Sports Medicine in the Pediatric Office

Includes 2+ hours of video!

A Multimedia Case-Based Text With Video

2nd Edition



Jordan D. Metzl, MD, FAAP

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Sports Medicine in the Pediatric Office

A Multimedia Case-Based Text With Video

2nd Edition

Jordan D. Metzl, MD, FAAP
Sports Medicine
Hospital for Special Surgery
New York, NY

WITH

David T. Bernhardt, MD, FAAP
Greg Canty, MD, FAAP
Thomas L. Devries, MD
Nicholas M. Edwards, MD, MPH, FAAP
Cassidy MacDowell Foley, DO, FAAP
Benton E. Heyworth, MD
Joseph Janosky, MS, PT, ATC
Hamish Kerr, MD, MSc, FAAP, FACSM
Derrick M. Knapik, MD
Peter Kriz, MD, FACSM, FAAP
Shaina A. Lipa, MD
Robert G. Marx, MD, MSc, FRCSC
Teri McCambridge, MD, FAAP
Kathryn Dunn McElheny, MD, FAAP
Suzy McNulty, MD, FAAP
Joshua A. Metzl, MD
Jeffrey M. Mjaanes, MD, FAAP, FACSM
Drago Novkovic, ATC
Katherine H. Rizzone, MD, MPH, FAAP
Amanda Sparrow, PT
Sarah A. Vengal, MD
James E. Voos, MD
Kristina Wilson, MD, MPH, CAQSM, FAAP
Mark Wu, BS
Tracy Zaslow, MD, FAAP, CAQSM
Stessie Dort Zimmerman, MD

WITH FOREWORD BY

Lewis R. First, MD, FAAP

American Academy of Pediatrics Publishing Staff

Mark Grimes, *Director, Department of Publishing*

Peter Lynch, *Manager, Digital Strategy and Product Development*

Theresa Wiener, *Manager, Publishing and Production Services*

Amanda Helmholz, *Editorial Specialist*

Linda Diamond, *Manager, Art Direction and Production*

Mary Lou White, *Chief Product and Services Officer/SVP, Membership, Marketing, and Publishing*

Linda Smessaert, *Brand Manager, Clinical and Professional Publications*

Published by the American Academy of Pediatrics

141 Northwest Point Blvd

Elk Grove Village, IL 60007-1019

Telephone: 847/434-4000

Facsimile: 847/434-8000

www.aap.org

First edition published 2008; 2nd, 2018.

Printed in the United States of America

9-398/0917 1 2 3 4 5 6 7 8 9 10

MA0842

ISBN: 978-1-61002-122-7

eBook: 978-1-61002-123-4

Cover design by Linda Diamond

Book design by Linda Diamond

Library of Congress Control Number: 2016960415

This book is dedicated to

health care professionals around the world

who care each day for children and adolescents.

This page intentionally left blank

Contributors

Jordan D. Metzl, MD, FAAP
Sports Medicine
Hospital for Special Surgery
New York, NY

David T. Bernhardt, MD, FAAP
Professor
Department of Pediatrics, Orthopedics and Rehab
Division of Sports Medicine
University of Wisconsin School of Medicine and Public Health

Greg Canty, MD, FAAP
Medical Director, Center for Sports Medicine
Fellowship Director, Pediatric Sports Medicine
Assistant Professor of Orthopedics & Pediatrics, University of Missouri Kansas City
Children's Mercy Kansas City

Thomas L. Devries, MD
Department of Pediatrics
University of Wisconsin Hospital and Clinics

Nicholas M. Edwards, MD, MPH, FAAP
Adjunct Assistant Professor of Orthopaedics
University of Minnesota

Cassidy MacDowell Foley, DO, FAAP
Pediatric Orthopedic Associates
Next Level Sports Medicine
Children's Healthcare of Atlanta
Atlanta Ballet

Benton E. Heyworth, MD
Assistant Professor, Harvard Medical School
Attending Orthopaedic Surgeon, Division of Sports Medicine, Boston Children's Hospital

Joseph Janosky, MS, PT, ATC
Director, Sports Safety
Hospital For Special Surgery
New York, NY

Hamish Kerr, MD, MSc, FAAP, FACSM
Associate Professor, Internal Medicine/Pediatrics
Fellowship Director, Sports Medicine
Albany Medical College

Derrick M. Knapik, MD
Resident Physician, PGY-II
Department of Orthopaedic Surgery
University Hospitals Cleveland Sports Medicine Institute

Peter K. Kriz, MD, FACSM, FAAP
Assistant Professor (Clinical)
Division of Sports Medicine
Rhode Island Hospital/Hasbro Children's Hospital
Warren Alpert Medical School, Brown University

Shaina A. Lipa, MD
Harvard Combined Orthopaedic Residency Program/Massachusetts General Hospital

Robert G. Marx, MD, MSc, FRCSC
Professor of Orthopedic Surgery
Weill Cornell Medicine
Hospital for Special Surgery

