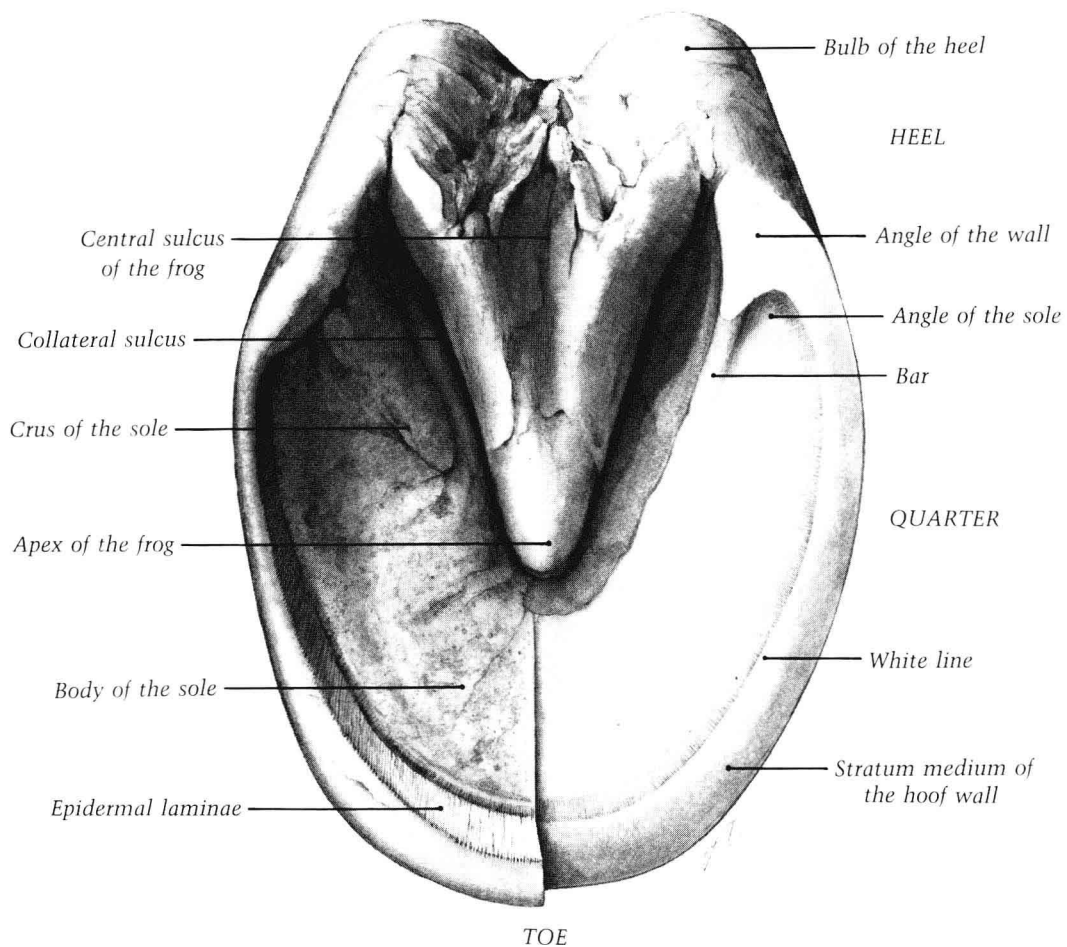


FIG. 1-3. Ground (solar) surface of the hoof. The right half has been trimmed to emphasize the formation of the white line (zona lamellata) by the epidermal laminae.

layer of horn extending distad from the periople a variable distance that decreases with age. The bulk of the wall is a stratum medium consisting of horn tubules and intertubular horn. The horn tubules are generated by the germinal layer of the coronary epidermis covering the long papillae of the coronary corium.¹ Intertubular horn is formed in between the projections. The relationship of the coronary papillae to the epidermis can be clarified by examining the coronary groove of the hoof into which the coronary corium fits. Fine pits that accommodate the papillae can be seen in the coronary groove. Distal to the coronary groove around 600 primary epidermal laminae (lamellae) of the stratum internum inter-

leave with the primary dermal laminae of the laminar (lamellar) corium (see Figs. 1-4 and 1-5). Approximately 100 microscopic secondary laminae branch at an angle from each primary lamina, further binding the hoof and corium together (Fig. 1-6).

Some confusion exists concerning the terms "insensitive" and "sensitive" laminae. In the strictest sense the keratinized parts of the primary epidermal laminae are insensitive; the stratum germinativum, which includes all of the secondary epidermal laminae, and the laminar corium are "sensitive." The terms epidermal and dermal (or corial) are far more accurate adjectives.²⁴

A relationship similar to that between the coro-