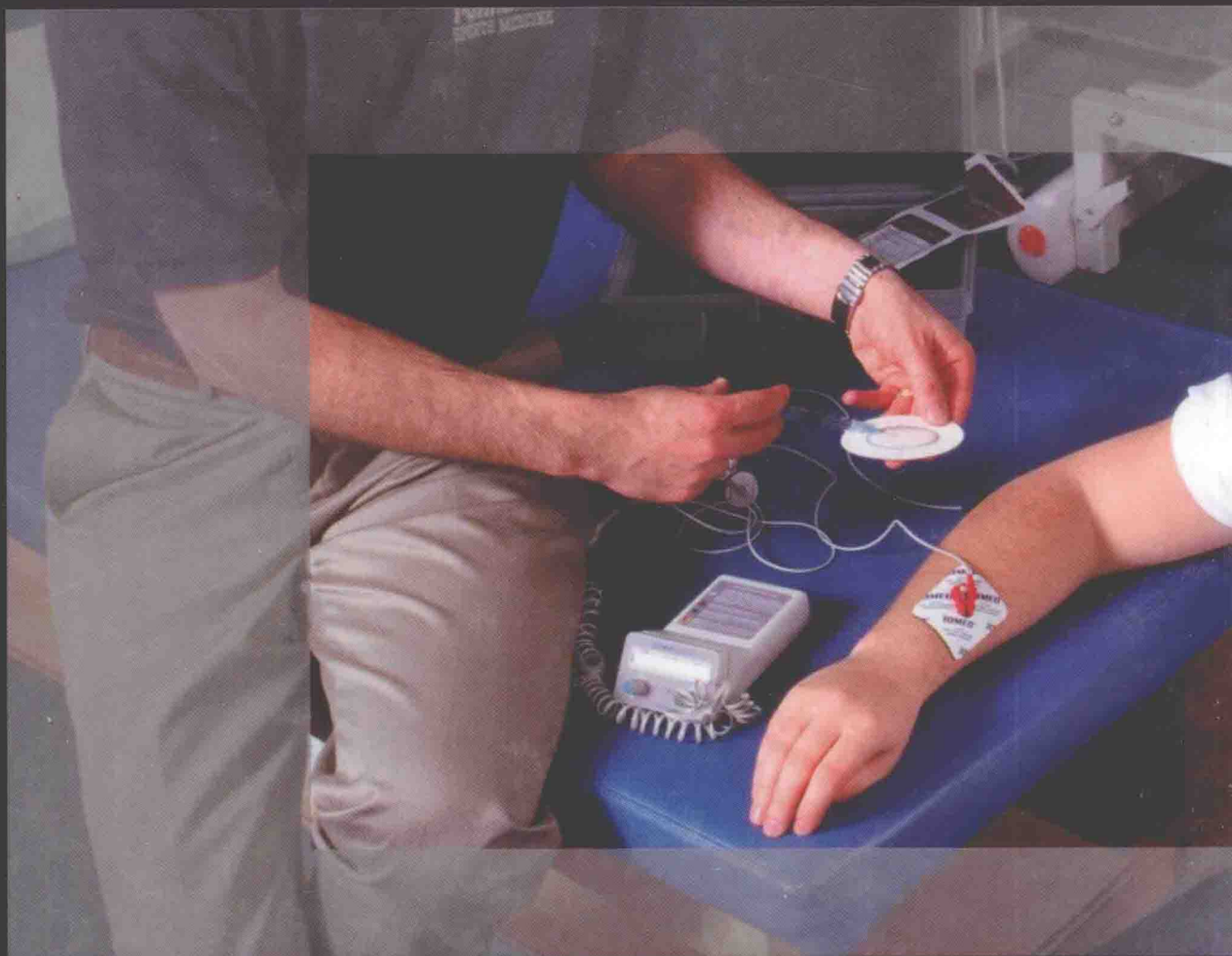


Third Edition

THERAPEUTIC MODALITIES FOR MUSCULOSKELETAL INJURIES



CRAIG R. DENEGAR
ETHAN SALIBA
SUSAN SALIBA

THIRD EDITION

THERAPEUTIC MODALITIES *for* MUSCULOSKELETAL INJURIES

ATHLETIC TRAINING EDUCATION SERIES

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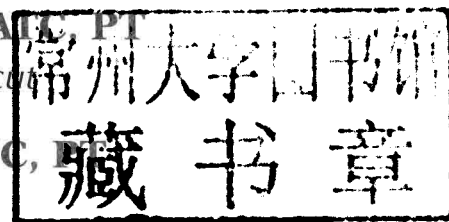
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Human Kinetics



Library of Congress Cataloging-in-Publication Data

Denegar, Craig R.