Teri McCambridge, MD, FAAP
Assistant Professor
Department of Pediatrics and Orthopedics
University of Maryland Medical System

Kathryn Dunn McElheny, MD, FAAP
Hospital for Special Surgery

Suzy McNulty, MD, FAAP
Mia Bella Pediatrics
General Pediatrics and Sports Medicine
CHOC Children's Concussion Clinic
Pediatric Concussion Specialist

Joshua A. Metzl, MD
Steadman Hawkins Clinic - Denver

Jeffrey M. Mjaanes, MD, FAAP, FACSM
Northwestern University
Director of Sports Medicine/Head Team

Drago Novkovic, ATC

Katherine H. Rizzone, MD, MPH, FAAP
Assistant Professor, Orthopaedics, Rehabilitation and Pediatrics
University of Rochester Medical Center
Rochester, NY

Amanda Sparrow, PT

Sarah A. Vengal, MD
Primary Care Sports Fellow

James E. Voos, MD
Jack and Mary Herrick Endowed Director, Sports Medicine
Associate Professor, Case Western Reserve University School of Medicine
Division Chief, Sports Medicine
Department of Orthopaedic Surgery
Head Team Physician, Cleveland Browns
University Hospitals Cleveland Sports Medicine Institute

Kristina Wilson, MD, MPH, CAQSM, FAAP
Medical Director, Pediatric and Adolescent Sports Medicine
Center for Pediatric Orthopaedics, Phoenix Children's Hospital
Co-Director, Brain Injury and Concussion Program
Barrow Neurologic Institute at Phoenix Children's Hospital
Assistant Clinical Professor, Department of Child Health
University of Arizona College of Medicine, Phoenix

Mark Wu, BS
M.D. Candidate 2018/Harvard Medical School

Tracy Zaslow, MD, FAAP, CAQSM
Children's Orthopaedic Center (COC) at Children's Hospital Los Angeles
Medical Director, COC Sports Medicine and Concussion Program
Assistant Professor, University of Southern California
LA Galaxy, Team Physician

Stessie Dort Zimmerman, MD
Johns Hopkins All Children's Hospital

Contents

This page intentionally left blank

Foreword

How often do we hear *"See one, do one, teach one,"* the usual expression for the learner trying to master something new? Yet in this superb revision of *Sports Medicine in the Pediatric Office: A Multimedia Case-Based Text With Video,* this famous phrase gets a whole new attitude.

My job as a department chair and chief of our children's hospital puts in me contact regularly with numerous pediatric health care professionals who often tell me about the many questions they get from parents asking about their child or an adolescent involved in sports, from requests for preventive strengthening exercises to concerns about how to evaluate and treat ankle or shoulder pain. Answering these concerns requires a familiarity with anatomy along with knowledge of orthopedic physical examination maneuvers (which I've often found described with complicated text and pictures). Then there are the requests from trainees as well as from peers to gain expertise in proper splinting techniques or what exercises should be done for a particular sports medicine problem.

Until the first edition of *Sports Medicine in the Pediatric Office: A Multimedia Case-Based Text With Video* arrived, I had difficulty recommending to colleagues one reference that could answer all sports medicine inquiries in one volume. But this book not only presents the information clearly and succinctly but also provides clear demonstrative videos for proper examination of an injured extremity, so that pediatric health care professionals can avoid having to search on the Internet for these educational aids. The second edition of *Sports Medicine in the Pediatric Office: A Multimedia Case-Based Text With Video* has been updated by one of the nation's leading experts and educators in pediatric sports medicine, Jordan D. Metzl, MD, FAAP, along with several of his colleagues from across the country. The use of written text supplemented by clear illustrations, clear images, and extremely easy-to-understand video demonstrations of the points highlighted in the revised text provides any learner, from novice to expert, with what he or she needs to know about common sports medicine problems that children and teenagers experience.

The second edition continues to offer case-based examples to highlight common injuries of the upper and lower extremities, the hips, and the spine and allows the learner to apply the fundamentals stressed at the start of each chapter. This well-written revised multimedia text also incorporates information on sports physical and head injuries to the athlete, provides new chapters focusing on specific sports, and gives updates on key issues that have arisen in sports medicine since the first edition. This book ensures that the clinician knows how to examine, diagnose, and manage a sports injury and, at the same time, instructs the patient on what to do to recover and prevent further injury upon return to play.

Thanks to what Dr Metzl and his team have created, now a learner such as myself can "see one" as many times as needed and even use the videos to "teach one" to others, while becoming much more skilled at the actual "doing," thanks to the interactive way the information is provided in this book. In many ways, this book remains a great resource for informational "strength training"—something we have all been waiting for when it comes to improving our knowledge and clinical skills in the field of sports medicine. For that reason, I congratulate the authors on revising what was an already terrific educational text into an even more outstanding up-to-date volume that will put us all in much better shape when it comes to knowing what to do when the next patient comes in with a sports medicine concern. If you liked the first edition, you'll love this second edition even more!

