

Get Full Access and More at

ExpertConsult.com

SURGICAL TECHNIQUES OF THE SHOULDER, ELBOW, AND KNEE IN SPORTS MEDICINE

edition 2



ELSEVIER
SAUNDERS

BRIAN J. COLE
JON K. SEKIYA

SECOND EDITION

Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine

Edited by

Brian J. Cole, MD, MBA

Professor, Department of Orthopaedics
Department of Anatomy and Cell Biology
Section Head, Cartilage Restoration Center
Rush University Medical Center
Chicago, Illinois

Jon K. Sekiya, MD

Larry S. Matthews Collegiate Professor of
Orthopaedic Surgery
Associate Professor
MedSport—University of Michigan
Ann Arbor, Michigan

Associate Editors

Geoffrey S. Van Thiel, MD, MBA

Clinical Instructor
Rush University Medical Center
Chicago, Illinois
Rockford Orthopedic Associates
Rockford, Illinois

Jack G. Skendzel, MD

Sports Medicine Fellow
The Steadman Philippon Research Institute
Vail, Colorado

SAUNDERS



ELSEVIER
SAUNDERS

1600 John F. Kennedy Blvd.
Ste 1800
Philadelphia, PA 19103-2899

SURGICAL TECHNIQUES OF THE SHOULDER,
ELBOW, AND KNEE IN SPORTS MEDICINE

ISBN: 978-1-4557-2356-0

Copyright © 2008, 2013 by Saunders, an imprint of Elsevier Inc.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

With respect to any drug or pharmaceutical products identified, readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of practitioners, relying on their own experience and knowledge of their patients, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data

Surgical techniques of the shoulder, elbow, and knee in sports medicine / edited by Brian J. Cole, Jon K. Sekiya; associate editors, Geoffrey S. Van Thiel, Jack G. Skendzel.—2nd ed.
p. ; cm.

Includes bibliographical references and index.

ISBN 978-1-4557-2356-0 (hardcover)

I. Cole, Brian J. II. Sekiya, Jon K.

[DNLM: 1. Arthroscopy. 2. Elbow—surgery. 3. Knee—surgery. 4. Shoulder—surgery.

5. Sports Medicine—methods. WE 304]

RC932

617.4'720597—dc23

2013008299

Printed in China

Last digit is the print number: 9 8 7 6 5 4 3 2 1

Senior Content Strategist: Don Scholz
Senior Content Development Specialist: Ann Ruzycka Anderson
Publishing Services Manager: Patricia Tannian
Project Manager: Carrie Stetz
Design Direction: Louis Forgiore



Working together
to grow libraries in
developing countries

www.elsevier.com • www.bookaid.org

Contributors

Sami Abdulmassih, MD

Visiting Associate, Division of Sports Medicine, Department of Orthopedic Surgery and Rehabilitation, University of Iowa Hospitals and Clinics, Iowa City, Iowa

Julie E. Adams, MD

Assistant Professor of Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota

Christopher S. Ahmad, MD

Assistant Professor of Orthopaedic Surgery, Center for Shoulder, Elbow and Sports Medicine, Columbia University, New York, New York

Answorth A. Allen, MD

Associate Professor, Weill Medical College of Cornell University, Associate Attending Physician, Hospital for Special Surgery, New York, New York

Laith Al-Shihabi, MD

Resident, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

David W. Altchek, MD

Hospital for Special Surgery, Chief, Sports Medicine and Shoulder Service, Professor of Orthopaedic Surgery, Weill Cornell Medical College, New York, New York

Annunziato Amendola, MD

Professor, Orthopaedics and Rehabilitation, University of Iowa; Director, University of Iowa Sports Medicine Center, University of Iowa Hospitals and Clinics, Iowa City, Iowa

Kyle Anderson, MD

Director, Sports Medicine and Shoulder Fellowship, Department of Orthopaedic Surgery, William Beaumont Hospital; Team Physician, Detroit Lions, Detroit, Michigan

Wade Andrews, MD

Orthopaedic Surgeon, OSS Health, York, Pennsylvania

Paulo H. Araujo, MD

Research Fellow, Department of Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania; Centro de Ortopedia e Traumatologia de Brasília, Sao Paulo, Brazil

Frederick M. Azar, MD

Professor and Residency Program Director, Sports Medicine Fellowship Director, Campbell Clinic, University of Tennessee, Memphis, Tennessee

Bernard R. Bach Jr, MD

The Claude N. Lambert–Susan Thomson Endowed Professor of Orthopedic Surgery, and Director, Division of Sports Medicine and Sports Medicine Fellowship, Rush University Medical Center; Team Physician, Chicago White Sox and Chicago Bulls, Chicago, Illinois

Champ L. Baker Jr, MD

Clinical Assistant Professor, Department of Orthopaedic Surgery, Tulane University School of Medicine, New Orleans, Louisiana; Clinical Assistant Professor, Department of Orthopaedics, Medical College of Georgia, Augusta; Staff Physician, The Hughston Clinic, Columbus, Georgia

Champ L. Baker III, MD

Resident, Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

Asheesh Bedi, MD

Assistant Professor, Harold and Helen W. Gehring Early Career Professor in Orthopaedic Surgery, MedSport, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

Knut Beitzel, MD

Department of Trauma and Orthopaedic Surgery, Trauma Center Murnau, Murnau, Germany

Patrick M. Birmingham, MD

Assistant Professor, Department of Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, Wisconsin; Orthopaedic Surgeon, Northwestern Orthopaedic Institute at NorthShore University Health System, Chicago, Illinois

Debdut Biswas, MD

Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Andrew J. Blackman, MD

Resident, Department of Orthopaedic Surgery, Washington University, St. Louis, Missouri

Matthew T. Boes, MD

Raleigh Orthopaedic Clinic, Raleigh, North Carolina

Pascal Boileau, MD

Consultant Orthopaedic Surgeon, St. James's Hospital, Dublin, Ireland

Davide Edoardo Bonasia, MD

Orthopaedic Clinic of the University of Turin, CTO Hospital, Turin, Italy

Craig R. Bottoni, MD

Chief of Surgery, Aspertar Sports Medicine Hospital, Doha, Qatar

Jay Boughanem, MD

Harvard Shoulder Service, Department of Orthopaedic Surgery, Brigham and Women's Hospital, Boston, Massachusetts

Mark K. Bowen, MD

Associate Professor of Clinical Orthopaedic Surgery, Northwestern University Medical School; Active Attending Physician, Northwestern Memorial Hospital, Chicago, Illinois