Therapeutic modalities for musculoskeletal injuries / Craig Denegar, Ethan Saliba, and Susan Saliba. -- 3rd ed.

p. ; cm. -- (Athletic training education series)

Includes bibliographical references and index.

ISBN-13: 978-0-7360-7891-7 (hard cover)

ISBN-10: 0-7360-7891-6 (hard cover)

1. Sports injuries--Treatment. 2. Musculoskeletal system--Wounds and injuries--Treatment. 3. Sports medicine. I. Saliba, Ethan, 1956- II. Saliba, Susan Foreman, 1963- III. Title. IV. Series: Athletic training education series.

[DNLM: 1. Athletic Injuries--therapy. 2. Musculoskeletal System--injuries. 3. Pain--prevention & control. 4. Rehabilitation--methods. QT 261 D392t 2010]

RD97.D46 2010

617.1'027--dc22

2009020454

ISBN-10: 0-7360-7891-6 (print)

ISBN-10: 0-7360-8558-0 (Adobe PDF)

ISBN-13: 978-0-7360-7891-7 (print)

ISBN-13: 978-0-7360-8558-8 (Adobe PDF)

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The Web addresses cited in this text were current as of June 4, 2009, unless otherwise noted.

Acquisitions Editor: Loarn D. Robertson, PhD; **Series Developmental Editor:** Amanda S. Ewing; **Developmental Editors:** Kathleen Bernard and Amanda S. Ewing; **Assistant Editors:** Nicole Gleeson and Casey A. Gentis; **Copyeditors:** Joyce Sexton and Jan Feeney; **Indexer:** Sharon Duffy; **Permission Manager:** Dalene Reeder; **Graphic Designer:** Bob Reuther; **Graphic Artist:** Kathleen Boudreau-Fuoss; **Cover Designer:** Keith Blomberg; **Photograph (cover):** © Human Kinetics; **Photographs (interior):** © Human Kinetics, unless otherwise noted; **Visual Production Assistant:** Jason Allen; **Art Manager:** Kelly Hendren; **Associate Art Manager:** Alan L. Wilborn; **Illustrators:** Argosy, Brian McElwain, Jason M. McAlexander, MFA, and Gary Hunt; **Printer:** Edwards Brothers

Printed in the United States of America 10 9 8 7 6 5 4 3 2 1

The paper in this book is certified under a sustainable forestry program.

Human Kinetics

Web site: www.HumanKinetics.com

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INTRODUCTION TO THE ATHLETIC TRAINING EDUCATION SERIES

The six titles of the Athletic Training Education Series—*Core Concepts in Athletic Training*, *Examination of Musculoskeletal Injuries*, *Therapeutic Exercise for Musculoskeletal Injuries*, *Therapeutic Modalities for Musculoskeletal Injuries*, *Management Strategies in Athletic Training*, and *Developing Clinical Proficiency in Athletic Training*—are textbooks for athletic training students and references for practicing certified athletic trainers. Other allied health care professionals, such as physical therapists, physician's assistants, and occupational therapists, will also find these texts to be invaluable resources in the prevention, examination, treatment, and rehabilitation of injuries to physically active people.

The rapidly evolving profession of athletic training necessitates a continual updating of the educational resources available to educators, students, and practitioners. The authors of the six new editions in the series have made key improvements and have added information based on the fourth edition of the NATA Athletic Training Educational Competencies.

