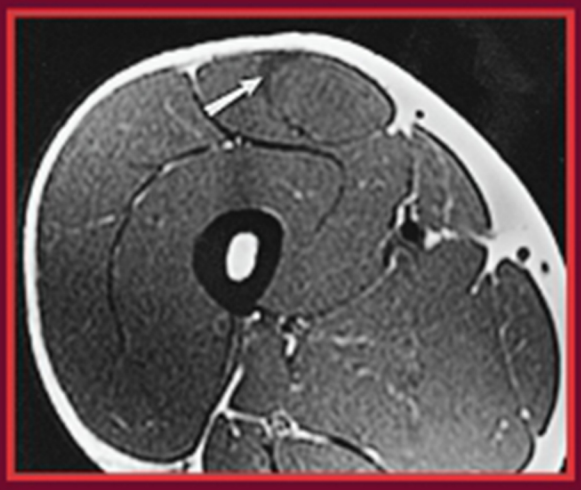

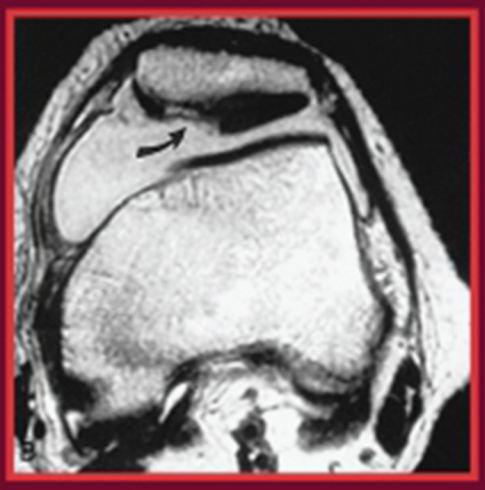

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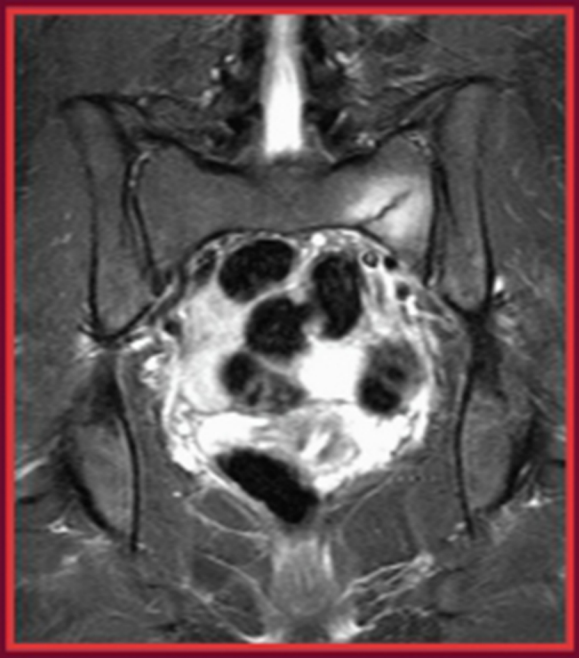

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Musculoskeletal MRI

Third Edition

Nancy M. Major, MD

Professor of Radiology and Orthopedics
Division of Musculoskeletal Imaging
University of Colorado School of Medicine
Aurora, Colorado

Mark W. Anderson, MD

Professor of Radiology and Orthopaedic Surgery
Harrison Distinguished Teaching Professor of Radiology
University of Virginia
Charlottesville, Virginia

Clyde A. Helms, MD

Durham, North Carolina

Phoebe A. Kaplan, MD

Niwot, Colorado

Robert Dussault, MD

Niwot, Colorado

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Elsevier
1600 John F. Kennedy Blvd.
Ste 1800
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To Austin, your support and humor saw me through this book. To my mother and father, I am forever grateful for your love and support.
To my dear friend, and co-author, Mark, your partnership and patience during this third edition was invaluable. And to Kenneth, thank you is not enough. Forever and always.

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To the residents and fellows who have made me a better radiologist and my job worth doing. To Nancy whose tireless efforts have made this a much-improved edition. And to Amy whose unwavering love and infinite patience have made me a better person.

Mark W. Anderson

Preface

Since the first edition of *Musculoskeletal MRI* was published in 2001, much has changed in the realm of musculoskeletal MRI. Scores of new articles have been published on every anatomic area, and new imaging techniques have been developed. Although we have attempted to incorporate these advances in the current edition, we stand firm in our original maxim that "less is more" when it comes to a text explaining the basics. Therefore we resolved to not let the size of this work increase dramatically. Almost every chapter has been significantly updated. Many new figures have been added and many of the original figures have been replaced by better examples using more current techniques. The text has been updated to reflect current research and practices.

Working on the third edition of *Musculoskeletal MRI* made us a little better at what we do, which is to practice and teach musculoskeletal MRI, and we are certain it also will help improve the skills of every reader of this book.

Nancy M. Major, MD
Mark W. Anderson, MD

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Basic Principles of Musculoskeletal MRI

CHAPTER OUTLINE

Although a detailed understanding of nuclear physics is not necessary to interpret magnetic resonance imaging (MRI) studies, it also is unacceptable to read passively whatever images you are given without concern for how the images are acquired or how they might be improved. Radiologists should have a solid understanding of the basic principles involved in acquiring excellent images. This chapter describes the various components that go into producing high-quality images, stressing the fundamental principles shared by all MRI scanners.

Every machine is different. Clinical scanners are now available at strengths ranging from 0.2 tesla (T) to 3.0T. Additionally, each vendor has its own language for describing its hardware, software, and scanning parameters, and an entire chapter could be devoted to deciphering the terms used by different manufacturers. Time spent learning the details of your machine with your technologists or physicists would be time well spent. If you are interested, read one of the excellent discussions of MRI physics in articles or other textbooks because, for the most part, in this book we leave the physics to the physicists.

What Makes a Good Image?

Lack of Motion

Motion is one of the greatest enemies of MRI (Fig. 1.1). It can arise from a variety of sources, such as cardiac motion, bowel peristalsis, and respiratory movement. For most musculoskeletal applications, motion usually stems from body movement related to patient discomfort. Patient comfort is of paramount importance because even if all the other imaging parameters are optimized, any movement would ruin the entire image.

Patient comfort begins with positioning. Every effort should be made to make the patient comfortable, such as placing a pillow beneath the knees when the patient is supine to reduce the stress on the back or providing padding at pressure points. When the patient is in a comfortable position, passive restraints, such as tape, foam rubber, or sandbags, can be used for maximal immobilization. Music via headphones can help alleviate anxiety. Short-acting sedation may be required for claustrophobic patients.

Another cause of patient motion is a prolonged examination, which is one reason why streamlined imaging protocols are useful. By designing efficient imaging sequences, the necessary scans are obtained in as short a time as possible, resulting in better patient compliance, improved technologist efficiency, and maximal scanner throughput. Standardized