Lewis R. First, MD, FAAP
Professor and Chair
Department of Pediatrics
University of Vermont
The Robert Larner, M.D. College of Medicine
Chief of Pediatrics
University of Vermont Children's Hospital
Burlington
Editor in Chief, *Pediatrics*

This page intentionally left blank

Preface

Dear Friends,

Thank you so much for looking at our updated version of *Sports Medicine in the Pediatric Office*. When we published the first version of this book more than 10 years ago, child and youth sport specialization had an upward trend, more young athletes were participating in sports than ever before, and pediatric health care professionals (including pediatricians, pediatric emergency medicine physicians, school and office-based pediatric nurses, athletic trainers, and team physicians) were faced with an ever-increasing number of sports medicine issues in the office. Thanks to readers like you, our first edition helped guide many pediatric health care professionals in navigating these new challenges and opportunities.

Today, the field of pediatric sports medicine has grown considerably, as has the science supporting the best ways to both manage and prevent injuries in the young athlete. Our goal with the updated version of *Sports Medicine in the Pediatric Office* is to bring pediatric health care professionals from around the globe up to speed on the changes that have been made over the past 10 years.

In today's health care world, pediatric and adolescent athletes are flocking to their pediatric health care professionals in high numbers, seeking guidance on the best ways to stay healthy on and off their field of choice. In this edition, we've included a series of new chapters dealing with specific sports scenarios, and we've expanded the body-specific areas and examination tools. We have also included new sections on prevention so health care professionals are better able to counsel their active patients on the subjects of preventive health.

The videos with musculoskeletal examinations were featured on a DVD in our first edition. They are now featured in an online library that we hope you will use as a supplement to the written text. Reading about knee injuries is one thing, but seeing how to examine someone's knee in a video is a different method of learning. We hope you'll take advantage of both methods in this new edition.

Finally, I'd like to thank our contributing authors, both returning authors from the first edition, who have updated their chapters, and new authors, many from the American Academy of Pediatrics Council on Sports Medicine and Fitness, who have joined this effort for the first time. Each author has graciously donated his or her time and expertise in an effort to better educate health care professionals about the optimal care and treatment of young athletes. I am so deeply appreciative of their help; thank you, everyone.

On behalf of the American Academy of Pediatrics and each of our outstanding authors, I hope you benefit from this updated version of *Sports Medicine in the Pediatric Office* as you care for active patients in your office.

Jordan D. Metzl, MD, FAAP
Sports Medicine
Hospital for Special Surgery
New York, NY

This page intentionally left blank

Introduction

Please view video clip:
"Welcome to the Video Component of Sports Medicine in the Pediatric Office."

Welcome to the workbook component of *Sports Medicine in the Pediatric Office.* We hope that this workbook and video will allow you to take better care of the hundreds of athletic children and teens who come into your office every year.

The field of pediatric sports medicine has evolved greatly over the past 30 years, and it is growing quickly, along with the number of children and teens who are involved in recreational and competitive sports in the United States and around the world.

For pediatricians, pediatric medical subspecialists, and pediatric surgical specialists (collectively referred to as *pediatricians* from this point on), the demands of taking care of athletic patients have changed considerably. The "stay off it until it gets better" approach used to be the accepted formula for taking care of athletic children. Patients would come in with an injury, and often the advice was, "Just stay off it until it gets better." As children and teens have become more active, the role of the pediatrician in the lives of athletic patients has changed, and that approach is no longer accepted by patients and families who are eager for safe return to play. Increasingly, patients and their families are looking for ways to reduce injury time, return to play, and prevent problems in the future.

So, let's talk about this workbook. This is not the be-all and end-all of sports medicine guides. Each topic addressed here is suitable for an entire book (and many such books already exist). The workbook and video provide a multimedia approach to basic sports medicine for the pediatric health care professional, resident, or medical student. The workbook is designed to be used interactively with the video; the intent is for you to view the video clips as you read through the corresponding text sections within the book (look for the special "video clip" icons throughout the text). By having both written and video materials, you will be able to see and practice specific examination techniques, see certain preventive strengthening exercises, and, ultimately, take better care of athletic patients.

In our updated version of this book, we have also included specific sections on prevention and sport-specific chapters. Both are designed to teach pediatric health care professionals how to better care for specific athletes in their office and to offer current recommendations that pertain to each specific sport.

Objectives

The pediatric health care professional, resident, or medical student using this book will be able to

- Better care for athletic patients.
- Display a greater feeling of comfort in dealing with sports medicine issues.
- Better serve as a resource for athletic children and teens and for the sports community.