- *Core Concepts in Athletic Training*, which replaces *Introduction to Athletic Training*, is suitable for introductory athletic training courses. Part I of the text introduces students to mechanisms of injury, pathophysiology, and injury assessment. It also includes a chapter with some of the injuries and tests that students should be aware of. Part II introduces topics in injury examination, and part III considers the use of modalities and exercise in the therapeutic rehabilitation process. Part IV covers prevention topics such as conditioning, nutrition, protective gear, and taping and bracing. Part V introduces the managerial and legal issues relevant to clinical practice in athletic training.
- In *Examination of Musculoskeletal Injuries*, new information about sensitivity and specificity

strengthens the evidence-based selection of special tests, and an increased emphasis on clinical decision making and problem solving and the integration of skill application in the end-of-chapter activities are now included.

- Two new chapters have been added to *Therapeutic Exercise for Musculoskeletal Injuries*. Chapter 16 focuses on arthroplasty, and chapter 17 contains information regarding various age considerations in rehabilitation. This text also provides more support of evidence-based care resulting from a blend of research results and the author's 40 years of experience as a clinician.
- The new edition of *Developing Clinical Proficiency in Athletic Training* contains 27 new modules, and embedded within it are all the 2006 NATA Athletic Training Educational Competencies. The concepts of progressive clinical skill development, clinical supervision and autonomy, and clinical decision making are introduced and explained. The nature of critical thinking and why it is essential to clinical practice are also discussed.
- The third edition of *Therapeutic Modalities for Musculoskeletal Injuries* continues to provide readers with information on evidence-based practice and includes recent developments in the areas of inflammation and laser therapy.
- The fourth edition of *Management Strategies in Athletic Training* continues to help undergraduate and graduate students master entry level concepts related to administration in athletic training. Each of the ten chapters has been thoroughly updated, with new material added on such topics as evidence-based medicine, professionalism in athletic training, health care financial management, cultural competence, injury surveillance systems, legal updates, athletic trainer compensation, and more.

The Athletic Training Education Series offers a coordinated approach to the process of preparing students for the Board of Certification examination. If you are a student of athletic training, you must master the material in each of the content areas delineated in the NATA Athletic Training Educational Competencies. The Athletic Training Education Series addresses each of the competencies sequentially while avoiding unnecessary duplication.

The series covers the educational content areas developed by the Education Council of the National Athletic Trainers' Association for accredited curriculum development. The content areas and the texts that address each content area are as follows:

- Risk management and injury prevention (*Core Concepts and Management Strategies*)
- Pathology of injury and illnesses (*Core Concepts, Examination, Therapeutic Exercise, and Therapeutic Modalities*)
- Orthopedic assessment and diagnosis (*Examination and Therapeutic Exercise*)
- Acute care (*Core Concepts, Examination, and Management Strategies*)
- Pharmacology (*Therapeutic Modalities*)
- Conditioning and rehabilitative exercise (*Therapeutic Exercise*)
- Therapeutic modalities (*Therapeutic Modalities*)
- Medical conditions and disabilities (*Examination*)
- Nutritional aspects of injury and illness (*Core Concepts*)
- Psychosocial intervention and referral (*Therapeutic Modalities and Therapeutic Exercise*)
- Administration (*Management Strategies*)
- Professional development and responsibilities (*Core Concepts and Management Strategies*)

The authors for this series—Craig Denegar, Peggy Houghlum, Richard Ray, Jeff Konin, Ethan Saliba, Susan Saliba, Sandra Shultz, Ken Knight, Kirk Brumels, and I—are certified athletic trainers with well over three centuries of collective experience as clinicians, educators, and leaders in the athletic training profession. The clinical experience of the authors spans virtually every setting in which athletic trainers practice: high schools, sports medicine clinics, universities, professional sports, hospitals, and industrial settings. The professional positions of the authors include undergraduate and graduate curriculum director, head athletic trainer, professor, clinic

director, and researcher. The authors have chaired or served on the NATA's most prominent committees, including Professional Education Committee, Education Task Force, Education Council, Research Committee of the Research and Education Foundation, Journal Committee, Appropriate Medical Coverage for Intercollegiate Athletics Task Force, and Continuing Education Committee.

This series is the most progressive collection of texts and instructional materials currently available to athletic training students and educators. Several elements are present in most of the books in the series:

- Chapter objectives and summaries are tied to one another so that students will know and achieve their learning goals.
- Chapter-opening scenarios illustrate the relevance of the chapter content.
- Thorough reference lists allow for further reading and research.

