

SMALL ANIMAL SURGERY

SECOND EDITION



— THERESA WELCH FOSSUM —

CHERYL S. HEDLUND • DONALD A. HULSE
ANN L. JOHNSON • HOWARD B. SEIM, III
MICHAEL D. WILLARD • GWENDOLYN L. CARROLL

 Mosby

SMALL ANIMAL SURGERY

SECOND EDITION

THERESA WELCH FOSSUM,
DVM, MS, PhD

Diplomate ACVS
Tom and Joan Read Chair in Veterinary Surgery
Associate Director Cardiothoracic Surgery
and Biomedical Devices, Michael E. DeBakey Institute
Professor of Surgery
Texas A&M University
College of Veterinary Medicine
College Station, Texas

LAURA PARDI DUPREY
Medical Illustrator

with more than 1800 illustrations

 **Mosby**

St. Louis London Philadelphia Sydney Toronto



Publishing Director: John A. Schrefer
Editorial Manager: Linda L. Duncan
Senior Developmental Editor: Teri Merchant
Project Manager: Linda McKinley
Production Editor: Rich Barber
Designer: Julia Dummitt
Cover Art and Chapter Openers: "On the Inside Looking Out" by Anne Embree

Copyright © 2002 by Mosby, Inc.
Previous edition copyrighted 1997

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher.

Notice

Pharmacology is an ever-changing field. Standard safety precautions must be followed, but as new research and clinical experience broaden our knowledge, changes in treatment and drug therapy may become necessary or appropriate. Readers are advised to check the most current product information provided by the manufacturer of each drug to be administered to verify the recommended dose, the method and duration of administration, and contraindications. It is the responsibility of the licensed prescriber, relying on experience and knowledge of the patient, to determine dosages and the best treatment for each individual patient. Neither the publisher nor the editor assumes any liability for any injury and/or damage to persons or property arising from this publication.

Permission to photocopy or reproduce solely for internal or personal use is permitted for libraries or other users registered with the Copyright Clearance Center, provided that the base fee of \$4.00 per chapter plus \$.10 per page is paid directly to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, Massachusetts 01923. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotion purposes, for creating new collected works, or for resale.

Mosby, Inc.
An Elsevier Science Company
11830 Westline Industrial Drive
St. Louis, Missouri 63146

Printed in the United States of America

International Standard Book Number 0-323-01238-8

02 03 04 05 06 / 9 8 7 6 5 4 3 2 1



SMALL ANIMAL SURGERY





THERESA WELCH FOSSUM, DVM, MS, PhD, Diplomate ACVS, Tom and Joan Read Chair in Veterinary Surgery, Professor of Surgery and Associate Director of the Michael E. DeBakey Institute, Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University. Dr. Fossum is recognized as an outstanding veterinarian and an excellent teacher. She has received several awards for

teaching excellence, including the Wiley Distinguished Teaching Professorship in Veterinary Medicine and the Norden Teaching Award. She frequently lectures and conducts laboratory sessions across the United States and the world. She has acted as principal investigator in a great number of funded research activities and received the American Kennel Club and American Veterinary Medical Foundation "Excellence in Canine Research" awarded in 1997 for her research of chylothorax. In addition, she has authored an impressive number of refereed publications and book chapters and acts as a reviewer for several leading veterinary journals.



CHERYL S. HEDLUND, DVM, MS, Diplomate ACVS, Professor of Surgery and Chief, Companion Animal Surgery, School of Veterinary Medicine, Louisiana State University. Dr. Hedlund has been working in veterinary medicine since she was a child, helping out in her father's rural veterinary practice. She is well respected in the field of veterinary medicine, particularly for her expertise in upper respiratory surgery. Dr.

Hedlund frequently contributes to articles to refereed publications and has authored many book chapters. She has been a member of the Editorial Review Boards for *Veterinary Surgery* and *Journal of the American Animal Hospital Association* and acts as an ad hoc reviewer for other journals. Dr. Hedlund has served on the ACVS's Credentials Committee and is a member of the AVMA and AAHA, among other professional organizations.



DONALD A. HULSE, DVM, Diplomate ACVS, Professor, Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University. Dr. Hulse is well recognized for his accomplishments in teaching and in small animal orthopedics. He served as Section Chief of Small Animal Surgery from 1992 to 1996. He served on the ACVS's Examination Committee from 1992 to 1995. Dr. Hulse

sat on the Board of Directors of the Veterinary Orthopedic Society from 1984 to 1987. He is also a member of the AVMA. Dr. Hulse's research in small animal orthopedics is extensive, including many funded projects. His articles on orthopedics have been widely published, and he is a frequent contributor to veterinary books.

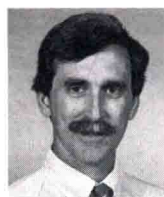


ANN L. JOHNSON, DVM, MS, Diplomate ACVS, Professor, Department of Veterinary Medicine, University of Illinois. Dr. Johnson is an internationally recognized veterinary orthopedic surgeon and educator. She has received the University of Illinois Award for Excellence in Graduate and Professional Teaching and the Purdue Outstanding Alumna Award in recognition of Distinguished Performance in Teaching, Research, and Organized Veterinary Medicine. She has been invited to lecture and conduct courses throughout the United States, Europe, and South America. Her research is significant, and she has had numerous journal articles and book chapters published. Dr. Johnson has been an active member of numerous committees in the ACVS since 1985 and was elected President of the ACVS in 1996. She is also a member of the AVMA, AO-Vet and the Veterinary Orthopedic Society.