This page intentionally left blank

Part 1
Overview and Prevention

This page intentionally left blank

CHAPTER 1

The Basics of Sports Injury Evaluation

Jordan D. Metzl, MD, FAAP

Taking the Patient History of a Sports-Related Injury

1. Mechanism of Injury
2. Swelling
3. Level of Disability
4. Return to Play

Keys to Physical Examination of a Sports-Related Injury

1. Inspection
2. Observation
3. Palpation
4. Active Motion (Muscle Strength)
5. Passive Motion (Joint Function)
6. Special Tests and Assessments
   - Ligamentous Stability
   - Neurologic Function
   - Specific Function

Obtaining Specific Images, Scans, and Test Results to Evaluate a Sports-Related Injury

1. Radiographs
2. Magnetic Resonance Image
3. Computed Tomography Scan
4. Bone Scan
5. Single-Photon Emission Computed Tomography Scan
6. Dual-Energy X-ray Absorptiometry Image
7. Ultrasound Image
8. Neurocognitive Test Results
9. Complete Blood Cell Count

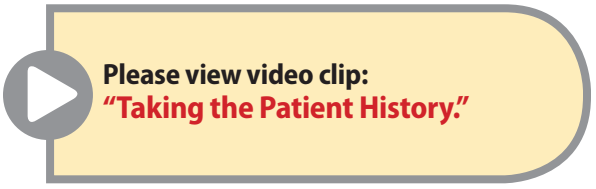
Referring an Athlete for Physical Therapy

Returning an Athlete to Play

1. Full Understanding of the Injury
2. Guidelines for Return to Play
3. Guidelines for Prevention

This page intentionally left blank

Taking the Patient History of a Sports-Related Injury



As attested by our experience teaching hundreds of pediatric residents, they do not seem as comfortable taking the history of a sports-related injury as they do dealing with a medical issue, such as an asthma exacerbation. Any difference in level of comfort felt by a pediatric health care professional, resident, or medical student between taking the history of a sports injury and the history of other medical issues would be unfortunate. Of all the issues discussed in this book, patient history is likely the most important. The way in which an injury occurs is the hallmark of the type of problem that is encountered in the office. For example, an ankle injury is often characterized by the mechanism of injury (ie, how the injury happened). The way the ankle rolls speaks volumes about the type of injury that might be anticipated when examining the patient.

Following are a few of the factors that are essential in taking the history of a sports-related injury:

1. Mechanism of Injury

The mechanism of injury is how an injury happens. This is the way in which an injury occurs, which should always be one of the first considerations in evaluating any injury in an athlete. This consideration, hopefully, should include questions such as, "How did the injury happen?" Through this knowledge, the examiner can gain a much better idea of the type of problem that might have resulted. Throughout this workbook and video, we have tried to present common injuries with common mechanisms. Sometimes, patients can essentially recreate the injury in the office, using the uninjured contralateral appendage, which is often helpful as well.

2. Swelling

Swelling is a helpful indicator that leads to the proper diagnosis of many sports-related injuries. The location and timing of the onset of swelling are important clues toward diagnosis. As is discussed in Chapter 4, Knee and Lower Leg Injuries in the Young Athlete, swelling that occurs quickly, typically within 1 hour of an injury, is likely blood related. When this bleeding occurs inside a joint, it is known as an acute hemarthrosis. Fractures, because of the readily available blood supply inside of bone, also swell quickly. As such, swelling onset is a helpful clue (ie, the quicker an injury swells, the more serious it is likely to be).

3. Level of Disability

Assessing the level of disability from an injury is helpful during evaluation of both acute traumas and overuse injuries. The rules here are simple: If an injury is limiting an athlete's ability to participate in sports, "hold the athlete out" until a clear diagnosis is reached and a treatment plan is implemented. If an athlete is having trouble participating in sports because of pain, do not clear the athlete to participate until a full understanding about the severity of the injury, as well as potential ramifications from participation, is understood. For children, when in doubt, "hold them out."

Basic Rule

If an athlete is having trouble participating in sports because of pain, do not clear the athlete to participate until a full understanding about the severity of the injury, as well as potential ramifications from participation, is understood.

For children, when in doubt, "hold them out."

4. Return to Play

When returning an athlete to play from an injury, the same issues discussed previously are important. A clear understanding of the injury and the knowledge that the appropriate preventive or physical therapy measures have been implemented are essential; examples are a preventive strengthening program for an athlete who has sprained his or her ankle or the implementation of a diet rich in calcium and vitamin D for an athlete who is being treated for a stress fracture. In both cases, the key to a safe and healthy return to play is remedy of the existing problem. The more knowledgeable health care professionals are about return-to-play decisions, the better able they are to make informed decisions on safe and effective return to play.

Keys to Physical Examination of a Sports-Related Injury

Please view video clip:
"Basics of Physical Examination of a Sports Injury."

Physical examination of the patient with a musculoskeletal concern should follow the same premise as the general physical examination. Before a health care professional examines the patient, a history (in this case, a targeted patient history) should precede the hands-on portion of the examination. However, in sports medicine, because the problems are injury- or concern-specific in most cases, the keys to proper examination are having a good concept of the mechanism and type of concern before the physical examination and possessing the skills to perform the targeted physical examination comfortably. As is the case with other skills, such as cardiac auscultation, the more times these examinations are repeated, the more effective the information-gathering skills become.