To enhance instruction, various ancillaries are included:

- All of the texts (except for *Developing Clinical Proficiency in Athletic Training*) include instructor guides and test banks.
- *Therapeutic Exercise for Musculoskeletal Injuries* includes a presentation package plus image bank.
- *Core Concepts in Athletic Training, Therapeutic Modalities for Musculoskeletal Injuries*, and *Examination of Musculoskeletal Injuries* all include image banks.
- *Examination of Musculoskeletal Injuries* includes an online student resource.

Presentation packages include text slides plus select images from the text. Image banks include most of the figures, tables, and content photos from the book. Presentation packages and image banks are delivered via PowerPoint, and instructors can use these to enhance lectures and demonstration sessions. Other features vary from book to book, depending on the subject matter; but all include various aids for assimilation and review of information, extensive illustrations, and material to help students apply the facts in the text to real-world situations.

The order in which the books should be used is determined by the philosophy of each curriculum director. In any case, each book can stand alone so that a curriculum director does not need to revamp an

entire curriculum in order to use one or more parts of the series.

When I entered the profession of athletic training over 30 years ago, one text—*Prevention and Care of Athletic Injuries* by Klafs and Arnheim—covered nearly all the subject matter required for passing the Board of Certification examination and practicing as an entry-level athletic trainer. Since that time we have witnessed an amazing expansion of the information

and skills one must master in order to practice athletic training, along with an equally impressive growth of practice settings in which athletic trainers work. You will find these updated editions of the Athletic Training Education Series textbooks to be invaluable resources as you prepare for a career as a certified athletic trainer, and you will find them to be useful references in your professional practice.

David H. Perrin, PhD, ATC
Series Editor

PREFACE

In 1988, Relman stated that health care had entered an “era of assessment and accountability.” We are still living in this era. Accountability is now linked to the practice of evidence-based health care, which has emerged as a dominant paradigm for teaching and practice across many disciplines. Although the phrase has become commonplace, evidence-based practice is complex. Akai (2002) noted that “evidence-based medicine is regarded as a new paradigm in medical practice, equal in enormity to the human genome project.”

Given the enormity of the challenge of implementing evidence-based practice across the spectrum of care for musculoskeletal injuries, let alone health care in general, this third edition of *Therapeutic Modalities for Musculoskeletal Injuries* continues on the path established in the first edition. Our objective has always been that readers will complete this text, and most often the associated coursework, with an understanding of the indications for modality applications and the ability to apply modalities safely in a manner that promotes completion of a rehabilitation plan of care.

Achieving these goals requires an understanding of the response to injury and the physical and physiological recovery from musculoskeletal injuries. Chapters 1 to 6 present an introduction to the rehabilitation plan of care and address the inflammatory response to injury, pain and pain modulation, persistent pain, neuromuscular control and psychological responses to injury, and the challenges of recovery from injury. For this edition, we also have attempted to fulfill the need for more information on the effectiveness of therapeutic modalities. The six chapters devoted to specific modalities have been revised with attention to recent clinical research. But, given the multitude of musculoskeletal conditions that clinicians encounter as well as the numerous modalities and parameter settings, it is impossible to address all questions of effectiveness in a single volume. A modality (such as laser) may be effective for management of symptoms related to carpal tunnel syndrome, yet ineffective in the treatment of lateral epicondylalgia. Therefore, while efforts have been made to expand discussions of the effectiveness of specific interventions, greater emphasis has been placed on illustrating the process

of gathering and evaluating information that allows clinicians to weigh the evidence when deciding how to best proceed with the care of individual patients.

The volume and rate of new information coupled with ever-increasing access through advances in information technology create both opportunity and challenge. The opportunity exists for students and clinicians with the commitment to remain abreast of the clinical literature and lead advances in patient care. The challenge lies in the pace of change and the difficulties of remaining current across a spectrum of clinical practice. We encourage you to apply the skills developed from reading the revised chapter 7, “Evidence-Based Application of Therapeutic Modalities,” and pursue the literature related to treatments with therapeutic modalities during studies of the subject. This effort will be rewarded with a greater understanding of the application of therapeutic modalities and the ability to offer a sound rationale for the clinical decisions you make.