HOWARD B. SEIM III, DVM, Diplomate ACVS, Associate Professor and Chief of Small Animal Surgery, Department of Clinical Sciences, Colorado State University. Dr. Seim has garnered accolades for his teaching ability. He was co-recipient of the 1993 Merck AGVET Award for Creative Teaching and was awarded Colorado State University's N. Preston Davis Award for Instructional Innovation in 1995. Dr. Seim has

been teaching for 25 years and has been an active student, intern, and resident advisor. Dr. Seim is well recognized for his knowledge of and experience in the field of neurosurgery. He has presented innumerable scientific papers in this field, and has authored or co-authored many book chapters. Dr. Seim has obtained funding for a variety of research projects, particularly developing implants for spinal fusion and disk replacement. He has been a member of the Editorial Review Board of the *Journal of the AVMA*, *Veterinary Surgery*, and *Journal of Feline Medicine and Surgery*. Dr. Seim served on the ACVS's Examination committee from 1991 to 1995 and as a member of their Board of Regents from 1998 to 2000.



MICHAEL D. WILLARD, DVM, MS, Diplomate ACVIM, Professor, Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University. Dr. Willard has received several awards for teaching excellence since 1987, among them the 1994 National Norden Award. In addition, he has numerous clinical presentations and has conducted some research in gastroenteric problems.

Dr. Willard is also a member of the AVMA, AAHA, and the Comparative Gastroenterology Society. He serves as a reviewer for several veterinary journals. He has contributed numerous journal articles and several monographs and book chapters. Dr. Willard was responsible for the endoscopy section and has reviewed most of the chapters in *Small Animal Surgery*, verifying the medical management of surgical diseases from an internist's perspective.



ANESTHESIA CONSULTANT - GWENDOLYN L. CARROLL, MS, DVM, Diplomate ACVA. Associate Professor, Anesthesiology, Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University. Her primary interest is perioperative analgesia. Dr. Carroll is a member of the AVMA, the International Veterinary Acupuncture Society, and the Veterinary Emergency and Critical Care Society, among other organizations. She has authored several refereed publications and book chapters, as well as a text on small animal pain management. She was responsible for reviewing and verifying most anesthetic regimens and dosages included throughout *Small Animal Surgery*.

*This book is dedicated to my husband (Matt Miller)
and sons, Chase and Kobe,
who made a personal sacrifice
while it was being written, to fellow practitioners throughout the world,
and to my students.*

While contemplating a second edition to this textbook, we decided that it was crucial that this edition be more than a simple update of procedures that had been included in the first edition. It was our goal to add significant new information to the text, while at the same time improving the format and artwork used in the first edition. We are extremely proud of this second edition. We hope that you will find that we have accomplished our goals. In addition to adding five totally new chapters on endoscopy and minimally invasive surgery, we have also expanded the section on neurosurgery, incorporating new chapters on surgery of the brain and peripheral nerves. We have also added procedures and indications for many commonly performed ophthalmic procedures in the integumentary chapter. Throughout the text, you will find that we have updated procedures with new information published since the first edition was printed, and in many cases we have added descriptions of entirely new procedures that were either rarely used, or not used, when the first edition was published. For example, we have included several new sections on arthroscopy in orthopedics; this minimally invasive procedure is quickly becoming a modality of choice in the treatment of many complex joint problems. It was our goal to make sure that we produced the most state-of-the-art book possible. Although it has always been our desire to provide clinically useful information, rather than a monologue of research on a given topic, we have addressed the need for a review of recent research by providing a new section at the end of the soft tissue, orthopedic, and neurosurgery chapters entitled "Selected abstracts of recent manuscripts." This section is not meant to be an all-inclusive review of recent publications, but within this section, the reader will find a concise review of selected manuscripts that were chosen because they address important clinical concerns. We hope to build on this section in future editions.

We have added new artwork to existing procedures, and you will find that there are more color illustrations in this edition than in the last. In fact, 75% of the illustrations in this edition are in full color. The artwork in the orthopedic section, in particular, has been vastly redone. In keeping with the first edition, we have maintained our initial goals of providing (1) a limited number of contributors, (2) an excellent and consistent artwork program, and (3) a precise and consistent format that varies minimally between chapters.

It has always been our intent to make this book as user-friendly as possible. For this reason, we have expanded the NOTE boxes, which highlight important concerns, key concepts, and precautions. We have also expanded the use of tables that provide antibiotic, anesthetic, and analgesic protocols. The tables are color-coded for easy reference, some-

thing new to this edition. As with the first edition, we believe that to be successful, surgeons must have detailed knowledge of the important issues regarding diagnosis, an awareness of potential differential diagnoses, and a thorough appreciation of preoperative concerns relative to the animal's disease or condition. These sections are each outlined in the text. Additionally, anesthetic concerns, surgical anatomy, wound healing, postoperative concerns, and potential complications are detailed. As with the first edition, the surgical technique itself is described in detail, which provides the reader with a comprehensive and thorough description of each procedure.