Karl F. Bowman Jr, MD

Fellow, Sports Medicine, UPMC Center for Sports Medicine, Pittsburgh, Pennsylvania

Michael B. Boyd, DO

Attending Physician, Department of Orthopaedic Surgery, St. Mary's Hospital and Deaconess Hospital, Evansville, Indiana

James P. Bradley, MD

Clinical Associate Professor of Orthopaedic Surgery, University of Pittsburgh Medical Center; Orthopaedic Surgeon, University of Pittsburgh Medical Center Shadyside and St. Margaret Hospitals; Head Orthopaedic Surgeon, Pittsburgh Steelers, Pittsburgh, Pennsylvania

William D. Bugbee, MD

Associate Professor, Department of Orthopaedic Surgery, University of California, San Diego; Attending Physician, Lower Extremity Reconstruction and Cartilage Restoration, Division of Orthopaedic Surgery, Scripps Clinic, La Jolla, California

Stephen S. Burkhart, MD

Fellowship Director, The San Antonio Orthopaedic Group, San Antonio, Texas

Joseph P. Burns, MD

Southern California Orthopedic Institute, Sports & Shoulder Team, Van Nuys, California

Charles A. Bush-Joseph, MD

Associate Professor, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Thomas R. Carter, MD

Emeritus Head of Orthopedic Surgery, and Consultant, Orthopedic Surgery, Arizona State University, Tempe, Arizona

Simone Cerciello, MD

Orthopaedic Surgeon and Professor, Molise University, Campobasso, Italy

Jaskarndip Chahal, MD

University Health Network and Women's College Hospital, University of Toronto, Toronto, Canada

Peter N. Chalmers, MD

Orthopaedic Surgery Resident, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Salma Chaudhury, MD, PhD

Orthopaedic Resident, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Oxford, United Kingdom

Neal C. Chen, MD

Resident, Department of Orthopedic Surgery, Harvard Combined Orthopedic Residency, Boston, Massachusetts

Emilie Cheung, MD

Assistant Professor, Shoulder and Elbow Surgery, Department of Orthopedic Surgery, Stanford University Medical Center, Redwood City, California

Robert M. Coale, MD

Orthopaedic Surgeon, Ortho West; Medical Director, Sports Medicine, Southwest General Health Center, Middleburg Heights, Ohio

Mark S. Cohen, MD

Director, Section of Hand and Elbow Surgery, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Steven B. Cohen, MD

Assistant Professor, Department of Orthopaedic Surgery, Thomas Jefferson University; Orthopaedic Surgeon, Rothman Institute; Assistant Team Physician, Philadelphia Phillies, Philadelphia, Pennsylvania

Brian J. Cole, MD, MBA

Professor, Departments of Orthopedics and Anatomy and Cell Biology, Section of Sports Medicine; Section Head, Cartilage Restoration Center, Rush University Medical Center, Chicago, Illinois

CPT Jay B. Cook, MD, MC, USA

Resident, Department of Orthopaedics, Tripler Army Medical Center, Honolulu, Hawaii

Andrew J. Cosgarea, MD

Associate Professor and Director of Sports Medicine and Shoulder Surgery, Department of Orthopaedic Surgery, Johns Hopkins University, Baltimore, Maryland

D. Jeff Covell, MPH

Research Assistant, Cognitive Neuroscience Laboratory, University of Kentucky College of Medicine, Lexington, Kentucky

Matthew Craig, BS

Georgetown University School of Medicine, Washington, DC

R. Alexander Creighton, MD

Assistant Professor of Orthopaedics, University of North Carolina at Chapel Hill and University of North Carolina Hospitals, Chapel Hill, North Carolina

Thomas DeBerardino, MD

Associate Professor, Department of Orthopaedic Surgery, University of Connecticut Health Center, Farmington, Connecticut

Scott J. Deering, MD

Fellow, Department of Orthopaedic Sports Medicine, University of Kentucky, Lexington, Kentucky

David Dejour, MD

Orthopaedic Surgeon, Lyon-Ortho-Clinic, Lyon, France

Patrick J. Denard, MD

Clinical Instructor, Department of Orthopaedics & Rehabilitation, Oregon Health & Science University, Portland, Oregon; Shoulder Surgeon, Southern Oregon Orthopedics, Medford, Oregon

Aman Dhawan, MD

Assistant Clinical Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, UMDNJ-Robert Wood Johnson Medical School, New Brunswick, New Jersey

Aad A.M. Dhollander, MD, PhD

Department of Orthopaedic Surgery, Ghent University Hospital, Ghent, Belgium

David R. Diduch, MD

Professor, University of Virginia Head Orthopaedic Team Physician; Director, Sports Medicine Fellowship Program, Charlottesville, Virginia

Joshua S. Dines, MD

Sports Medicine and Shoulder Service, The Hospital for Special Surgery, Great Neck, New York

Christopher C. Dodson, MD

Rothman Institute, Department of Sports Medicine; Assistant Professor of Orthopaedic Surgery, Thomas Jefferson Medical College, Philadelphia, Pennsylvania

Kevin M. Doulens, MD

Clinical Fellow, Sports Medicine, Orthopaedics and Rehabilitation, Vanderbilt University Medical Center, Nashville, Tennessee

Alex Dukas, MD

Resident Physician, New England Musculoskeletal Institute, Department of Orthopaedics, University of Connecticut Health Center, Farmington, Connecticut

Neal S. ElAttrache, MD

Sports Medicine Surgeon, Kerlan-Jobe Orthopaedic Clinic, Los Angeles, California

Gregory C. Fanelli, MD

Fanelli Sports Injury Clinic, Geisinger Medical Center, Danville, Pennsylvania

Jack Farr II, MD

Associate Clinical Professor of Orthopaedic Surgery, Indiana University School of Medicine; Orthopaedic Surgeon, St. Francis Hospital and Health Centers and Indiana Orthopaedic Hospital, Indianapolis, Indiana

Diego Fernandez, MD

Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, University of Bern and Lindenhof Hospital, Bern, Switzerland

John J. Fernandez, MD

Assistant Professor, Department of Orthopaedics, Rush University Medical Center, Chicago, Illinois

Paolo Ferrua, MD

Orthopaedic Surgeon, G. Pini Orthopaedic Institute, Milan, Italy

Larry D. Field, MD

Clinical Instructor, Orthopaedic Surgery, University of Mississippi School of Medicine; Co-Director, Upper Extremity Service, Mississippi Sports Medicine and Orthopaedic Center, Jackson, Mississippi