The ability to select treatments that foster completion of a comprehensive and progressive plan of care is further developed in chapters 14 to 16, which are devoted to the management of acute musculoskeletal injuries and persistent pain. The application of therapeutic modalities is discussed in the context of the stage of inflammation or the source of persistent pain. Impaired neuromuscular control is revisited from the perspective of retraining and includes detailed discussion of EMG biofeedback as an adjunct to exercise in rehabilitation.

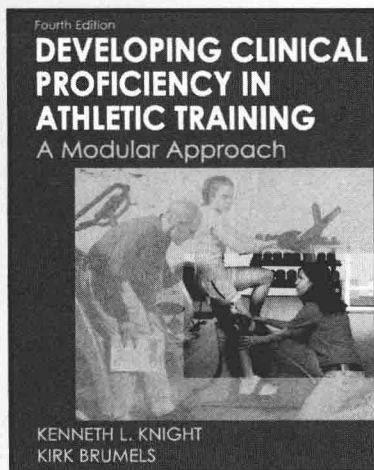
Many additional features in the book will help you understand and retain the content. Each chapter opens with objectives, and a scenario provides the context for the subject. Throughout the chapters, many terms are set apart as key terms, and definitions are provided in the glossary. Sidebars and review sections illustrate the applications of concepts in clinical practice. Each chapter concludes with a summary of the content, a key concepts and review section that shows how each objective was supported by the chapter’s content, and a list of additional sources. A thorough set of references is also provided.

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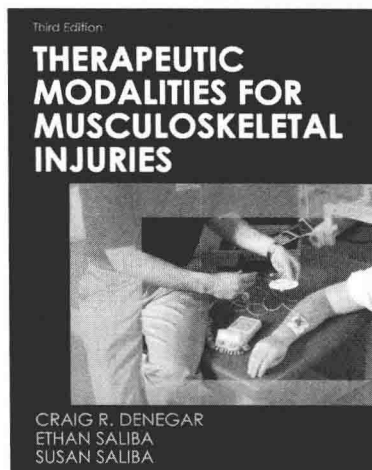
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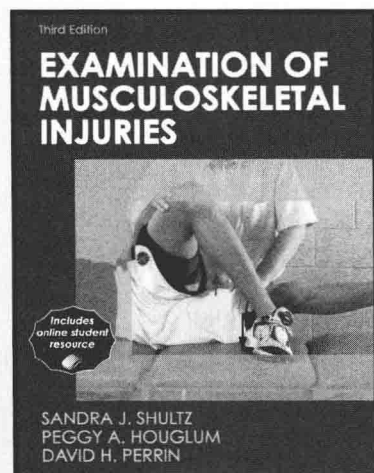
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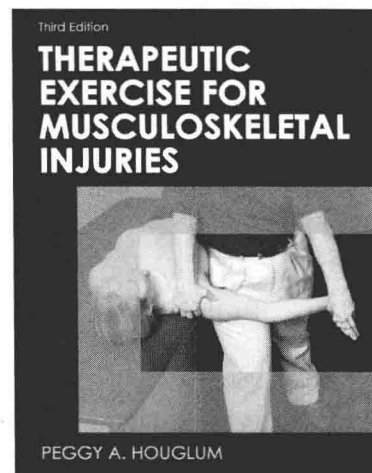
Therapeutic Modalities for Musculoskeletal Injuries, Third Edition
Craig R. Denegar, PhD, ATC, PT, Ethan Saliba, PhD, ATC, PT, and Susan Foreman Saliba, PhD, ATC, PT
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Print: ISBN 978-0-7360-7891-7
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E-Book: ISBN 978-0-7360-8694-3
Print & E-Book: ISBN 978-0-7360-8691-2



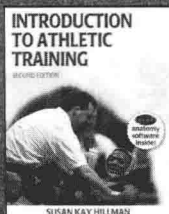
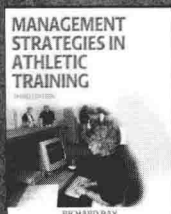
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The Contemporary Use of Therapeutic Modalities

