LET'S DISCUSS Series

Adolescent Sports Injuries

Edited by

Robert F. LaPrade, MD, PhD

Chief Medical Officer The Steadman Clinic Vail, Colorado

Mininder S. Kocher, MD, MPH

Boston Children's Hospital, Deptment of Orthopaedic Surgery Associate Director, Division of Sports Medicine Boston, Massachusetts

Series Editor

Adam J. Schwartz, MD

Assistant Professor Department of Orthopaedic Surgery Mayo Clinic Phoenix, Arizona

AAOS

AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS



AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

BOARD OF DIRECTORS, 2016-2017

Gerald R. Williams Jr, MD

President

William J. Maloney, MD First Vice-President

David A. Halsey, MD Second Vice-President

M. Bradford Henley, MD, MBA

Treasurer

David D. Teuscher, MD

Past-President

Basil R. Besh, MD

Lisa K. Cannada, MD

Howard R. Epps, MD

Daniel C. Farber, MD

Brian J. Galinat, MD, MBA

Daniel K. Guy, MD

Lawrence S. Halperin, MD

Amy L. Ladd, MD

Brian G. Smith, MD

Ken Sowards, MBA

Karen L. Hackett, FACHE, CAE (ex officio)

STAFF

Ellen C. Moore, Chief Education Officer Hans Koelsch, PhD, Director, Department of Publications Lisa Claxton Moore, Senior Manager, Book Program Randall Towns, Senior Manager, Education and Instructional Design

Daniel Blaustein, Managing Editor, Orthopaedic Knowledge Online

Brian Moore, Manager, Electronic Media

Steven Kellert, Senior Editor

Courtney Dunker, Editorial Production Manager

Abram Fassler, Publishing Systems Manager

Suzanne O'Reilly, Graphic Designer

Susan Morritz Baim, Production Coordinator

Karen Danca, Permissions Coordinator

Charlie Baldwin, Digital and Print Production Specialist

Hollie Muir, Digital and Print Production Specialist

Katie Hovany, Digital Media Specialist

Emily Douglas, Page Production Assistant

Sylvia Orellana, Publications Assistant

The material presented in *Let's Discuss Series*: Adolescent Sports Injuries has been made available by the American Academy of Orthopaedic Surgeons for educational purposes only. This material is not intended to present the only, or necessarily best, methods or procedures for the medical situations discussed, but rather is intended to represent an approach, view, statement, or opinion of the author(s) or producer(s), which may be helpful to others who face similar situations.

Some drugs or medical devices demonstrated in Academy courses or described in Academy print or electronic publications have not been cleared by the Food and Drug Administration (FDA) or have been cleared for specific uses only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or device he or she wishes to use in clinical practice.

Furthermore, any statements about commercial products are solely the opinion(s) of the author(s) and do not represent an Academy endorsement or evaluation of these products. These statements may not be used in advertising or for any commercial purpose.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.

Cover art courtesy of thinkstockphotos.com

Published 2016 by the

American Academy of Orthopaedic Surgeons

9400 West Higgins Road

Rosemont, IL 60018

Copyright 2016

by the American Academy of Orthopaedic Surgeons

ISBN 978-1-62552-552-9

Printed in the USA





Contributors

Julie Agel, MA, ATC

Research Coordinator Department of Orthopaedic Surgery University of Minnesota Minneapolis, Minnesota

Michael A. Beasley, MD

Attending Physician Division of Sports Medicine Boston Children's Hospital Boston, Massachusetts

Michael Davies, BS

Department of Orthopaedic Surgery University of California, San Francisco San Francisco, California

Chase S. Dean, MD

Clinical Research Assistant Center for Outcomes-Based Orthopaedic Research Steadman Philippon Research Assistant Vail, Colorado

Matthew Ellington, MD

Fellow

Department of Pediatric Orthopedics Rady Children's Hospital San Diego, California