David C. Flanigan, MD

Assistant Professor of Orthopedics, Team Physician, The Ohio State University Athletic Department, The Ohio State University, Columbus, Ohio

Brian Forsythe, MD

Orthopedic Surgeon, Sports Medicine Specialist, Midwest Orthopedics, Rush University Medical Center, Chicago, Illinois

Tyler Fox, MD

Harvard Shoulder Service, Department of Orthopaedic Surgery, Brigham and Women's Hospital, Boston, Massachusetts

Jonathan M. Frank, MD

Resident Physician, Department of Orthopaedics, Rush University Medical Center, Chicago, Illinois

Rachel M. Frank, MD

Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Heather Freeman, PT, DHS

Shelbourne Knee Center, Indianapolis, Indiana

Freddie H. Fu, MD, DSc(Hon), DPs(Hon)

Chairman, Orthopaedic Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

John P. Fulkerson, MD

Clinical Professor of Orthopedic Surgery, University of Connecticut School of Medicine, Farmington, Connecticut

Andrew Gelven, DO

Atlanta Sports Medicine & Orthopaedic Center, Atlanta, Georgia

Scott Gillogly, MD

Medical Staff, Department of Orthopaedic Surgery, St. Joseph's Hospital, Atlanta, Georgia

M. Mustafa Gomberawalla, MD

Orthopaedic Surgery Resident, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

Andreas H. Gomoll, MD

Instructor of Orthopaedic Surgery, Harvard Medical School; Cartilage Repair Center, Department of Orthopaedic Surgery, Brigham and Women's Hospital, Boston, Massachusetts

Simon Görtz, MD

Resident Physician, Department of Orthopaedic Surgery, University of California–San Diego, San Diego, California

James Hammond, DO, ATC

Clinical Instructor, Bone and Joint/Sports Medicine Institute, Department of Orthopaedics, Shoulder/Elbow Sports Surgeon, Naval Medical Center Portsmouth, Portsmouth, Virginia

Michael G. Hannon, MD

Chief Resident, Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, New York

Shane Hanzlik, MD

Chief Resident, Department of Orthopedics, Case Western Reserve University, Cleveland, Ohio

Christopher D. Harner, MD

Professor, Department of Orthopaedic Surgery, University of Pittsburgh; Medical Director, Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Center for Sports Medicine, Pittsburgh, Pennsylvania

Marc S. Haro, MD

University of Virginia, Department of Orthopaedic Surgery, Charlottesville, Virginia

Wendell Heard, MD

Assistant Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, Section of Sports Medicine, Tulane University School of Medicine, New Orleans, Louisiana

Laurence D. Higgins, MD

Chief, Harvard Shoulder Service and Sports Medicine, Brigham and Women's Hospital, Department of Orthopaedic Surgery, Boston, Massachusetts

Stephen M. Howell, MD

Professor, Department of Mechanical Engineering, University of California–Davis, Sacramento, California

Nicholas D. Iagulli, MD

Mississippi Sports Medicine and Orthopaedic Center, Jackson, Mississippi

Mary Lloyd Ireland, MD

President/Director, Kentucky Sports Medicine Clinic, Lexington, Kentucky

Warren R. Kadrmaz, MD

Fellow, Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, New York; Staff Orthopaedic Surgeon, Wilford Hall Medical Center, Lackland Air Force Base, Texas

Christopher C. Kaeding, MD

Professor of Orthopaedics and Director of Sports Medicine, Department of Orthopaedic Surgery; Head Team Physician, Department of Athletics, The Ohio State University, Columbus, Ohio

Richard Kang, MD

Resident, Orthopedic Surgery, Rush University Medical Center, Chicago, Illinois

Anjan P. Kaushik, MD

University of Virginia Department of Orthopaedic Surgery, Charlottesville, Virginia

Michael W. Kessler, MD, MPH

Assistant Professor, Department of Orthopaedic Surgery,
Associate Residency Program Director, Georgetown
University Hospital, Washington, DC

W. Ben Kibler, MD

Medical Director, Shoulder Center of Kentucky,
Lexington, Kentucky

Matthew A. Kippe, MD

Department of Orthopedic Surgery, Hawthorn Medical
Associates, North Dartmouth, Massachusetts

Pradeep Kodali, MD

Resident Physician, Department of Orthopaedic Surgery,
McGraw Medical Center-Northwestern University,
Chicago, Illinois

Nate Kopydlowski, BA

University of Michigan Medical School, Ann Arbor,
Michigan

Marc Korn, BA

Department of Orthopaedics, Wayne State University,
Detroit, Michigan

John E. Kuhn, MD

Associate Professor and Chief of Shoulder Surgery,
Division of Sports Medicine, Department of
Orthopaedics and Rehabilitation, Vanderbilt University
Medical Center, Nashville, Tennessee

Laurent Lafosse, MD

Chairman, Alps Surgery Institute, Clinique Generale
d'Annecy, Annecy, France

Robert F. LaPrade, MD, PhD

Chief Medical Research Officer, Steadman Philippon
Research Institute, The Steadman Clinic, Vail, Colorado

Christian Lattermann, MD

Assistant Professor for Orthopaedics and Sports
Medicine, and Director, Center for Cartilage Repair and
Restoration, Department of Orthopaedic Surgery,
University of Kentucky, Lexington, Kentucky

Keith Lawhorn, MD

Orthopaedic Surgeon, Commonwealth Orthopaedics and
Rehabilitation, Fairfax, Virginia

Lance LeClere, MD, LCDR MC USN

Assistant Professor, Uniformed Services University of
Health Sciences, Division of Sports Medicine and
Shoulder Surgery, Naval Medical Center San Diego, San
Diego, California

James H. Lubowitz, MD

Director, Taos Orthopaedic Institute, Taos Orthopaedic
Institute Research Foundation, Taos Orthopaedic
Institute Sports Medicine Fellowship Training Program,
Taos, New Mexico

Jamie L. Lynch, MD

Northeast Orthopaedics & Sports Medicine, San
Antonio, Texas

Nathan Mall, MD

Director, St. Louis Center for Cartilage Restoration and
Repair Regeneration Orthopedics, St. Louis, Missouri

Fabrizio Margheritini, MD

University of Rome-Foro Italico-IUSM, Department of
Health Science, Unit of Orthopedics and Sports
Traumatology, Rome, Italy