OBJECTIVES

After reading this chapter, the student will be able to

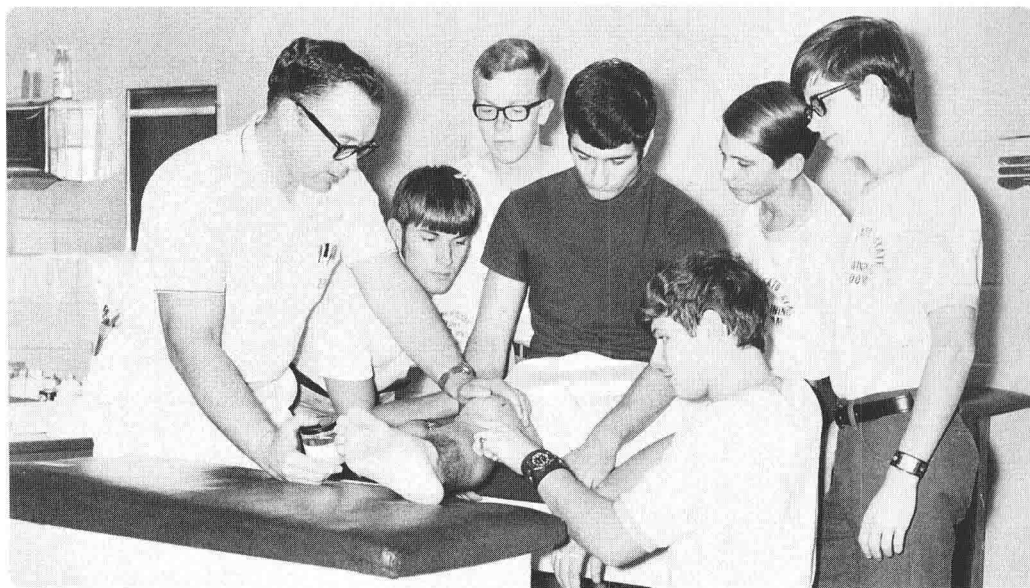
1. discuss how state regulation of athletic training may influence the use of therapeutic modalities in the care of physically active individuals;
2. identify the hierarchy of components in a progressive rehabilitation plan; and
3. discuss guidelines for progressing an athlete through a comprehensive plan of care.

- It is your first day working as a certified athletic trainer for a sports medicine clinic. Your position primarily involves service to a local high school but also involves a few hours in the clinic each morning. A varsity football player for the local high school sprained his ankle on the first day of practice yesterday. The team physician has evaluated the injury and referred the athlete to the clinic for treatment.

Questions arise, and the answers lead to more questions. What will be the plan of care for this injured athlete (i.e., short- and long-term treatment goals)? Can therapeutic modalities be used to achieve any of these goals? You identify pain control, restoration of range of motion, and return to full weight bearing as goals to be achieved within 7 to 10 days, and you choose therapeutic modalities including cold and transcutaneous electrical nerve stimulation (TENS). Can you, as a certified athletic trainer, administer these modalities to this athlete in the sports medicine clinic? Who has the answers?

Chapter 1 introduces a progressive rehabilitation paradigm from which treatment goals can be developed. In addition, the chapter discusses medical-legal issues affecting modality application, including regulation of practice and negligence. These issues are basic to the practice of athletic training and the use of therapeutic modalities.

The use of therapeutic modalities or physical agents in treating human ailments is not new. Massage, “cupping” (applying heated shells over painful areas), and the use of electric eels are mentioned in archives dating back to early Greek and Roman cultures. However, there was little scientific evidence to support the treatments administered by early practitioners. Today, therapeutic modalities are primarily applied by providers whose professional origins date back less than 100 years. Although several medical and allied medical care providers, including physicians, chiropractors, podiatrists, and dentists, may administer or apply therapeutic modalities, this practice is undertaken primarily by physical therapists and certified athletic trainers. Athletic trainers have applied therapeutic modalities since the beginnings of the profession (figure 1.1) and have contributed to the collective knowledge of therapeutic modalities through writing and research.



► **Figure 1.1** An early athletic training room.