We were lucky to enlist the aid of the same surgeons from the first edition in this revised edition. As with the first edition, the bulk of this book was written by five surgeons and an internist. Dr. Howard Seim and I were responsible for Part I, *General Surgical Principles*, while Dr. Mike Willard contributed Section II, *Endoscopy*. Dr. Cheryl Hedlund and I were responsible for Part III, *Soft Tissue Surgery*, and Drs. Ann Johnson and Don Hulse provided the material encompassed in Part IV, *Orthopedic Surgery*. Dr. Howard Seim contributed Part V, *Neurosurgery*. Dr. Gwen Carroll provided the chapter on pain management (Chapter 12). Lastly, Dr. Mike Willard reviewed and provided his perspective to many of the chapters so that we might provide the most up-to-date information on the medical management of surgical disease.

SPECIAL FEATURES

Art Program

We were extremely privileged to be able to work with our original illustrator, Laura Duprey, on this second edition. In addition to being an incredibly skilled artist, she has an extremely broad-based and detailed knowledge of anatomy. You will find that the illustrations in this text are exceptionally clear and accurate. We have added many new illustrations, and revised many more, in our attempt to make this book the best illustrated textbook in veterinary medicine.

OVERALL ORGANIZATION OF THE BOOK

The first edition garnered much praise for using a consistent and user-friendly format. We have maintained that format here, expanding upon it where appropriate. Because we know that veterinary practitioners are busy, we have used tables throughout the text to provide easy reference and to reduce the amount of time spent searching for drug doses and other important information. Again, to prevent excessive duplication of material throughout the text, we have in some instances referred readers to other pages; however, when we have done so we have attempted to provide a specific page

number for reference to help you find the information as quickly and easily as possible.

General Format

This book comprises 44 chapters and is organized into five parts. The first 10 chapters of Part I, *General Surgical Principles*, were written with veterinary medical students in mind. The information contained within these chapters is the information we teach our students in their introductory surgery courses. Found within these chapters is detailed information on the basics of sterile technique, surgical instrumentation, suturing, preoperative care, and rational antibiotic use. The color photographs illustrating hand ties, pack preparation, and surgical instruments should be particularly useful. Chapter 11 contains information on postoperative care, including nutrition for surgical patients. Because nutrition affects many body systems and is an important adjunct to case management, we have included detailed information on techniques for hyperalimentation in this chapter. Chapter 12 is a practical description of the use of analgesics in veterinary patients, which has been expanded from the first edition.

Part II is a new section that describes endoscopy and minimally invasive surgical techniques. It uses the same user-friendly format as the other chapters and includes many beautiful photographs and drawings that illustrate techniques and equipment for performing these procedures. Parts III, IV, and V contain information on soft tissue surgery, orthopedic surgery, and neurosurgery, respectively. These chapters are divided into a section detailing general principles and a section on specific diseases. The *General Principles and Techniques* portion begins with definitions of procedures and terms relevant to the organ system detailed. Next are sections detailing information on preoperative concerns and anesthetic considerations. This is followed by a discussion on antibiotic use (including recommendations for antibiotic prophylaxis) and a brief description of pertinent surgical anatomy. Anatomy is too often neglected in surgical textbooks, or because of formatting is not well correlated with the techniques in a given chapter. As with the first edition, we have circumvented this problem by including it as separate and consistent heading under *General Principles and Techniques*. Surgical techniques that are broadly applicable to a number of diseases are also detailed in this section. However, if a surgical procedure is specific to a particular disease, the description of the technique will be found instead with the specific disease description. Brief discussions on healing of the specific organ or tissue as well as suture material and special instruments follow the surgical techniques descriptions. The final headings in the *General Principles and Techniques* section are *Postoperative Care and Assessment*, *Complications*, and *Special Age Considerations*.

The *Specific Diseases* portion of each chapter begins with definitions, usually of the disease. When relevant, synonyms for the disease or techniques are given. Next, general considerations and clinically relevant pathophysiology are detailed. This information is meant to provide practical material for

General chapter format

- I. General principles and techniques
 - A. Definitions
 - B. Preoperative concerns
 - C. Anesthetic considerations
 - D. Antibiotics
 - E. Surgical anatomy
 - F. Techniques
 - G. Wound healing
 - H. Suture materials/special instruments
 - I. Postoperative care and assessment
 - J. Complications
 - K. Special age considerations
 - II. Specific diseases
 - A. Definitions
 - B. Synonyms
 - C. General considerations and clinically relevant pathophysiology
 - D. Diagnosis
 1. Clinical presentation
 - a. Signalment
 - b. History
 2. Physical examination findings
 3. Radiography/Ultrasonography
 4. Laboratory findings
 - E. Differential diagnosis
 - F. Medical management
 - G. Surgical treatment
 1. Preoperative management
 2. Anesthesia
 3. Surgical anatomy
 4. Positioning
 - H. Surgical technique
 - I. Suture materials/special instruments
 - J. Postoperative care and assessment
 - K. Complications
 - L. Prognosis
-

case management, rather than serving as a supplemental text for pathophysiology. The discussions of diagnoses are detailed and include information on signalment and history, physical examination findings, radiography and ultrasonography, and pertinent laboratory abnormalities. Sections on differential diagnoses and medical management of affected animals are consistently provided. These are followed by a detailed description of the relevant surgical techniques. We have attempted to detail most commonly used techniques, although we may have noted our preference for a particular method. Information on positioning patients for a given procedure is often neglected in surgical textbooks; to avoid this we have provided this information as a separate and consistent heading. The remainder of the *Specific Diseases* section deals with postoperative care of the surgical patient, potential complications, and prognosis.