Lars Engebretsen, MD, PhD

Professor Orthopedic Clinic University of Oslo Oslo, Norway

Brian Feeley, MD

Associate Professor Department of Orthopaedic Surgery University of California, San Francisco San Francisco, California

Benton E. Heyworth, MD

Pediatric Orthopaedic Surgeon
Department of Orthopaedics and Division of
Sports Medicine
Boston Children's Hospital
Boston, Massachusetts

Sarah Jackson, MD, CSCS

Sports Medicine Fellow Department of Orthopedics Division of Sports Medicine Boston Children's Hospital Boston, Massachusetts

Neeru Jayanthi, MD, USPTA, PTR

Director, Tennis Medicine Department of Orthopaedics and Family Medicine Emory University Atlanta, Georgia

Scott H. Kozin, MD

Chief of Staff
Department of Orthopaedic Surgery
Shriners Hospitals for Children Philadelphia
Philadelphia, PA

Robert F. LaPrade, MD, PhD

Chief Medical Officer The Steadman Clinic Vail, Colorado





Contributors

Dominique Laron, MD

Department of Orthopaedics
University of California, San Francisco
San Francisco, California

Lyle J. Micheli, MD

Director Sports Medicine Division Boston Children's Hospital Boston, Massachusetts

Christine Holm Moseid, MD

PhD Candidate
Oslo Sports Trauma Research Centre
Norwegian School of Sports Sciences
Oslo, Norway

Carl W. Nissen, MD

Physician/Surgeon Elite Sports Medicine Connecticut Children's Medical Center Farmington, Connecticut

Michael J. O'Brien

Director of the Sports Concussion Clinic Department of Orthopedics Boston Children's Hospital Boston, Massachusetts

Joshua M. Pahys, MD

Adjunct Clinical Associate Professor
Department of Orthopaedic Surgery, Sidney
Kimmel Medical College at Thomas Jefferson
University
Shriners Hospitals for Children—Philidelphia
Philadelphia, Pennsylvania

Andrew Pennock, MD

Associate Clinical Professor Department of Orthopedics Rady Children's Hospital University of California, San Diego San Diego, California

Marc J. Philippon, MD

Managing Partner The Steadman Clinic Vail. Colorado

Matthew T. Provencher, MD

Shoulder, Knee, and Sports Surgeon The Steadman Clinic Vail, Colorado

Bridget J. Quinn, MD

Instructor

Division of Sports Medicine, Department of Orthopaedic Surgery Boston Children's Hospital Boston, Massachusetts

Stephanie A. Russo, MD, PhD

Resident Physician Department of Orthopaedic Surgery University of Pittsburgh Medical Center, Hamot Erie, Pennsylvania

George Sanchez, BS

Research Coordinator Department of Sports Medicine Massachusetts General Hospital Boston, Massachusetts



Contributors

Deborah Anne Skinstad, MA

Sport Science PhD Student Stellenbosch Sport Science Department Stellenbosch University Stellenbosch, Western Cape, South Africa

Matthew J. Solomito, PhD

Manager – Orthopedic and Sports Medicine Research Department of Orthopedic Surgery and Sports Medicine Connecticut Children's Medical Center Farmington, Connecticut

Kathrin Steffen, PhD

Senior Researcher
Oslo Sports Trauma Research Center, Department
of Sports Medicine
Norwegian School of Sport Sciences
Oslo, Norway

Ashley J. Tisosky, MD

Resident Physician Harvard Combined Orthopaedic Residency Program Massachusetts General Hospital Boston, Massachusetts

Timilehin Wusu, MD

Orthopaedic Resident Physician Department of Orthopaedics Boston Children's Hospital Boston, Massachusetts

Yi-Meng Yen, MD, PhD

Assistant Professor
Department of Orthopaedics
Boston Children's Hospital, Harvard
Medical School
Boston, Massachusetts

Preface

Adolescent sports injuries are being seen with increased frequency as a result of greater participation in youth sports at higher competitive levels, early sports specialization, and increased recognition of injury. These injuries have the potential to negatively affect the adolescent's physical health and psychosocial well-being. In addition, these injuries may have longer term implications for arthritis, mobility, and productivity.