Pier Paolo Mariani, MD

University of Rome-Foro Italico-IUSM, Department of
Health Science, Unit of Orthopedics and Sports
Traumatology, Rome, Italy

Augustus D. Mazzocca, MD

Assistant Professor, Orthopaedic Surgery, University of
Connecticut, Farmington, Connecticut

Eric McCarty, MD

Associate Professor and Chief of Sports Medicine and
Shoulder Surgery, Department of Orthopaedic Surgery,
University of Colorado Health Science Center; Attending
Physician, Boulder Community Hospital, Boulder,
Colorado

L. Pearce McCarty III, MD

Sports and Orthopaedic Specialists, Minneapolis,
Minnesota

Mark McConkey, MD

Orthopaedic Surgeon, Iowa City, Iowa

John E. McDonald, MD

Texas Orthopedics, Sports, and Rehabilitation, Austin,
Texas

LCDR Lucas S. McDonald, MD, MPH, MC, USN

Department of Orthopaedic Surgery, Naval Medical
Center San Diego, San Diego, California

John McMullen, MS, ATC

Director Orthopedic Service, Shoulder Center of
Kentucky, Lexington, Kentucky

Emmanuel N. Menga, MD

Resident, Department of Orthopaedic Surgery, Johns
Hopkins University, Baltimore, Maryland

Kellie K. Middleton, MD, MPH

Resident, Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

Mark D. Miller, MD

S. Ward Casscells Professor of Orthopaedic Surgery, University of Virginia, Charlottesville, Virginia

Kai Mithoefer, MD

Department of Orthopedics and Sports Medicine, Harvard Vanguard Medical Associates, Harvard Medical School, Boston, Massachusetts

Craig D. Morgan, MD

Clinical Professor, University of Pennsylvania; Associate Clinical Professor, Thomas Jefferson University, Philadelphia, Pennsylvania; Orthopaedic Surgeon, Morgan Kalman Clinic, Wilmington, Delaware

Gregory P. Nicholson, MD

Associate Professor, Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois

Gordon Nuber, MD

Professor of Clinical Orthopaedics, Northwestern University, Chicago, Illinois

Michael O'Brien, MD

Tulane School of Medicine, Department of Orthopaedics, Tulane Institute of Sports Medicine, New Orleans, Louisiana

Kieran O'Shea, FRCSI

Consultant Orthopaedic Surgeon, St. James's Hospital, Dublin, Ireland

Michael J. Pagnani, MD

Director, Nashville Knee and Shoulder Center; Head Team Physician, Nashville Predators Hockey Club, Nashville, Tennessee

Michael Pensak, MD

Resident, Department of Orthopaedic Surgery, University of Connecticut Health Center, Farmington, Connecticut

Matthew T. Provencher, MD

Chief, Sports Medicine and Surgery, Associate Professor of Surgery, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts

R. David Rabalais, MD

Sports Medicine and Shoulder Surgery Fellow, Department of Orthopaedic Surgery, University of Colorado Health Science Center and Boulder Community Hospital, Boulder, Colorado

Richard Rainey, MD

Fellow, Department of Orthopaedics, University of Tennessee-Campbell Clinic, Germantown, Tennessee

Andrew Riff, MD

Resident, Department of Orthopaedics, Rush University Medical Center, Chicago, Illinois

Eric Rightmire, MD

Attending Physician, Orthopedic Surgery, Jordan Hospital, Plymouth, Massachusetts; Orthopedic Surgeon, Plymouth Bay Orthopedic Associates, Duxbury, Massachusetts

David Ring, MD, PhD

Assistant Professor, Orthopaedic Surgery, Harvard Medical School; Medical Director and Director of Research, Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, Massachusetts

Scott A. Rodeo, MD

Associate Professor of Orthopaedic Surgery, Weill Medical College of Cornell University; Associate Attending Physician, Sports Medicine and Shoulder Service, Hospital for Special Surgery; Associate Team Physician, New York Giants, New York, New York

William G. Rodkey, DVM (Dipl), ACVS

Director, Basic Science Research, Steadman Hawkins Research Foundation, Vail, Colorado

Anthony A. Romeo, MD

Associate Professor, Department of Orthopaedics, Rush Medical College and Rush-Presbyterian-St. Luke's Medical Center, Chicago, Illinois

Marc R. Safran, MD

Professor of Orthopaedic Surgery, Associate Director of Sports Medicine, and Fellowship Director, Department of Orthopaedic Surgery, Stanford University, Stanford, California

Paulo R.F. Saggin, MD

Orthopaedic Surgeon, Instituto de Ortopedia e Traumatologia (IOT), Passo Fundo, Brazil

Dipit Sahu, MS

Consultant Orthopaedic Surgeon, Department of Orthopaedics, Sahu Hospital and Research Center, Agra, India

Michael J. Salata, MD

Assistant Professor, Division of Sports Medicine, Department of Orthopaedic Surgery; Director, Joint Preservation and Cartilage Restoration Center, University Hospitals Case Medical Center, Cleveland, Ohio

Rodrigo Salim, MD

Research Fellow, Sports Medicine, UPMC Center for Sports Medicine, Pittsburgh, Pennsylvania

Felix H. Savoie III, MD

Professor of Clinical Orthopaedics, Department of Orthopaedics, Section of Orthopaedic Surgery; Chief, Section of Sports Medicine, Tulane University School of Medicine, New Orleans, Louisiana

Aaron Sciascia, MS, ATC

Coordinator, Shoulder Center of Kentucky, Lexington, Kentucky

Jon K. Sekiya, MD

Associate Professor, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

K. Donald Shelbourne, MD

Orthopaedic Surgeon, Shelbourne Knee Center, Indianapolis, Indiana

Seth L. Sherman, MD

Assistant Professor, Department of Orthopedic Surgery, Division of Sports Medicine, University of Missouri, Columbia, Missouri

Lewis L. Shi, MD

Assistant Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery and Rehabilitation Medicine, University of Chicago Medical Center, Chicago, Illinois

Keerat Singh, MD

Resident, Department of Orthopaedic Surgery and Rehabilitation, Vanderbilt University School of Medicine, Memphis, Tennessee

Jack G. Skendzel, MD

Sports Medicine Fellow, The Steadman Philippon Research Institute, Vail, Colorado