Anesthesia Protocols

In most surgery textbooks, anesthesia is either totally neglected or is included in separate chapters near the end of the book. Busy practitioners often find it difficult to access this information and correlate it with the cases they are operat-

ing. Therefore, recommendations for anesthetizing animals with a particular disease or disorder are found in the *Specific Diseases* section of each chapter. As with the first edition, Dr. Gwen Carroll served as our anesthesia consultant for this revision. Gwen was responsible for reviewing the general anesthesia information for each organ system included in the *General Principles and Techniques* sections. Also included in this book are numerous suggested anesthetic protocols, including drug dosages. Although we recognize that many veterinarians have established protocols that they prefer and with which they are comfortable, the protocols provided in this book have proved to be a handy resource for both students and doctors.

References

As with the first edition, rather than provide a long list of available references, we have chosen to provide selected references under the heading *Suggested Reading*. When a specific study or finding is indicated in the text, the reference has been noted and included in a separate heading called *References*. It was our feeling that with the ready availability of computerized bibliographic information, laundry lists of references are no longer necessary. In order to make room for newer references, we have removed many references more than 10 years old from this edition, unless the reference was thought to be a “classic.”

Selected Abstracts of Recent Manuscripts

In keeping with our desire to provide concise, useful information to practitioners and students of veterinary medicine, we have purposely avoided providing research material on a given topic not yet proven to have clinical relevance. However, with this edition, we have addressed the need for a review of recent research by providing a new section at the end of the soft-tissue, orthopedic, and neurosurgery chapters called *Selected abstracts of recent manuscripts*. This section is not meant to be an all-inclusive review of recent publications; however, it will provide a concise review of selected manuscripts that were chosen because they address important clinical concerns. We hope to expand this section in future editions.

Tables

As in the first edition, we have included hundreds of summary tables for key clinical information. To facilitate ease of access and to promote comprehension, we have created unique logos and color schemes for tables with similar types of information:

- Etiology
- Classifications of Disease
- Clinical Signs
- Diagnosis and Differential Diagnosis
- Antibiotics
- Anesthetics and Sedation
- Analgesics/Pain Management
- General Treatment
- Complications
- Calculations
- General Tables

Index

We felt that an extensive index was mandatory. The index of *Small Animal Surgery* is thorough and exhaustive. Additionally, we have avoided cross-referencing readers to separate entries in the index. Rather, we have opted to duplicate page sources each time a topic is listed because we believe that this is the most useful format for practitioners.

Acknowledgments

A textbook of this nature takes the input and hard work of a great number of people to ensure that it is a quality reference. Special thanks to Linda Duncan and Rich Barber and all the others at Mosby who worked on this project. We thank them for their enthusiasm, words of encouragement, vision, and most of all for their belief in this book. Without them, this edition would not have been possible.

We would also like to thank our mentors and colleagues, who have instilled in us a love of surgery and a dedication to our profession. Without you, this book would not have become a reality. I would particularly like to thank Dr. Phil Hobson, whose vision, support, and words of encouragement I hold dear.

To all of you who purchased the first edition, we appreciate your input and recommendations. We particularly welcome your suggestions on how to improve future editions. We hope you find this edition a worthy effort.

I would like to once again thank my fellow contributors on this book. I am blessed to have been able to work with some of the best and most dedicated surgeons in veterinary medicine. This edition was no less of an undertaking than the first edition, and your dedication and hard work made it a timely and worthwhile edition to the veterinary literature. Many thanks!

Finally, I would like to acknowledge the support and encouragement of my wonderful family: my husband, Matt Miller; my sons, Chase and Kobe Miller; my mother, Marian Smith; and my mother-in-law, Diane Miller.



SMALL ANIMAL SURGERY



CONTENTS

PART I GENERAL SURGICAL PRINCIPLES

- 1** Principles of Surgical Asepsis, 1
- 2** Sterilization and Disinfection, 7
- 3** Surgical Facilities, Equipment, and Personnel, 11
- 4** Care and Maintenance of the Surgical Environment, 15
- 5** Preoperative Assessment of the Surgical Patient, 18
- 6** Preparation of the Operative Site, 23
- 7** Preparation of the Surgical Team, 27
- 8** Surgical Instrumentation, 34
- 9** Biomaterials, Suturing, and Hemostasis, 43
- 10** Surgical Infections and Antibiotic Selection, 60
- 11** Postoperative Care of the Surgical Patient, 69
- 12** Treatment of Perioperative Pain, 93

PART II ENDOSCOPY

- 13** Endoscopy: General Principles and Techniques, 103
- 14** Alimentary Tract Endoscopy, 109
- 15** Respiratory Tract Endoscopy, 121
- 16** Endoscopy of Body Cavities, 127
- 17** Urinary Tract Endoscopy, 132

PART III SOFT TISSUE SURGERY

- 18** Surgery of the Integumentary System, 134
- 19** Surgery of the Ear, 229
- 20** Surgery of the Abdominal Cavity, 254
- 21** Surgery of the Digestive System, 274
- 22** Surgery of the Liver, 450
- 23** Surgery of the Extrahepatic Biliary System, 475
- 24** Surgery of the Endocrine System, 487