We stress that not every injury and physical examination needs to entail each of the categories discussed in the following text. However, these provide a helpful guideline from which the examiner can start to work. In general, physical examination is divided into the following portions:

1. Inspection

The inspection process starts the moment the examiner observes the patient. How is the patient moving? Is he or she using an injured extremity? Is associated swelling significant? These are all important considerations.

2. Observation

Observation pertains to watching the patient for function.

3. Palpation

Palpation is the actual (hands-on) portion of the examination. During palpation, the examiner, knowledgeable about the specific bony and soft-tissue landmarks, attempts to find pertinent areas of tenderness that can give clues to the specific diagnosis. For example, in the ankle, pain on focal palpation of the distal fibular physis is suggestive of a distal fibular physeal fracture, while pain to palpation of the anterior talofibular ligament (ATFL) is suggestive of an ATFL sprain. Palpation becomes a key issue in deciding management as well. For example, pain in the anatomical snuff-box on palpation, even in the presence of negative radiographic findings, mandates presumptive treatment for a scaphoid fracture, through the use of thumb spica splinting.

4. Active Motion (Muscle Strength)

Active motion applies to functional joint examination, during which the power of movement is performed by the patient, not the examiner. In this type of scenario, the joint or body part is actively moved by the patient and, as such, gives important clues about the integrity of the muscular attachments into bone. In young athletes, examinations primarily pertain to apophyseal attachments, such as the origin of the flexor muscle mass at the medial epicondyle of the elbow. When the elbow is flexed and the wrist is volar flexed, traction is placed on the medial elbow, which reproduces pain caused by traction.

5. Passive Motion (Joint Function)

Passive motion, the way in which a joint moves when the power is applied by the examiner, is an essential part of joint examination. Passive motion is especially important in joints, such as that of the hip, in which a limitation of passive motion during the rotational portion of the examination can indicate the presence of a structural problem in the joint, such as a slipped capital femoral epiphysis. In addition, limitation of passive flexion in the hip can be indicative of a structural problem in the anterior-inferior iliac spine, the apophyseal origin of the rectus femoris, which sits on the anterior-superior portion of the hip joint.

6. Special Tests and Assessments

Some special tests and assessments are tailored to specific parts of the body. Some of these special tests and assessments are reviewed in the following text:

Ligamentous Stability

For certain areas of the body, ligamentous examination provides important clues about the structural stability of a joint. For example, the athlete who experiences an inversion injury to the ankle generally injures the lateral ankle, and, if the athlete is skeletally mature, that often means a sprain of the ATFL. The anterior drawer test is used to assess laxity in the ATFL and is important to help grade the amount of joint laxity and the likelihood of further injury.

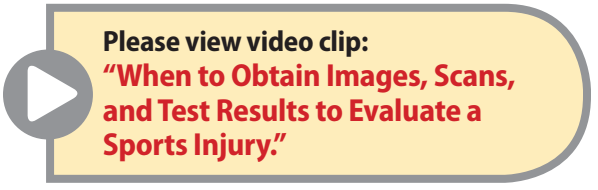
Neurologic Function

Neurologic assessment is also important for certain areas of the body, mainly as related to cervical or lumbar spine injury or, occasionally, with peripheral nerve injury, such as ulnar nerve subluxation in the cubital tunnel. Neurologic assessment generally includes muscle-strength testing, reflex testing, and sensory examination. These are often considered in the setting of an associated injury, such as an upper-extremity strength, reflex, and sensory loss in an athlete, such as a football player who has experienced an axial-load injury to the cervical spine. Mechanism and history of injury are important in helping assess these types of problems.

Specific Function

Finally, functional testing becomes important as athletes are ready to return to play. For example, before returning to play, the athlete who has experienced the ATFL sprain described previously will often be asked to stand for 30 seconds, with his or her eyes closed, on the injured foot or ankle. This is especially important because the ability or inability to perform this task is a good predictor of injury risk going forward.

Obtaining Specific Images, Scans, and Test Results to Evaluate a Sports-Related Injury



Knowing what image, scan, or test result to get, when to get it, and what to do with the information is tremendously important. The following text will review some of the common images, scans, and test results used in sports medicine:

1. Radiographs

Radiographs are an essential part of the evaluation of many sports-related injuries. The keys to getting proper radiographs are knowing when to get them, knowing what views to get, and developing a comfort level in evaluating musculoskeletal images. Because education regarding skeletal radiographic evaluation is minimal during many primary care residency programs, getting proper radiographs is sometimes difficult. When ordering bone radiographs, it is important to have an idea of the mechanism of injury as well as the age-appropriate findings in a particular patient. Furthermore, although not required for every injury, contralateral radiographs can aid in the comparison of injury (the injured as compared with the uninjured side). Generally, we find that repeated review of normal radiographic findings aids significantly in the ability to recognize abnormal findings.

In each section in the video, we have tried to provide the appropriate views for each body part. Although more views are needed in specific cases (and at times the opposite extremity is radiographed for comparison in evaluation of a growth plate injury), most basic information can be obtained through the radiographic screening views listed in Table 1-1. Each view is explained during the video portion of the material.