Photo courtesy of Minnesota State University Mankato.

Therapeutic modality literally means a device or apparatus having curative powers. Heat, cold, massage, ultrasound, and diathermy have been used by athletic trainers since the profession's early days. These treatments may be better classified as **physical agents**, treatments that cause some change to the body. The scientific basis for the use of these therapeutic modalities has grown, providing a greater understanding of how modality applications may help injured patients achieve treatment goals and return to normal activity including sport and work.

Athletic trainers' educational preparation to use these modalities, however, has been challenged. As athletic trainers have sought recognition through state credentialing and establishment of practice acts, the use of therapeutic modalities has been an issue. Because internships are no longer the route to athletic training certification, all athletic trainers will receive formal preparation in the safe use of therapeutic modalities based on the best available science.

To effectively use therapeutic modalities to treat physically active individuals and other patients, we must cooperate and share knowledge. Our collective understanding of the physics of therapeutic modalities, physiological responses to therapeutic modalities, and clinical benefits of these modalities is evolving. Over the last 70 years, therapeutic ultrasound, diathermy, and the therapeutic use of electricity have been developed. Researchers are exploring how to best use these and other therapeutic modalities. As we learn more, our practices change, which is critical to our profession. The health care system is changing, and all providers are under increasing scrutiny to demonstrate improved patient outcomes and cost-effectiveness.

More athletic trainers than ever are working outside the traditional setting of the professional, college, and high school athletic training room. The profession is seeking greater recognition of the certified athletic trainer as a care provider to physically active individuals. Thus, although some athletic trainers practice in settings sheltered from some of the changes in health care, such as capitated services, these issues touch all in the profession.

Much has been learned about how therapeutic modalities affect the body. The theoretical basis for the application of therapeutic modalities after musculoskeletal injuries continues to evolve, and the rationale for the use of therapeutic modalities is often based upon "logical argument." In the last two decades, however, a model of evidence-based practice in health care has emerged. Databases have been developed to provide clinicians rapid access to reports of clinical trials, including the applications of therapeutic modalities for the treatment of several musculoskeletal disorders. Most of the revisions in this text are the result of new research on the evolution of evidence-based health care. This topic is discussed in greater detail in chapter 7.

An evidence-based approach to clinical practice, as described by Sacket (Sacket et al. 2000, 1), is the "integration of best research evidence with clinical expertise and patient values." Evidence that application of a therapeutic modality improves treatment outcomes or hastens the return to athletic competition, however, is often lacking. Until more is discovered through research, certified athletic trainers and other health care providers must integrate theory and clinical observations and research evidence to guide their use of therapeutic modalities in clinical practice.

LEGAL ASPECTS OF THERAPEUTIC MODALITY APPLICATION: PRACTICE ACTS AND NEGLIGENT TREATMENT

Athletic training has been recognized as a distinct allied medical profession in most states through the development of **practice acts** and state credentialing. Recognition of the profession and higher educational standards influence the practice of athletic training. The certified athletic trainer must comply with regulations set forth by the state in which he or she practices, including regulations that affect the therapeutic modalities an athletic trainer may apply, whom the athletic trainer may administer treatment to, and the setting in which the athletic trainer may render treatment. The agency responsible for regulating athletic training practice can provide or direct you to the relevant practice act. These materials may also be available through state athletic trainers' associations or societies.

Changes in athletic training regulation and the education of athletic trainers also have elevated the standard of care expected from certified athletic trainers. Before the days of certification by the National Athletic Trainers' Association (NATA), there was no standard by which to judge athletic trainers' actions. Today, certification by the Board of Certification (BOC) for the NATA, recognition of athletic training as a profession by individual states through licensure or certification, and higher educational standards have defined the standards of athletic training and elevated levels of practice. Failure to practice according to these standards, including causing injury by therapeutic modality application, may constitute negligence.

State Regulation of Athletic Training

Athletic trainer certification by the BOC for the NATA is determined by an examination that tests the applicant's knowledge and skills in preventing, recognizing, treating, and rehabilitating athletic injuries as well as performing administrative aspects of athletic training. A standard of preparation for the certified athletic trainer has been established through the examination.