- 25** Surgery of the Hemolymphatic System, 531
- 26** Surgery of the Kidney and Ureter, 549
- 27** Surgery of the Bladder and Urethra, 572
- 28** Surgery of the Reproductive and Genital Systems, 610
- 29** Surgery of the Cardiovascular System, 675
- 30** Surgery of the Upper Respiratory System, 716
- 31** Surgery of the Lower Respiratory System: Lungs and Thoracic Wall, 760
- 32** Surgery of the Lower Respiratory System: Pleural Cavity and Diaphragm, 788

PART IV ORTHOPEDICS

- 33** Fundamentals of Orthopedic Surgery and Fracture Management, 821
- 34** Management of Specific Fractures, 901
- 35** Diseases of the Joints, 1023
- 36** Management of Muscle and Tendon Injury or Disease, 1158
- 37** Other Diseases of Bones and Joints, 1168

PART V NEUROSURGERY

- 38** Fundamentals of Neurosurgery, 1192
- 39** Surgery of the Cervical Spine, 1213
- 40** Surgery of the Thoracolumbar Spine, 1269
- 41** Surgery of the Lumbosacral Spine, 1302
- 42** Surgery of the Brain, 1322
- 43** Surgery of the Peripheral Nerves, 1346
- 44** Nonsurgical Diseases of the Spine, 1361

DETAILED CONTENTS

PART I GENERAL SURGICAL PRINCIPLES

1 Principles of Surgical Asepsis, 1

Howard B. Seim III, Theresa Welch Fossum

Preparation of Surgical Packs, 1

Handling and Storage of Sterilized Instruments and Equipment, 3

2 Sterilization and Disinfection, 7

Howard B. Seim III

Disinfection, 7

Sterilization, 7

Sterilization Indicators, 10

3 Surgical Facilities, Equipment, and Personnel, 11

Howard B. Seim III

Structure and Design of the Surgical Area, 11

Description and Function of Rooms in the Surgical Area, 11

Personnel, 13

4 Care and Maintenance of the Surgical Environment, 15

Howard B. Seim III

Daily Cleaning Routines, 15

Weekly and Monthly Cleaning Routines, 16

5 Preoperative Assessment of the Surgical Patient, 18

Theresa Welch Fossum

History Taking, 18

Physical Examination, 18

Laboratory Data, 19

Determination of Surgical Risk, 20

Client Communication, 20

Patient Stabilization, 20

6 Preparation of the Operative Site, 23

Theresa Welch Fossum

Dietary Restrictions, 23

Excretions, 23

Treatment of Hair, 23

Positioning, 24

Sterile Skin Preparation, 24

Draping, 25

7 Preparation of the Surgical Team, 27

Theresa Welch Fossum

Surgical Attire, 27

Surgical Scrub, 28

Gowning, 30

Gloving, 31

Maintaining Sterility During Surgery, 31

8 Surgical Instrumentation, 34

Theresa Welch Fossum

Instrument Categories, 34

Instrument Care and Maintenance, 40

Draping and Organizing the Instrument Table, 42

9 Biomaterials, Suturing, and Hemostasis, 43

Theresa Welch Fossum

Sutures and suture selection, 43

Other Biomaterials, 48

Common Suture Techniques, 49

Hemostatic Techniques and Materials, 58

10 Surgical Infections and Antibiotic Selection, 60

Howard B. Seim III, Theresa Welch Fossum

Mechanisms of Antibiotic Action, 60

Causes of Antibiotic Failure and Mechanisms of Antibiotic Resistance, 64

Surgical Infections, 64

Prophylactic and Therapeutic Use of Antibiotics, 66

11 Postoperative Care of the Surgical Patient, 69

Howard B. Seim III, Michael D. Willard

Nutritional Management of the Surgical Patient, 70

Methods of Providing Hyperalimentation, 74

Calculation of Rate and Volume of Feeding, 90

Complications, 90

12 Treatment of Perioperative Pain, 93

Gwendolyn L. Carroll

Pain Management, 93

Postoperative Patient Evaluation, 101

PART II ENDOSCOPY

13 Endoscopy: General Principles and Techniques, 103

Michael D. Willard

Indications, 103
Equipment, 104
Equipment Care, 106
Antibiotics, 107
Procedures, 107
Postendoscopy Care, 108

14 Alimentary Tract Endoscopy, 109

Michael D. Willard

Gastroduodenoscopy, 109
Esophagoscopy, 114
Rigid Proctoscopy and Colonoscopy, 117
Flexible Colonoscopy, 118

15 Respiratory Tract Endoscopy, 121

Michael D. Willard

Laryngoscopy, 121
Bronchoscopy, 121
Rhinoscopy, 124
Examination of the Posterior Nares, 125

16 Endoscopy of Body Cavities, 127

Michael D. Willard

Laparoscopy, 127
Thoracoscopy, 130

17 Urinary Tract Endoscopy, 132

Michael D. Willard

Urethrocystoscopy, 132

PART III SOFT TISSUE SURGERY

18 Surgery of the Integumentary System, 134

Cheryl S. Hedlund

General Principles and Techniques, 134
 Wound Management, 134
 Bandages, 145
Principles of Plastic and Reconstructive Surgery, 153
 Skin Tension and Elasticity, 153
 Pedicle Flaps, 165
 Composite Flaps, 174
 Myocutaneous and Muscle Flaps, 174
 Omental Flaps, 180
 Microvascular Flap Transfer, 182
 Skin Grafts, 182