Table 1-1. Standard Radiographic Views to Screen for a Sports Injury

Body Part	Radiographic Views
Ankle	AP, lateral, mortise
Foot	AP; lateral; oblique; sesamoid (for suspected sesamoid injury)
Knee	AP, lateral, tunnel, Merchant
Tibia or fibula	AP, lateral
Shoulder	AP, axillary (for most screening examinations)
Clavicle	AP, 10° tilt
Wrist	AP; lateral; scaphoid (for suspected scaphoid fracture)
Hip	AP pelvis (for apophyseal injury), frog-leg lateral (for suspected SCFE)
Lumbar spine	AP, lateral, oblique (any for suspected spondylolysis)
Thoracic spine	AP, lateral
Cervical spine	AP, lateral, flexion, extension, odontoid (AP and lateral for basic screening, all for suspected instability)

Abbreviations: AP, anteroposterior; SCFE, slipped capital femoral epiphysis.

A radiograph is not only a helpful image for diagnosing bone injury but also the preferred image for diagnosing most apophyseal injuries, such as apophyseal avulsion fractures. These commonly occur in the hip, the knee, and the elbow, as discussed in the video examination.

2. Magnetic Resonance Image

Magnetic resonance imaging (MRI) has changed the face of medicine in the past 25 years. In many specialties, sports medicine included, MRI has allowed physicians to look inside the body, to avoid either delays or incorrect diagnoses. Because this is a magnetic-based study, it does not expose patients to radiation.

For the sports medicine physician, and for the primary care physician, obtaining and using an MRI is an important and helpful tool. However, please note and understand that an MRI is only as good as the context in which it is obtained. For example, an MRI can be a tremendously helpful tool in diagnosing conditions such as stress fractures (before they show on radiograph), edema in the capitellum if osteochondritis dissecans development is a concern in the lateral elbow of throwing athletes, and ligament or cartilage injuries in areas such as knees, shoulders, hips, ankles, and elbows. However, an MRI can also show information that does not necessarily pertain to the clinical picture, such as the presence of a small inter-substance meniscus tear in a patient with patellofemoral knee pain. Although the meniscus tear is present, it is not contributing to the cause of knee pain.

Therefore, the key to obtaining and using an MRI is realizing when to use MRI and what to do with the information. Magnetic resonance imaging is most helpful as a secondary study, to assess injuries that do not show on radiograph. The information from MRI, however, should be considered only in the context of an associated clinical scenario. The key to assessing if an MRI finding is significant is by assessing the patient history, physical examination, and MRI findings together. Throughout the workbook and video, we have tried to illustrate when and how MRI is helpful as a diagnostic tool.

A rule that was taught in residency applies here, as with many studies: if you are not comfortable interpreting the results of a test, it is probably best not to order that test. Many clinicians around the world have become comfortable interpreting an MRI; as such, this is a helpful image to obtain for further clarification. However, if the MRI findings

are not part of your normal clinical practice, results should be interpreted with caution.

Basic Rule

If you are not comfortable interpreting the results of a test, it is probably best not to order that test.

3. Computed Tomography Scan

Computed tomography (CT) scan is a helpful method for providing close-up, detailed information of bony anatomy. Like radiography, CT scan is a radiation-based study. The radiation dose is considerably higher during CT scan as compared with radiography, so these studies should always be performed with thoughtful consideration. Computed tomography scan is rarely used in the primary care setting, but, in sports medicine and all fields of orthopedic surgery, CT scan is helpful in providing further information about suspected bone injury. It is the scan of choice for evaluation of bone injuries, such as assessment of the anatomy of a spondylolysis lesion (in the spine) or the anatomical assessment and location of osteoid osteoma, a benign tumor that occurs in bone. Computed tomography scan also has the unique capability to provide 3-dimensional reconstruction views, which are especially helpful in the evaluation of trauma to bone.

4. Bone Scan

Radionuclide bone scan is a time-delayed scan that is used to screen for occult bone lesions. This scan involves injecting a radionuclide dye intravenously. A radiation-based scan is performed several hours later to screen for dye uptake. Bone scan used to be the scan of choice for diagnosing stress fracture before the age of MRI. However, if the origin of the bone-related pain is unclear, such as with suspected bone tumor, bone scan still has tremendous usefulness. In sports medicine, bone scan is a helpful screening device, but it has largely been replaced by MRI for many cases, unless the specific focus of the pain is unknown. Since the first edition of this book, bone scan use has thankfully decreased in the field of orthopedics and sports medicine and has largely been replaced by MRI.

5. Single-Photon Emission Computed Tomography Scan

Single-photon emission computed tomography (SPECT) scan is essentially a combination of bone scan and CT scan. In sports medicine, the SPECT scan has been used historically as a method to assess spondylolysis. The study is used similarly to bone scan in that it offers a time-delayed presence of dye uptake, and the CT imagery is particularly sensitive to the spinal anatomy. Increasingly, MRI has replaced this as well in many areas of the country. The image quality from MRI remains variable; as such, MRI diagnosis of spondylolysis is not universally available. In these cases, the SPECT scan is still a scan of value. Since the first edition of this book, SPECT bone scan use has thankfully decreased in the field of orthopedics and sports medicine and has largely been replaced by MRI.