Adam M. Smith, MD

Kentucky Sports Medicine, Lexington, Kentucky

Matthew V. Smith, MD

Washington University Department of Orthopaedics, St. Louis, Missouri

Patrick A. Smith, MD

Clinical Practice at the Columbia Orthopaedic Group, LLP, Columbia, Missouri; Director of Sports Medicine, University of Missouri Head Team Physician, University of Missouri, Columbia, Missouri

Stephen J. Snyder, MD

Director, Shoulder Arthroscopy Service, Southern California Orthopedic Institute, Van Nuys, California

John W. Sperling, MD, MBA

Associate Professor, Department of Orthopedic Surgery, Mayo Clinic College of Medicine; Consultant, Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

Umasuthan Srikumaran, MD

Assistant Professor, Department of Orthopaedic Surgery, Johns Hopkins School of Medicine, Baltimore, Maryland

Scott P. Steinmann, MD

Associate Professor, Department of Orthopedic Surgery, Mayo Clinic College of Medicine; Consultant in Shoulder, Elbow, and Hand Surgery, Department of Orthopedic Surgery, Saint Mary's Hospital, Rochester, Minnesota

Zachary Stender, MD

Resident, Department of Orthopaedics, New England Musculoskeletal Institute, University of Connecticut, Farmington, Connecticut

Eric J. Strauss, MD

Assistant Professor, Division of Sports Medicine, Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, New York

Justin P. Strickland, MD

Resident, Department of Orthopedic Surgery, Mayo Clinic Graduate School of Medicine, Rochester, Minnesota

Kenneth G. Swan Jr, MD

Sports Medicine and Shoulder Surgery Fellow, Department of Orthopaedic Surgery, University of Colorado Health Science Center and Boulder Community Hospital, Boulder, Colorado

Thomas Tampere, MD

Resident, Department of Orthopaedic Surgery, Ghent University Hospital, Ghent, Belgium

Gof Tantisrichaorenkun, MD, CDR

Research Fellow, Department of Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania; Orthopaedic Surgeon, Department of Orthopaedic Surgery, Royal Thai Navy, Somdejprapinklao Hospital, Bangkok, Thailand

Sam G. Tejwani, MD

Southern California Permanente Medical Group, Kaiser Permanente Hospital, Department of Orthopaedic Surgery, Division of Sports Medicine, Fontana, California

James A. Thiel, DO

Orthopaedic Surgeon, WellSpan Orthopedics, Gettysburg, Pennsylvania

Lt Col John M. Tokish, MD, MC, USAF

Orthopedic Residency Program Director, Tripler Army Medical Center, Honolulu, Hawaii

Jeffrey D. Tompson, MS

Clinical Research Assistant, Harvard Shoulder Service, Massachusetts General Hospital, Boston, Massachusetts

Jeffrey M. Tuman, MD

University of Virginia, Department of Orthopaedic Surgery, Charlottesville, Virginia

Max Tyorkin, MD

Associate Attending Physician, Orthopaedic Surgery, Beth Israel Medical Center and Lenox Hill Hospital, New York, New York

Tim Uhl, PhD, ATC, PT

Associate Professor of Athletic Training, Co-Director of Musculoskeletal Laboratory, University of Kentucky, Lexington, Kentucky

Geoffrey S. Van Thiel, MD, MBA

Clinical Instructor, Rush University Medical Center, Chicago, Illinois; Rockford Orthopedic Associates, Rockford, Illinois

Peter C.M. Verdonk, MD, PhD

Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, Monica Hospitals Antwerp, Antwerp, Belgium

René Verdonk, MD

Emeritus Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, Ghent University Hospital, Ghent, Belgium

Nikhil N. Verma, MD

Attending Orthopaedic Surgeon, Department of Orthopaedic Surgery, Rush University, Chicago, Illinois

Michael Walsh, MD

Orthopaedic Surgery Resident, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

Robert Waltz, MD

Department of Orthopaedic Surgery, Naval Medical Center San Diego, San Diego, California

Bryan A. Warme, MD

HSS Sports and Shoulder Fellow, Iowa State University Sports Medicine, McFarland Clinic, Ames, Iowa

Jon J.P. Warner, MD

Professor of Orthopaedics, Department of Orthopaedics, Harvard Medical School; Chief, Harvard Shoulder Service, Department of Orthopaedics, Massachusetts General Hospital, Boston, Massachusetts

Alexander E. Weber, MD

Orthopaedic Surgery Resident, Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

Robin V. West, MD

Assistant Professor, Department of Orthopaedics, University of Pittsburgh, Pittsburgh, Pennsylvania

Lucas R. Wymore, MD

Chief Resident, Department of Orthopedic Surgery, University of North Carolina, Chapel Hill, North Carolina

Robert W. Wysocki, MD

Orthopaedic Surgery Resident, Department of Orthopaedic Surgery, Rush University and Rush University Medical Center, Chicago, Illinois

Adam B. Yanke, MD

Orthopedic Surgeon, Chicago, Illinois

Preface

We are excited to present the second edition of *Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine*. As educators, our most formidable challenge is to teach proper decision making and the techniques required to succeed in the operating room setting. As students, we are continuously pressured to compress the learning experience outside the operating room into efficient and digestible bits of information. We all recognize the importance of having access to accurate, timely, and concise tools to supplement our knowledge base. The emergence of digital content has positively influenced our access to up-to-date information. Simply “reading” about surgical procedures seems somewhat at odds with “doing” a series of steps that require dexterity and skill. More important, the act of physical repetition is what seems to propel us along the typically steep learning curve, especially when it involves the arthroscope.

The second edition of *Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine* was developed with these principles in mind. The principal objective of this textbook was to maximize its value by being thorough in the breadth of open and arthroscopic procedures covered, yet remaining concise in specific content. Authors have uniformly adhered to a template that we believe will optimize an efficient learning experience that is visually consistent, simple, and descriptive. To this end, each chapter is crafted with a brief introduction, a thumbnail of only the most relevant preoperative and postoperative considerations, a thorough and visually supported step-by-step explicit description of the procedure, and a table with the most up-to-date results related to that specific procedure. Simply stated, it is exactly what you need to know before entering the operating room.

It is nearly impossible to cover every joint in a single-volume textbook. While the term “sports medicine” has broad-reaching connotations, the vast majority of the conditions faced by the orthopedic surgeon who practices sports medicine and arthroscopy involve the shoulder, elbow, and knee. Thus, *Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine* intentionally limits the number of joints to those most commonly seen and treated, but covers them comprehensively without exception. This edition is bigger and better, with more chapters and newer, updated information. Most important, the content is provided by authors who have largely developed and popularized the procedures discussed.