Surgical Management of Specific Skin Disorders, 186

Burns and Other Thermal Injuries, 186
Electrical Injuries, 188
Frostbite, 189
Chemical Injuries, 189
Radiation Injury, 189
Snakebite, 190
Pressure Sores, 191
Elbow Hygroma, 192
Lick Granuloma, 193
Dermoid Sinus (Pilonidal Sinus), 194
Interdigital Pyoderma, 195
Redundant Skin Folds, 195

Surgery of the Tail, 198

Caudectomy, 198

Surgery of the Digits and Footpads, 202

Onychectomy, 202

Surgery of the Eye, 210

19 Surgery of the Ear, 229

Theresa Welch Fossum

General Principles and Techniques, 229

Specific Diseases, 239

Otitis Externa, 239

Otitis Media and Interna, 243

Aural Hematomas and Traumatic Lesions of the Pinna, 246

Neoplasia of the Pinna and External Ear Canal, 251

20 Surgery of the Abdominal Cavity, 254

Theresa Welch Fossum

General Principles and Techniques, 254

Specific Diseases, 259

Umbilical and Abdominal Hernias, 259

Inguinal, Scrotal, and Femoral Hernias, 261

Peritonitis, 267

21 Surgery of the Digestive System, 274

Surgery of the Oral Cavity and Oropharynx, 274

Cheryl S. Hedlund

General Principles and Techniques, 274

Specific Diseases, 285

Congenital Oronasal Fistula (Cleft Palate), 285

Acquired Oronasal Fistulae, 291

Oral Tumors, 297

Salivary Mucoceles, 302

Surgery of the Esophagus, 307

Cheryl S. Hedlund

General Principles and Techniques, 307

Specific Diseases, 318

Esophageal Foreign Bodies, 318

Esophageal Strictures, 321

Esophageal Diverticula, 323
Esophageal Neoplasia, 324
Hiatal Hernia, 326
Gastroesophageal Intussusception, 330
Cricopharyngeal Achalasia, 332
Vascular Ring Anomalies, 334

Surgery of the Stomach, 337

Theresa Welch Fossum

General Principles and Techniques, 337

Specific Diseases, 352

Gastric Foreign Bodies, 352
Gastric Dilatation-Volvulus, 354
Benign Gastric Outflow Obstruction, 360
Gastric Ulceration and Erosion, 363
Gastric Neoplasia and Infiltrative Disease, 366

Surgery of the Small Intestine, 369

Cheryl S. Hedlund

General Principles and Techniques, 369

Specific Diseases, 384

Intestinal Foreign Bodies, 384
Intestinal Neoplasia, 388
Intussusception, 390
Infectious and Inflammatory Conditions, 393
Intestinal Volvulus and Torsion, 395

Surgery of the Large Intestine, 398

Cheryl S. Hedlund

General Principles and Techniques, 398

Specific Diseases, 408

Neoplasia, 408
Colitis, 410
Megacolon, 412

Surgery of the Perineum, Rectum, and Anus, 415

Cheryl S. Hedlund

General Principles and Techniques, 415

Specific Diseases, 424

Anal Neoplasia, 424
Anal Sac Infection and Impaction, 428
Perineal Hernia, 433
Perianal Fistulae, 437
Rectal Prolapse, 441
Fecal Incontinence, 444

22 Surgery of the Liver, 450

Theresa Welch Fossum

General Principles and Techniques, 450

Specific Diseases, 457

Portosystemic Vascular Anomalies, 457
Cavitary Hepatic Lesions, 468
Hepatobiliary Neoplasia, 471

23 Surgery of the Extrahepatic Biliary System, 475

Theresa Welch Fossum

General Principles and Techniques, 475

Specific Diseases, 482

Cholelithiasis, 482
Bile Peritonitis, 483

24 Surgery of the Endocrine System, 487

Theresa Welch Fossum

Surgery of the Adrenal and Pituitary Glands, 487

General Principles and Techniques, 487

Specific Diseases, 492

Adrenal Neoplasia, 492
Pituitary Neoplasia, 497

Surgery of the Pancreas, 501

General Principles and Techniques, 501

Specific Diseases, 506

Pancreatic Abscesses and Pseudocysts, 506
Insulinomas, 509
Gastrinomas, 512
Exocrine Pancreatic Neoplasia, 514

Surgery of the Thyroid and Parathyroid Glands, 516

General Principles and Techniques, 516

Specific Diseases, 519

Feline Hyperthyroidism, 519
Hyperparathyroidism, 525
Thyroid Carcinomas in Dogs, 527

25 Surgery of the Hemolymphatic System, 531

Theresa Welch Fossum

Surgery of the Lymphatic System, 531

General Principles and Techniques, 531

Specific Diseases, 534

Lymphedema, 534

Surgery of the Spleen, 537

General Principles and Techniques, 537

Specific Diseases, 542

Splenic Torsion, 542
Splenic Neoplasia, 544

26 Surgery of the Kidney And Ureter, 549

Theresa Welch Fossum

General Principles and Techniques, 549

Specific Diseases, 558

Ectopic Ureter, 558
Renal and Ureteral Calculi, 565
Renal and Ureteral Neoplasia, 568