Therapeutic modalities are addressed in a subsection of *Athletic Training Educational Competencies, 4th Edition* (NATA 2007). Through education and supervised clinical experience, the athletic trainer learns how and when to apply therapeutic modalities and then demonstrates the associated knowledge and skills during the certification examination. The certified athletic trainer has met established standards to practice athletic training and to use therapeutic modalities. One might then assume that a certified athletic trainer's practice is governed by the National Athletic Trainers' Association's *Code of Ethics* (NATA 2005), the *Role Delineation Study* (NATA 2004), and the *Athletic Training Educational Competencies, 4th edition* (NATA 2007).

Such an assumption should never be made. The Commission for Accreditation of Athletic Training Education (CAATE) has established criteria for accreditation of educational programs including preparation in the use of therapeutic modalities. The examination administered by the BOC for the NATA assesses this preparation. The BOC for the NATA further requires evidence of continuing education to maintain certification. The practice of athletic training was, however, governed by the state in which the athletic trainer practiced in 44 states of the United States in 2007. Thus, although a certified athletic trainer may be well qualified to use a specific therapeutic modality or administer a particular treatment, state laws specify what the athletic trainer may legally do. Moreover, in states that do not regulate the practice of athletic training, the application of a modality may infringe upon the practice of other disciplines as defined in that state. The certified athletic trainer must understand and practice within the boundaries of the state's practice act. Failure to do so may lead to revocation of a state license or certification and loss of practice privileges or charges of practicing another discipline without proper credentials.

It is not possible here to review the regulations of all states. In addition, regulations may change. This text and the instruction you receive are intended to develop your knowledge and skills related to the clinical competencies established by the profession. It is your responsibility to learn how the laws of your state affect what you can do and whom you can treat.

Consent to Treat and Tort

Other medical and legal considerations relate to athletic training in general and the use of therapeutic modalities. This text is not intended to cover the legal and administrative aspects of athletic training and sports medicine in detail. However, two issues closely related to the application of therapeutic modalities are covered: informed consent and liability in tort.

Informed Consent

Informed consent refers to the right of physically active individuals to receive information about their diagnosis and treatment options and consent to treatment. Informed consent has received little attention from certified athletic trainers. Schools and community youth athletic programs receive parental consent to provide immediate treatment of injuries. However, few

athletic training rooms have policies regarding obtaining consent for modality application or participation in therapeutic exercises. Furthermore, although individuals entering a medical practice, including sports medicine clinics, routinely sign forms giving health care providers permission to treat them, these individuals often do not provide informed consent for specific treatments.

Often a bond of trust exists between the physically active individual and the certified athletic trainer, whereby the individual believes that the athletic trainer will provide the best possible care. Additionally, the injured person may have observed treatments administered to others and may know what to expect. Failure to receive consent prior to treatment does not routinely lead to litigation against a certified athletic trainer. However, you should not ignore this issue. Make it a habit to explain any proposed treatment to the injured person and provide an opportunity for questions. This facilitates communication in the sports medicine clinic, where the injured person is encountering an unfamiliar health care facility and providers. It is also good practice in the athletic training room, where explaining the rehabilitation plan and proposed treatments engages the injured individual and allows the certified athletic trainer to review his or her responsibilities in the rehabilitation plan (figure 1.2).

The components of informed consent, as described by Scott (1990), are presented on page 6. Clearly, items 2 through 5 are directly related to the application of therapeutic modalities. This text is intended to provide the certified athletic trainer and athletic training student with the physical and physiological principles for modality application, the mechanisms by which the therapeutic benefits of modalities are achieved, and the contraindications and precautions for modality use. With this background, the certified athletic trainer can provide physically active individuals with what they need to make informed decisions about their health care.

Liability in Tort for Negligent Treatment and Professional Negligence

A **tort** is a private, civil legal action brought by an injured party, or the party's representative, to redress an injury caused by another person. **Negligence** entails doing something that an ordinary person under like circumstances would not have done (a negligent act or an act of commission), or failing to do something that an ordinary, reasonable, prudent person would



► **Figure 1.2** Explaining the rehabilitation plan and proposed treatments allows the athletic trainer to review his or her own responsibilities as well as inform the injured individual.