Part 1, “The Shoulder,” covers the general technical aspects of shoulder arthroscopy, including patient positioning, portal placement, rehabilitation of the shoulder, and specific steps required to pass sutures and tie knots. Because so many different techniques are performed to address the same pathology, we include 16 chapters describing surgical techniques for shoulder instability, including arthroscopic and open management of bone lesions of the glenoid and humeral head. Similarly, the management of rotator cuff pathology is addressed by no less than six chapters, including single-row, double-row, and mini-open techniques, and the role of tendon transfers. Finally, this section is complemented by chapters that address the treatment of the most common entities, including SLAP tears and instability, scapulothoracic disorders, and glenohumeral arthritis. Part 1 is a stand-alone compendium of the treatment of virtually every clinical problem seen by the shoulder surgeon.

Part 2, “The Elbow,” is also comprehensive in that it includes the requisite steps required to perform elbow arthroscopy, such as patient positioning, portal placement, and a review of normal arthroscopic anatomy. In addition to providing excellent chapters on the most common conditions that are treated arthroscopically (e.g., osteochondritis dissecans, stiffness, synovitis, impingement, arthritis, and lateral epicondylitis), this part also contains an entire section on the most important open elbow procedures. Surgeons who treat athletes with ulnar and lateral collateral ligament disruption, elbow stiffness, instability of the elbow, biceps tendon tears, and epicondylitis will recognize that the section on open procedures of the elbow is thorough and completely up-to-date with surgical principles and techniques.

Part 3, “The Knee,” is another virtual compendium that includes the complete management of any knee-related pathology. For example, management of meniscus-related issues has led to the development of multiple techniques to excise, repair, and replace the meniscal-deficient knee. Twelve chapters thoroughly review all these techniques. Articular cartilage, the subject of stand-alone textbooks, is completely covered with the management of virtually every problem that involves cartilage short of arthroplasty. Eight chapters address every cartilage repair procedure in addition to realignment osteotomy. One of the most exciting sections is the management of the anterior and posterior cruciate ligaments. This section includes single- and double-bundle as well as inlay techniques written by the

surgeons who have popularized these procedures. Finally, management of the multi-ligament-injured knee, arthrofibrosis, and patellofemoral joint completes a text that leaves the reader with little need to turn to any other resource.

Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine is the product of almost 3 years of hard work by its contributors. These authors are frequently asked to further the education of others, yet never seem to wane in their enthusiasm and completeness. It is an honor to work with the contributors of this textbook, and the readers will appreciate the highly edited and consistent style that completely eliminates the noise of unnecessary information.

We would like to also thank our families, who once again have created an environment where a labor of love can result in something invaluable for our students and, more importantly, for our patients. Specifically, Dr.

Cole would like to thank Emily, Ethan, Adam, and Ava for their willingness to occasionally forego a late-night story so Daddy can stay awake to edit these chapters. Dr. Sekiya would like to thank his parents, Fred and Pat Sekiya, and wife, Jennie, for their never-ending support and understanding, and their sons, Kimo and Koa. We would like to thank our co-editors for helping complete the final details of this task, Dr. Geoffrey S. Van Thiel and Dr. Jack G. Skendzel. Finally, we would thank the many people at Elsevier, including Don Scholz, Ann Ruzycka Anderson, and Carrie Stetz, for governing the entire process until the book was released. So, read the text and prepare to challenge your mentors. *Surgical Techniques of the Shoulder, Elbow, and Knee in Sports Medicine* will allow you to do just that.

Brian J. Cole, MD, MBA
Jon K. Sekiya, MD

Contents

PART 1 THE SHOULDER

General Principles

- 1 Patient Positioning, Portal Placement, Normal Arthroscopic Anatomy, and Diagnostic Arthroscopy..... 3
Peter N. Chalmers and Seth L. Sherman
 - 2 Rehabilitation of the Athlete's Shoulder 13
W. Ben Kibler, Aaron Sciascia, John McMullen, and Tim Uhl
 - 3 Knot-Tying and Suture-Passing Techniques..... 23
Adam M. Smith, Scott J. Deering, and Mary Lloyd Ireland
- ### Surgical Techniques for Shoulder Instability
- 4 Suture Anchor Fixation for Anterior Shoulder Instability 33
Jay B. Cook and Craig R. Bottoni
 - 5 Arthroscopic Instability Repair with Knotless Suture Anchors 43
Laith Al-Shihabi, Geoffrey S. Van Thiel, and Brian J. Cole
 - 6 Arthroscopic Rotator Interval Capsule Closure..... 53
Rachel M. Frank and Matthew T. Provencher
 - 7 Management of the Throwing Shoulder..... 65
John M. Tokish and Jay B. Cook
 - 8 Arthroscopic Management of Rare Intra-articular Lesions of the Shoulder..... 77
Felix H. Savoie III, Michael O'Brien, and Wendell Heard
 - 9 Arthroscopic Repair of Posterior Shoulder Instability 85
Steven B. Cohen, Sam G. Tejwani, and James P. Bradley
 - 10 Arthroscopic Repair of Multidirectional Instability of the Shoulder 97
Matthew Craig and Jon K. Sekiya
 - 11 Arthroscopic Treatment of the Disabled Throwing Shoulder..... 109
Matthew T. Boes, James A. Thiel, and Craig D. Morgan
 - 12 Open Repair of Anterior Shoulder Instability 133
Michael J. Pagnani
 - 13 Open Repair of Posterior Shoulder Instability 145
Patrick M. Birmingham and Mark K. Bowen
 - 14 Open Repair of Multidirectional Instability 153
Pradeep Kodali and Gordon Nuber
 - 15 Treatment of Combined Bone Defects of Humeral Head and Glenoid: Arthroscopic and Open Techniques 161
Jack G. Skendzel and Jon K. Sekiya
 - 16 Treatment of Recurrent Anterior Inferior Instability Associated with Glenoid Bone Loss: Distal Tibial Allograft Reconstruction 175
Robert Waltz, Lance LeClere, and Matthew T. Provencher
 - 17 Arthroscopic Remplissage for Management of Engaging and Deep Hill-Sachs Lesions..... 183
Kieran O'Shea and Pascal Boileau
 - 18 Coracoid Transfer: The Modified Latarjet Procedure for the Treatment of Recurrent Anterior Inferior Glenohumeral Instability in Patients with Bone Deficiency 191
Patrick J. Denard and Stephen S. Burkhart
 - 19 Arthroscopic Latarjet Procedure 203
Laurent Lafosse, Dipit Sahu, and Wade Andrews
- ### Surgical Techniques of the Rotator Cuff
- 20 Arthroscopic Rotator Cuff Repair: Single-Row Technique 215
L. Pearce McCarty III