27 Surgery of the Bladder and Urethra, 572

Theresa Welch Fossum

General Principles and Techniques, 572

Specific Diseases, 587

Uroabdomen, 587

Bladder and Urethral Calculi, 590

Urethral Prolapse, 595

Bladder and Urethral Neoplasia, 597

Urinary Incontinence, 600

Feline Urologic Syndrome

(Sterile Cystitis), 604

28 Surgery of the Reproductive and Genital Systems, 610*Cheryl S. Hedlund*

General Principles and Techniques, 610

Surgery of the Female Reproductive Tract, 632

Specific Diseases, 632

Mammary Neoplasia, 632

Uterine Neoplasia, 638

Pyometra, 639

Vaginal Prolapse/Hyperplasia, 644

Uterine Prolapse, 646

Surgery of the Male Reproductive Tract, 648

Specific Diseases, 648

Prostatic Hyperplasia, 648

Prostatic Abscesses, 650

Prostatic Cysts, 654

Prostatic Neoplasia, 658

Testicular and Scrotal Neoplasia, 659

Hypospadias, 662

Phimosis, 666

Paraphimosis, 668

Penile and Preputial Trauma and
Neoplasia, 671**29 Surgery of the Cardiovascular System, 675***Theresa Welch Fossum*

General Principles and Techniques, 675

Specific Diseases, 683

Mitral Regurgitation, 683

Patent Ductus Arteriosus, 686

Pulmonic Stenosis, 690

Aortic Stenosis, 694

Ventricular Septal Defect, 696

Tetralogy of Fallot, 699

Pericardial Effusion and Pericardial
Constriction, 701

Cardiac Neoplasia, 706

Bradycardia, 708

30 Surgery of the Upper Respiratory System, 716*Cheryl S. Hedlund*

General Principles and Techniques, 716

Specific Diseases, 727

Stenotic Nares, 727

Elongated Soft Palate, 730

Everted Laryngeal Saccules, 732

Laryngeal Collapse, 734

Laryngeal Paralysis, 735

Tracheal Collapse, 740

Theresa Welch Fossum

Laryngeal and Tracheal Tumors, 745

Nasal Tumors, 748

Nasal Aspergillosis, 755

31 Surgery of the Lower Respiratory System: Lungs and Thoracic Wall, 760*Theresa Welch Fossum*

General Principles and Techniques, 760

Specific Diseases, 770

Thoracic Wall Trauma, 770

Pulmonary Neoplasia, 773

Pulmonary Abscess, 776

Lung Lobe Torsion, 777

Pectus Excavatum, 780

Thoracic Wall Neoplasia, 784

32 Surgery of the Lower Respiratory System: Pleural Cavity and Diaphragm, 788*Theresa Welch Fossum*

General Principles and Techniques, 788

Specific Diseases, 795

Traumatic Diaphragmatic Hernia, 795

Peritoneopericardial Diaphragmatic
Hernia, 798

Pneumothorax, 800

Pleural Effusion, 804

Chylothorax, 805

Pyothorax, 812

Thymomas and Thymic Branchial
Cysts, 815**PART IV****ORTHOPEDICS****33 Fundamentals of Orthopedic Surgery and Fracture Management, 821***Ann L. Johnson, Donald A. Hulse*

General Principles and Techniques, 821

Orthopedic Examination, 844

Decision Making in Fracture
Management, 855

Fracture Fixation Systems, 859

External Coaptation, 859

Internal Fixation, 874

Fracture Reduction, 889

Bone Grafts, 893

34 Management of Specific Fractures, 901*Ann L. Johnson, Donald A. Hulse*

Maxillary and Mandibular Fractures, 901

Scapular Fractures, 913

Humeral Fractures, 919

*Humeral Diaphyseal and Supracondylar Fractures, 919**Humeral Epiphyseal, Physeal and Metaphyseal Fractures, 931*

Radial and Ulnar Fractures, 938

*Radial and Ulnar Diaphyseal Fractures, 938**Radial and Ulnar Metaphyseal and Epiphyseal Fractures, 948**Radial and Ulnar Physeal Fractures, 951**Radial and Ulnar Growth Deformities, 955*

Carpal and Tarsal Fractures, 963

Metacarpal, Metatarsal, Phalangeal, and Sesamoid Fractures and Luxations, 965

Pelvic Fractures, 971

*Acetabular Fractures, 971**Iliac, Ischial, and Pubic Fractures, 975**Sacroiliac Luxations and Fractures, 981*

Femoral Fractures, 984

*Femoral Diaphyseal Fractures, 984**Femoral Metaphyseal Fractures, 994**Femoral Physeal Fractures, 996**Patellar Fractures, 1004*

Tibial and Fibular Fractures, 1006

*Tibial and Fibular Diaphyseal Fractures, 1006**Tibial and Fibular Metaphyseal and Epiphyseal Fractures, 1014**Tibial and Fibular Physeal Fractures, 1017*

Temporomandibular Joint, 1043

*Temporomandibular Joint Luxation, 1043**Temporomandibular Joint Dysplasia, 1045*