6. Dual-Energy X-ray Absorptiometry Image

Dual-energy x-ray absorptiometry (DEXA) is a low-dose radiation study used to assess bone density and to screen for osteopenia and osteoporosis. These studies have been used more often for screening in the young athlete population in the past several years for several reasons, including the increasing recognition of the importance of diagnosing bone density abnormalities in teens and improved DEXA values that are now specific for adolescents. The DEXA study provides 2 scores: T and Z scores. T scores provide a comparison of bone mass between sex and race. Z scores compare bone mass by age.

The concern with DEXA has been that the developmental stage of an adolescent is not age based but rather sexual maturity rating based. As such, T and Z scores are highly variable between adolescents of the same age. Recently, however, DEXA values have been published for adolescents on the basis of sexual maturity rating, which has made this study more meaningful for teens.

Dual-energy x-ray absorptiometry studies are helpful to screen for low bone density, osteopenia (defined as a T score between −1 and −2.5 SDs from the mean), and osteoporosis (defined at less than −2.5 from the mean). In the clinical setting,

DEXA is often used to obtain a baseline value on a patient who is suspected to be at risk for low bone density, such as a teenaged athlete who has experienced a femoral stress fracture. If these values are low, a follow-up study 18 to 24 months after intervention will provide meaningful information about the trend in bone density value since the initial reading. This is often performed in an intervention setting, such as the implementation of a calcium and vitamin D supplement.

7. Ultrasound Image

Used for many years in Europe, musculoskeletal ultrasound is rapidly gaining popularity as a diagnostic study in sports medicine in the United States. Similar to the ultrasound used for fetal evaluation, diagnostic musculoskeletal ultrasound is a device that is especially helpful for evaluating soft-tissue abnormalities, such as tendon injuries. The benefit of ultrasound is that it is a dynamic study; the images it projects are moveable. This capability is especially important for tendon injuries, which, through the use of ultrasound, can be visualized easily while the affected extremity is moved. In some cases, such as iliopsoas tendinitis in dancers whose physical therapy has failed, ultrasound can be coupled with a therapeutic injection into a small area, such as the iliopsoas tendon sheath. At present, musculoskeletal ultrasound is a somewhat specialized procedure that is mostly found at some major medical centers. Since the first edition of this book, ultrasound use has increased in the fields of orthopedics and sports medicine because of ease of use, low cost, and assistance with the diagnosis and management of musculoskeletal injury.

8. Neurocognitive Test Results

Neurocognitive testing is a newer testing device used to assess athletes who have a concussion. First studied in professional football players, neurocognitive testing is becoming increasingly common in high-contact sports, which carry a higher risk of concussion. This type of testing allows for more objective decision-making when deciding whether to return an athlete to play. Neurocognitive testing works best when compared to a baseline for each individual athlete, so, if use of neurocognitive testing is indicated, such as for an athlete who has had several concussions, these tests are best administered in the preseason period. Increasingly, online computer programs are available to provide remote neurocognitive testing. Since the first edition of this book, use of neurocognitive testing has dramatically increased as a tool for evaluating concussion in pediatric and adolescent athletes.

9. Complete Blood Cell Count

A complete blood cell count is useful in many clinical situations outside of sports medicine. We have chosen to include this because, although they may look immune to infection in their sports outfits, athletes are equally prone to medical conditions such as infection and anemia, both of which can be diagnosed with a complete blood cell count. With increasing prevalence of methicillin-resistant *Staphylococcus aureus* in athletes of sports with padding, such as football and lacrosse, it is important to remind athletes that hygiene and regular cleaning of equipment are helpful preventive measures.

Referring an Athlete for Physical Therapy

In general, physical therapists are extremely helpful when caring for many musculoskeletal problems, and they can help fix the mechanical factors that are causing an injury or, sometimes, are the result of an injury.

Please note that some schools have on-site certified athletic trainers (they have earned an ATC credential) who provide a similar role inside the school. When a certified athletic trainer is available for this purpose, this scenario provides a tremendous benefit for the athletes and families at the school. Physical therapy can be used for the cases that are too time-consuming to be handled inside the school setting.

When referring a patient for physical therapy, it is helpful to ascertain if the therapist has a particular interest in treating young athletes, and also expertise in a particular type of activity. For example,

a physical therapist who knows about dance is well suited to aid the young dancer, while a physical therapist who works frequently with baseball players is well suited to work with them.

Physical therapy prescriptions should include a diagnosis and a frequency of treatment. In general, it is best to see patients again after roughly 4 to 6 weeks of them starting physical therapy to ascertain progress. For athletic children and adolescents, a sports-minded physical therapist tends to provide optimal results.