- 21** Arthroscopic Rotator Cuff Repair:
Double-Row Techniques 225
*Andrew Riff, Adam B. Yanke,
Geoffrey S. Van Thiel, and Brian J. Cole*
- 22** Arthroscopic Subscapularis Repair..... 241
*Lucas R. Wymore, Anthony A. Romeo, and
R. Alexander Creighton*
- 23** Mini-Open Rotator Cuff Repair..... 249
Gregory P. Nicholson and James Hammond
- 24** Open Rotator Cuff Repair 255
John W. Sperling
- 25** Tendon Transfers for Rotator Cuff
Insufficiency 261
*Jay Boughanem, Tyler Fox, and
Laurence D. Higgins*
- 34** Anatomic Acromioclavicular Joint
Reconstruction 351
*Knut Beitzel, Simone Cerciello, and
Augustus D. Mazzocca*
- 35** Management of Pectoralis Major Muscle
Injuries 359
Robert M. Coale and Jon K. Sekiya
- 36** Nonarthroplasty Options for Glenohumeral
Arthritis and Chondrolysis..... 367
*Rachel M. Frank, Lucas S. McDonald, and
Matthew T. Provencher*
- 37** Biologics in Rotator Cuff Repair..... 383
Salma Chaudhury and Scott A. Rodeo
- 38** Tendon Augmentation Devices in Rotator
Cuff Repair..... 391
Stephen J. Snyder and Joseph P. Burns

Other Techniques of the Shoulder

- 26** Arthroscopic Repair of Superior Labral
Anterior-Posterior Lesions by the
Single-Anchor Double-Suture Technique 279
*Joseph P. Burns, Max Tyorkin, and
Stephen J. Snyder*
- 27** Arthroscopic and Open Decompression of
the Suprascapular Nerve 287
*Umasuthan Srikumaran, Lewis L. Shi,
Jeffrey D. Tompson, Laurence D. Higgins,
and Jon J.P. Warner*
- 28** Arthroscopic Subacromial Decompression
and Distal Clavicle Excision..... 295
Eric J. Strauss and Michael G. Hannon
- 29** Arthroscopic Management of
Glenohumeral Arthritis 305
*Rachel M. Frank, Geoffrey S. Van Thiel,
and Nikhil N. Verma*
- 30** Arthroscopic Capsular Release for the
Treatment of Stiff Shoulder Pathology 315
Gregory P. Nicholson
- 31** Arthroscopic and Open Management of
Scapulothoracic Disorders..... 323
Kevin M. Doulens and John E. Kuhn
- 32** Scapulothoracic Fusion..... 333
*James Hammond, Geoffrey S. Van Thiel,
Nathan Mall, and Anthony A. Romeo*
- 33** Biceps Tenodesis: Arthroscopic and Open
Techniques 341
Shane Hanzlik and Michael J. Salata

PART 2 THE ELBOW

General Principles

- 39** Patient Positioning and Portal Placement..... 403
Frederick M. Azar and Richard Rainey

Arthroscopic Procedures

- 40** Arthroscopic and Open Management of
Osteochondritis Dissecans of the Elbow..... 413
*Nicholas D. Iagulli, Larry D. Field, and
Felix H. Savoie III*
- 41** Arthroscopy for the Thrower's Elbow 423
Michael J. O'Brien and Felix H. Savoie III
- 42** Arthroscopic Management of Elbow
Stiffness 435
*Debdut Biswas, Robert W. Wysocki, and
Mark S. Cohen*
- 43** Elbow Synovitis, Loose Bodies, and
Posteromedial Impingement 447
*Jamie L. Lynch, Matthew A. Kippe, and
Kyle Anderson*
- 44** Arthroscopic Management of the Arthritic
Elbow 457
*Julie E. Adams, Justin P. Strickland, and
Scott P. Steinmann*
- 45** Arthroscopic Treatment of Lateral
Epicondylitis 467
*Christian Lattermann, Anthony A. Romeo,
Brian J. Cole, and D. Jeff Covell*

- 46** Ulnar Collateral Ligament Repair and Reconstruction 473
 Ulnar Collateral Ligament Repair
Champ L. Baker Jr and Champ L. Baker III
 Docking Technique
Christopher C. Dodson, Joshua S. Dines, and David W. Altchek
 Modified Jobe Technique
Andrew J. Blackman and Matthew V. Smith
 DANE Technique
Joshua S. Dines and Neal S. ElAttrache
- 47** Surgical Treatment of Posterolateral Instability of the Elbow 499
Emilie Cheung, Eric Rightmire, and Marc R. Safran
- 48** Open Elbow Contracture Release 509
David Ring and Diego Fernandez
- 49** Open Treatment of Lateral and Medial Epicondylitis 519
Michael W. Kessler and Neal C. Chen
- 50** Distal Biceps Repair 527
Peter N. Chalmers, Geoffrey S. Van Thiel, John J. Fernandez, and Nikhil N. Verma
- 56** Allograft Meniscus Transplantation: Bridge-in-Slot Technique 585
Andreas A. Gomoll, Jack Farr II, and Brian J. Cole
- 57** Allograft Meniscus Transplantation: Dovetail Technique 595
Thomas R. Carter
- 58** Arthroscopic Meniscus Transplantation: Bone Plug 605
Alex Dukas, Michael Pensak, Zachary Stender, and Thomas DeBerardino
- 59** Meniscus Substitution: The European Perspective on Scaffolds, Allografts, and Prosthetic Implants 615
Peter C.M. Verdonk, Aad A.M. Dhollander, Thomas Tampere, and René Verdonk
- 60** Meniscus Regeneration with Biologic or Synthetic Scaffolds 625
William G. Rodkey
- 61** Combined Anterior Cruciate Ligament Reconstruction and Meniscal Allograft Transplantation 633
M. Mustafa Gomberawalla and Jon K. Sekiya
- 62** Combined Anterior Cruciate Ligament Reconstruction and High Tibial Osteotomy 643
Davide Edoardo Bonasia and Annunziato Amendola
- 63** Osteochondral Allografting in the Knee 653
Andreas H. Gomoll, Richard Kang, and Brian J. Cole
- 52** Arthroscopic Meniscectomy 545
David C. Flanigan and Christopher C. Kaeding
- 53** Arthroscopic Meniscus Repair: Inside-Out Technique 553
Jeffrey M. Tuman and Mark D. Miller
- 54** Arthroscopic Meniscus Repair: Outside-in Technique 561
Marc Korn, Asheesh Bedi, and Answorth A. Allen
- 55** Arthroscopic Meniscus Repair: All-Inside Technique 569
Marc S. Haro, Jeffrey M. Tuman, and David Diduch
- 64** Microfracture Technique in the Knee 663
Kai Mithoefer
- 65** Primary Repair of Osteochondritis Dissecans in the Knee 671
Jonathan M. Frank, Geoffrey S. Van Thiel, L. Pearce McCarty III, and Brian J. Cole
- 66** Osteonecrosis of the Knee 681
Michael B. Boyd, Simon Görtz, and William D. Bugbee
- 67** Osteochondral Autograft for Cartilage Lesions of the Knee 691
Kenneth G. Swan Jr, R. David Rabalais, and Eric McCarty