Scapulohumeral Joint, 1048

*Osteochondritis Dissecans of the Proximal Humerus, 1048**Scapulohumeral Joint Luxation, 1057**Scapular Luxation, 1064**Bicipital Tenosynovitis, 1065*

Elbow Joint, 1066

*Canine Elbow Dysplasia, 1066**Fragmented Coronoid Process, 1067**Osteochondritis Dissecans of the Distal Humerus, 1073**Ununited Anconeal Process, 1075**Traumatic Elbow Luxation, 1079**Elbow Luxation or Subluxation Caused by Premature Closure of the Distal Ulnar or Radial Physes, 1084**Congenital Elbow Luxation, 1086**Carpal Luxation or Subluxation, 1089*

Coxofemoral Joint, 1093

*Hip Dysplasia, 1093**Coxofemoral Luxation, 1102**Legg-Perthes Disease, 1109*

Stifle, 1110

*Cranial Cruciate Ligament Rupture, 1110**Caudal Cruciate Ligament Injury, 1122**Collateral Ligament Injury, 1125**Multiple Ligament Injuries, 1128**Meniscal Injury, 1130**Medial Patellar Luxation, 1133**Lateral Patellar Luxation, 1140**Osteochondritis Dissecans of the Stifle, 1142*

Tarsus, 1143

*Ligament Injury of the Tarsus, 1143**Osteochondritis Dissecans of the Tarsus, 1150***35 Diseases of the Joints, 1023***Ann L. Johnson, Donald A. Hulse*

General Principles and Techniques, 1023

*Nonsurgical Joint Disease, 1023**Selected Nonsurgical Diseases of Joints, 1033**Septic (Bacterial) Arthritis, 1036**Rickettsial Polyarthritis, 1038**Lyme Disease, 1038**Nonerosive Idiopathic Immune-Mediated Polyarthritis, 1039**Chronic Inflammatory-Induced Polyarthritis, 1040**Plasmacytic-Lymphocytic Synovitis, 1040**Systemic Lupus Erythematosus-Induced Polyarthritis, 1040**Rheumatoid Arthritis, 1041**Feline Chronic Progressive Polyarthritis, 1042***36 Management of Muscle and Tendon Injury or Disease, 1158***Ann L. Johnson, Donald A. Hulse*

General Principles and Techniques, 1158

*Muscle Contusion and Strains, 1158**Muscle-Tendon Unit Laceration, 1160**Muscle-Tendon Unit Rupture, 1162**Muscle Contracture and Fibrosis, 1164***37 Other Diseases of Bones and Joints, 1168***Ann L. Johnson, Donald A. Hulse*

Hypertrophic Osteopathy, 1168

Panosteitis, 1169

Craniomandibular Osteopathy, 1170
 Hypertrophic Osteodystrophy, 1171
 Bone Neoplasia, 1173
 Joint Neoplasia, 1185
 Synovial Cysts, 1186
 Osteomyelitis, 1186

PART V NEUROSURGERY

38 Fundamentals of Neurosurgery, 1192

Howard B. Seim III

General Principles and Techniques, 1192
 Definitions, 1192
 Problem Identification, 1192
 Physical Examination, 1193
 Neurologic Examination, 1193
 Lesion Localization, 1200
 Differential Diagnosis of Spinal Disorders
 and Diagnostic Methods, 1201
 Imaging the Spine, 1202
 Imaging the Skull and Brain, 1210

39 Surgery of the Cervical Spine, 1213

Howard B. Seim III

General Principles and Techniques, 1213
 Cervical Disk Disease, 1228
 Wobbler Syndrome, 1237
 Atlantoaxial Instability, 1250
 Fractures and Luxations of the Cervical
 Spine, 1255
 Neoplasia of the Cervical Vertebrae, Spinal
 Cord, and Nerve Roots, 1263

40 Surgery of the Thoracolumbar Spine, 1269

Howard B. Seim III

General Principles and Techniques, 1269

Specific Diseases, 1278

 Thoracolumbar Disk Disease, 1278
 Fractures and Luxations of the
 Thoracolumbar Spine, 1288
 Neoplasia of Thoracolumbar Vertebrae,
 Spinal Cord, and Nerve Roots, 1298

41 Surgery of the Lumbosacral Spine, 1302

Howard B. Seim III

General Principles and Techniques, 1302
 Specific Diseases, 1305
 Cauda Equina Syndrome, 1305
 Fractures and Luxations of the
 Lumbosacral Spine, 1312
 Neoplasia of the Lumbosacral Spine and
 Nerve Roots, 1318

42 Surgery of the Brain, 1322

Howard B. Seim III

General Principles and Techniques, 1322
 Specific Diseases, 1336
 Head Trauma, 1336
 Neoplasia, 1340

43 Surgery of the Peripheral Nerves, 1346

Howard B. Seim III

General Principles and Techniques, 1346
 Specific Diseases, 1350
 Peripheral Nerve Trauma, 1350
 Neoplasia, 1353

44 Nonsurgical Diseases of the Spine, 1361

Howard B. Seim III

Specific Diseases, 1361
 Diskospondylitis, 1361
 Granulomatous Meningoencephalitis, 1364
 Degenerative Myelopathy, 1367
 Spinal Cord Ischemia, 1368