Returning an Athlete to Play

1. Full Understanding of the Injury

The ultimate responsibility (and liability) for making the decision to clear an athlete for return to play rests with the physician, even though the decision is often made with input from a physical therapist or certified athletic trainer. The keys to authorizing this return to play are a full understanding of the injury and the knowledge that the appropriate preventive measures have been taken to reduce risk of repeat injury. In sports medicine, this type of clearance can be everything from the return to play of a football player after a concussion (from the sideline while the game is in progress or from the office) to a return to play of a ballet dancer to full dance after a stress fracture. The keys in all cases are knowledge of what the injury is, how it has occurred, and the level of healing of the athlete.

2. Guidelines for Return to Play

Guidelines are available for many types of injuries, and we have tried to include many of these in the context of this book. The key point here, however, is that every injury is different, as is every athlete (eg, although an injury such as traction apophysitis at the medial epicondyle in a pitcher might initially present with the same physical examination findings in 2 athletes [pain with throwing and tenderness to palpation at the medial epicondyle], both injuries may heal at quite different rates). This altered healing response has many causes, including biological considerations (eg, the cellular healing rate), as well as extrinsic factors (eg, underlying strength and throwing mechanics). As such, there is no absolute rule for any injury. The main point is that return to play is an individual decision for each athlete and depends on issues such as presence of ongoing symptoms, ability to perform at one's pre-injury level of ability, and ability to protect oneself when on the sports field.

3. Guidelines for Prevention

Guidelines for prevention are also an important part of sports medicine. For example, an athlete with a history of several ankle sprains requires not only absence of symptoms before returning to play but a clear plan of preventive exercises to reduce the likelihood of this injury happening again. Giving guidelines for prevention (eg, the need for maintaining an ongoing ankle-strengthening program when the ankle is uninjured) is an essential part of the safe and healthy return of athletes to play.

This page intentionally left blank

CHAPTER 2

Trends in Prevention of Sports Injury in the Young Athlete

Cassidy MacDowell Foley, DO, FAAP,
and Kathryn Dunn McElheny, MD, FAAP

This page intentionally left blank

Please view video clips:
"Prevention of Sports Injury in the Young Athlete."

As the field of sports medicine grows, there is a particular need to devise preventive strategies to keep young athletes safe and on their field of choice. This chapter examines some of the various areas in which prevention can make a difference for young athletes.

According to the 2008 National Council of Youth Sports' report on trends and participation in organized child and youth sports, 60 million 6- to 18-year-olds participated in organized sports compared with 45 million in 1997 (Brenner). This increase in participation allows more children and youths to benefit from the numerous well-recognized gains of child and youth sports participation, including socialization with peers, lifelong physical activity skills, teamwork and leadership skill development, improving self-esteem, having fun, and the decreased risk of major chronic diseases, including diabetes, cardiovascular (CV) disease, colon cancer, and osteoporosis. The growing popularity of child and youth sports is also increasing awareness among general pediatricians of sports medicine injuries in young athletes and the need for preventive measures.

Preventive medicine is a focal point of pediatric training and a crucial aspect of how pediatricians care for patients. Pediatricians can take an active role in starting or recommending prevention programs for their patients. Resources such as the Centers for Disease Control and Prevention Web site on Heads Up Concussion and the American Academy of Pediatrics (AAP) Council on Sports Medicine and Fitness have an abundance of resources for injury prevention and education.

This chapter will focus on trends in prevention, in the areas of sport specialization and burnout, concussions, heat illness, CV screening, spine injuries, anterior cruciate ligament (ACL) injuries, and bone health and energy deficiency as they relate to stress fracture prevention and metabolic needs of young athletes.

Sport Specialization

Case 1

Is sport specialization always a good idea?

Description

A 9-year-old female diver presents to her primary care professional's office with one month of progressively distracting wrist pain. She is diving 3 hours a day, 4 days a week, and getting only 2 hours a week of free play or dry land training.

The diver is in a sport whose participants may benefit from early specialization. However, to decrease her risk of injury, the pediatrician recommends decreasing her training hours to less than her years of age (9 years). The health care professional also recommends increasing hours of free play to achieve closer to a 2:1 ratio of organized training to free play. Last, she will be monitored closely for indicators of burnout, overuse, injury, or potential decrements in performance caused by overtraining.

Workup and Management

Caused by exposure of athletes to competition at earlier ages, a hot topic among young athletes is the trend toward sport specialization. Sport specialization is intensive, year-round training in a single sport at the exclusion of other sports. An emphasis on competitive success has become more widespread, including increased pressure to begin high-intensity training at younger ages, with select travel leagues starting as young as 7 years of age. Often the motivation for early specialization seems to stem from the athlete or parent, or both, wanting to capture a piece of the very small "pie," namely, the end goal of collegiate and professional-level athletics. Unfortunately, 70% of children and adolescents drop out of organized sports by 13 years of age; between 3% and 11% of high school athletes compete at the college level, with only 1% receiving scholarships; and only 0.03% to 0.50% of high school athletes will go on to reach professional-level sports (Figure 2-1).