Adolescent Sports Injuries is an ebook in the Let's Discuss series by the American Academy of Orthopaedic Surgeons that allows the integration of text, video, and test questions. An expert group of authors has shared their insights and expertise in adolescent sports injuries. This text covers the epidemiology of injury, upper extremity injuries, lower extremity injuries, and sport-specific injuries, and also provides an international perspective. It is our hope that this comprehensive overview allows for better understanding and treatment of injuries in this unique age group.

We would like to thank the authors for their hard work in crafting chapters that are informative, interesting, and practical. We would also like to thank the AAOS Publications Committee and members of the AAOS staff for their invaluable help and guidance in developing this text, including Hans Koelsch, PhD, Director, Publications; Adam Schwartz, MD, Series Editor; Lisa Claxton Moore, Senior Manager, Book Program; Randall Towns, Senior Manager, Education Programs and Instructional Design; Brian Moore, Manager, Electronic Media; Daniel Blaustein, Managing Editer, Orthpaedic Knowledge Online; Joan Golembiewski, Publications Manager; Courtney Dunker, Editorial Production Manager; Abram Fassler, Publishing Systems Manager; Steven Kellert, Senior Editor; Katie Hovany, Digital Media Specialist; Meghan Jacobs, Marketing Specialist; and Sylvia Orellana, Publications Assistant.

Finally, we would like to thank our families, colleagues, and patients for their help and inspiration in preparing this work. We hope you find it educational and useful.

Robert F. LaPrade, MD, PhD Mininder S. Kocher, MD, MPH Editors

Editor and Staff Disclosure

Dr. LaPrade or an immediate family member has received royalties from Arthrex and Smith & Nephew; serves as a paid consultant to Arthrex, Össur, and Smith & Nephew; has received research or institutional support from Arthrex, Smith & Nephew, Össur, and Linvatec; and serves as a board member, owner, officer, or committee member of the American Orthopaedic Society for Sports Medicine, The International Society of Arthroscopy, Knee Surgery, and Orthopaedics Sports Medicine, the Arthroscopy Association of North America, and the European Society for Sports Traumatology, Knee Surgery and Arthroscopy.

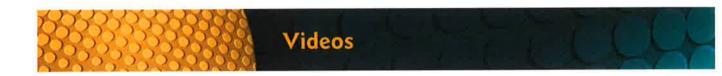
Dr. Kocher or an immediate family member has received royalties from OrthoPediatrics; serves as a paid consultant to Best Doctors, CONMED Linvatec, OrthoPediatrics, Össur, and Smith & Nephew; has stock or stock options held in Fixes 4 Kids and Pivot Medical; has received nonincome support (such as equipment or services), commercially derived

honoraria, or other non-research–related funding (such as paid travel) from Saunders/Mosby-Elsevier and Wolter Kluwer Health; serves as a board member, owner, officer, or committee member of the American Academy of Orthopaedic Surgeons, the ACL Study Group, the American Orthopaedic Society for Sports Medicine, the Harvard Medical School, the Harvard School of Public Health, the Herodicus Society, the Pediatric Orthopaedic Society of North America, and Steadman Philippon Research Institute.

None of the following AAOS editorial staff or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Ms. Moore, Mr. Towns, Mr. Moore, Ms. Golembiewski, Mr. Kellert, Ms. Dunker, Mr. Fassler, Ms. Orellana, Ms. Hovany, Ms. Jacobs, and Mr. Blaustein.