PART 3 THE KNEE

General Principles

- 51** Patient Positioning, Portal Placement, and Normal Arthroscopic Anatomy 539
Robin V. West and Keerat Singh

Surgical Techniques of the Meniscus

- 52** Arthroscopic Meniscectomy 545
David C. Flanigan and Christopher C. Kaeding
- 53** Arthroscopic Meniscus Repair: Inside-Out Technique 553
Jeffrey M. Tuman and Mark D. Miller
- 54** Arthroscopic Meniscus Repair: Outside-in Technique 561
Marc Korn, Asheesh Bedi, and Answorth A. Allen
- 55** Arthroscopic Meniscus Repair: All-Inside Technique 569
Marc S. Haro, Jeffrey M. Tuman, and David Diduch

Surgical Techniques of the Articular Cartilage

- 64** Microfracture Technique in the Knee 663
Kai Mithoefer
- 65** Primary Repair of Osteochondritis Dissecans in the Knee 671
Jonathan M. Frank, Geoffrey S. Van Thiel, L. Pearce McCarty III, and Brian J. Cole
- 66** Osteonecrosis of the Knee 681
Michael B. Boyd, Simon Görtz, and William D. Bugbee
- 67** Osteochondral Autograft for Cartilage Lesions of the Knee 691
Kenneth G. Swan Jr, R. David Rabalais, and Eric McCarty

- 68** Complex Problems in Knee Articular Cartilage..... 703
Rachel M. Frank, Jaskarndip Chahal, Geoffrey S. Van Thiel, and Brian J. Cole
- 69** Autologous Chondrocyte Implantation in the Knee..... 721
Scott D. Gillogly and Andrew Gelven
- 70** High Tibial Osteotomy 733
Mark McConkey, Sami Abdulmassih, and Annunziato Amendola
- 71** Distal Femoral Osteotomy 741
Sami Abdulmassih, Mark McConkey, and Annunziato Amendola

Surgical Techniques of the Anterior Cruciate Ligament

- 72** Patellar Tendon Autograft for Anterior Cruciate Ligament Reconstruction..... 755
Aman Dhawan and Charles A. Bush-Joseph
- 73** Allografts for Anterior Cruciate Ligament Reconstruction 767
Michael Walsh and Asheesh Bedi
- 74** Hamstring Tendon Autograft for Anterior Cruciate Ligament Reconstruction..... 785
Keith Lawhorn and Stephen M. Howell
- 75** Central Quadriceps Free Tendon Harvest for Anterior Cruciate Ligament Reconstruction 795
John P. Fulkerson
- 76** Revision Anterior Cruciate Ligament Reconstruction 799
Geoffrey S. Van Thiel, Brian Forsythe, Adam B. Yanke, and Bernard R. Bach Jr
- 77** Anatomic Anterior Cruciate Ligament Concept: Single- and Double-Bundle Anterior Cruciate Ligament Reconstruction 813
Paulo H. Araujo, Kellie K. Middleton, Gof Tantisricharoenkun, and Freddie H. Fu
- 78** Double-Bundle Anterior Cruciate Ligament Reconstruction 827
Patrick A. Smith
- 79** All-Inside Anterior Cruciate Ligament GraftLink Technique: Second-Generation, No-Incision Anterior Cruciate Ligament Reconstruction 841
James H. Lubowitz, Christopher S. Ahmad, and Kyle Anderson

Surgical Techniques of the Posterior Cruciate Ligament and Posterolateral Corner

- 80** Transtibial Tunnel Posterior Cruciate Ligament Reconstruction 853
Gregory C. Fanelli
- 81** Arthroscopic Double-Bundle Tibial Inlay Posterior Cruciate Ligament Reconstruction 861
Alexander E. Weber and Jon K. Sekiya
- 82** Posterior Cruciate Ligament Tibial Inlay 871
Anjan P. Kaushik and Mark D. Miller
- 83** Arthroscopic Posterior Cruciate Ligament Inlay..... 881
Fabrizio Margheritini and Pier Paolo Mariani
- 84** Posterolateral Corner Reconstruction..... 887
Bryan A. Warme and Warren R. Kadrmaz

Other Surgical Techniques of the Knee

- 85** Medial Collateral Ligament and Posteromedial Corner Repair and Reconstruction 895
John E. McDonald and Robert F. LaPrade
- 86** Multiligament Knee Reconstruction: The Pittsburgh Approach 903
Karl F. Bowman Jr, Rodrigo Salim, and Christopher D. Harner
- 87** Arthroscopic Lateral Retinacular Release and Lateral Retinacular Lengthening..... 917
Jack Farr II, Christian Lattermann, and D. Jeff Covell
- 88** Medial Patellofemoral Ligament Reconstruction and Repair for Patellar Instability 925
Emmanuel N. Menga and Andrew J. Cosgarea
- 89** Sulcus Deepening Trochleoplasty 935
Paulo R.F. Saggin, Paolo Ferrua, and David Dejour
- 90** Management of Arthrofibrosis of the Knee.... 943
K. Donald Shelbourne and Heather Freeman
- 91** Distal Realignment for Patellofemoral Disease..... 951
Jack Farr II, Christian Lattermann, and D. Jeff Covell
- 92** Management of Proximal Tibiofibular Instability 965
Nate Kopydlowski and Jon K. Sekiya