Table of Contents

1	Prefacevi What Is Early Sports Specialization?	6 7	Baseball Injuries in Adolescents
and 2	Davies, BS, Brian Feeley, MD	8	Football Injuries in Adolescents
3		9	Gymnastics Injuries in Adolescents
4	-	10	Dance Injuries in Adolescents 183 Sarah Jackson, MD, CSCS, Bridget J. Quinn, MD, and Lyle J. Micheli, MD
5	Ellington, MD Concussions in Adolescents75 Michael A. Beasley, MD and Michael J. O'Brien, MD	(11)	Ice Hockey Injuries in Adolescents
(2) 6	Tennis Injuries in Adolescents93 Neeru Jayanthi, MD, USPTA, PT and, Deborah Anne Skinstad, MA	12	International Perspectives on Adolescent Sports Injuries 247 Christine Holm Moseid, MD, Kathrin Steffen, PhD, and Lars Engebretsen, MD. PhD



Chapter 6: Tennis Injuries in Adolescents



VIDEO I Low Back Stress Injuries in the Junior Tennis Player. Jayanthi N, MD: Video. *Low Back Stress Injuries in the Junior Tennis Player*. Johns Creek, GA, 2016.



VIDEO 2 Low Back Stress Injuries in the Junior Tennis Player Corrected. Jayanthi N, MD: Video. *Low Back Stress Injuries in the Junior Tennis Player Corrected*. Johns Creek, GA, 2016.



VIDEO 3 Ulnar Pain in a Forehand Stroke. Jayanthi N, MD: Video. *Ulnar Pain in a Forehand Stroke*. Johns Creek, GA, 2016.



VIDEO 4 Ulnar Pain in a Forehand Stroke Corrected. Jayanthi N, MD: Video. *Ulnar Pain in a Forehand Stroke Corrected*. Johns Creek, GA, 2016.



VIDEO 5 Ulnar Pain in a Backhand Stroke. Jayanthi N, MD: Video. *Ulnar Pain in a Backhand Stroke*. Johns Creek, GA, 2016.



Videos



VIDEO 6 Ulnar Pain in a Backhand Stroke Corrected. Jayanthi N, MD: Video. *Ulnar Pain in a Backhand Stroke Corrected*. Johns Creek, GA, 2016.



VIDEO 7 Shoulder and Elbow During a Serve. Jayanthi N, MD: Video. *Shoulder and Elbow During a Serve*. Johns Creek, GA, 2016.

Chapter 7: Baseball Injuries in Adolescents



VIDEO I Internal Impingement.
Nissen CW, MD: Video. *Internal Impingement*. Farmington, CT, 2016.



VIDEO 2 Side View of a Pitcher. Nissen CW, MD: Video. *Side View of a Pitcher*. Farmington, CT, 2016.



VIDEO 3 Aerial View of a Pitcher. Nissen CW, MD: Video. *Aerial View of a Pitcher*. Farmington, CT, 2016.



Chapter 11: Ice Hockey Injuries in Adolescents



VIDEO I 17-Year-Old Male Ice Hockey Goaltender With Persistent Left Hip Pain Philippon MJ, MD: Video. 17-Year-Old Male Ice Hockey Goaltender With Persistent Left Hip Pain. Vail, CO, 2016.



CME Assessment/Information

CME Assessment Questions

The American Academy of Orthopaedic Surgeons is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this enduring material for a maximum of 8 AMA PRA Category 1 CreditsTM. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Education Objectives

As a result of participation in this activity, participants will be able to:

- Quickly address the economics, biology, diagnosis, and treatment of various conditions in adolescent athletes.
- Avoid the pitfalls of increased complications, increased length of hospital stay, poorer outcomes, and increased mortality associated with injuries in adolescents.
- Reduce the substantial resource utilization and the economic burden of treating adolescent patients with sports injuries.

Explore the full portfolio of AAOS educational programs and publications across the orthopaedic spectrum for every stage of an orthopaedic surgeon's career, at www.aaos.org. The AAOS, in partnership with Jones & Bartlett Learning, also offers a comprehensive collection of educational and training resources for emergency medical providers, from first responders to critical care transport paramedics. Learn more at www.aaos.org/ems.