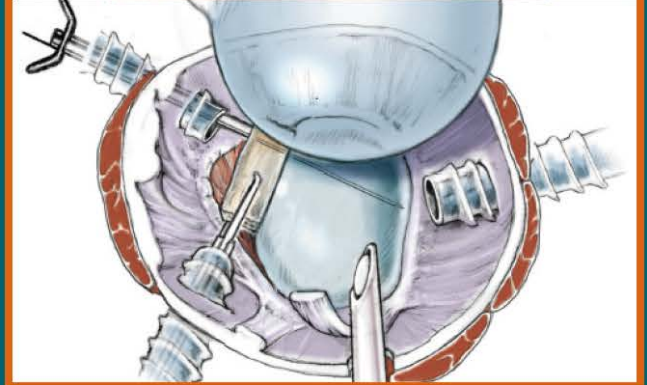
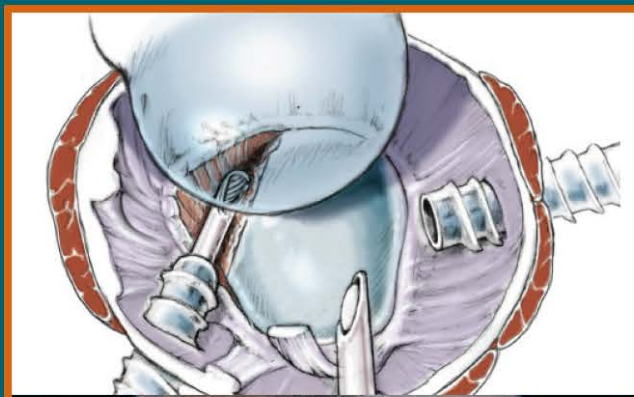


ATLAS OF ADVANCED SHOULDER ARTHROSCOPY



EDITED BY

ANDREAS B. IMHOFF • JONATHAN B. TICKER
AUGUSTUS D. MAZZOCCA • ANDREAS VOSS



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To my lovely and beautiful wife, Susann, for her love and continuous support, to our son Florian and his wife Mareen, with our grandson Louis, and to my sons Pascal and Dominik with his wife Dominique for encouragement and accepting the lifestyle of an orthopaedic surgeon. To my mother, Marianne, and in memory of my father, Urs, for their love. Finally, to all my fellows in the last 30 years for their support and questions to help me in treating patients better.

Andreas B. Imhoff

To Alyse.

Jonathan B. Ticker

To my wonderful and beautiful wife, Jennifer, who holds our whole family together and is dedicated to making the world a better place. My wonderful children, Gus, Nico, and Jillian, who have given me my greatest joy to see them work hard and become successful adults. Finally, my parents, Gus and D'Ann, who taught me that hard work and honesty will always succeed.

Augustus D. Mazzocca

To my wonderful wife, Maria, and my parents, Marita and Jörg, for their continuous support.

Andreas Voss



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Preface

After the success of our 1st and 2nd editions, focusing on the basics of shoulder surgery and shoulder arthroscopy, we are pleased to introduce the 3rd edition. The aim of this book is to create a bridge between basic and advanced operative procedures in shoulder arthroscopy. Therefore, we are delighted that numerous specialized shoulder surgeons from all over the world have contributed to this edition. Their insight in special procedures will help the reader to understand and to treat difficult pathologies of the shoulder. We have also aimed to make allowance for the diversity of operative procedures for treating the same pathology. Therefore, we have provided alternative operative techniques for identical or similar pathologies. We hope that through this variety the reader will find the one option which fits best for him or her, as well as the patient and surgical setup.

Each chapter is structured to show: indication; operation principles; preoperative assessment, with clinical

examination, patient information, and consent; relevant imaging; positioning and preparation; operative technique; and postoperative management, as well as follow-up treatment.

A big thank you to our families, partners, and children, who have supported our activities and duties much more than normal.

We hope that those who laid their hands on the 1st edition 20 years ago, as well as those who show their curiosity for the first time, will read the chapters and study the illustrations with great interest, so expanding their knowledge and surgical horizons.

Andreas B. Imhoff
Jonathan B. Ticker
Augustus D. Mazzocca
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Editors



Professor Andreas B. Imhoff, MD, graduated from Basel University in 1980. He started his residency in General Surgery and Traumatology in Davos, Switzerland, under the guidance of Professor Peter Matter, and in General Surgery, Traumatology, and Knee Surgery at the University Hospital Bruderholz-Basel under the guidance of Professor Werner Müller

and Professor Peter Waibel in 1982. He completed his Orthopedic Residency at the Balgrist University Hospital, University of Zurich, under the direction of Professor Adam Schreiber, Professor Hans Zollinger, and Professor Christian Gerber between 1983 and 1996, after 1987 as head of different departments for knee, shoulder, and sports medicine. A one-year exchange fellowship brought him to the department of orthopedic surgery in the Center of Sports Medicine at the University of Pittsburgh, PA, USA, under the direction of Professor Freddie Fu, Professor Jon J.P. Warner, and Professor Chris Harner, but also at the Musculoskeletal Research Center, University of Pittsburgh under the direction of Professor Savio L.-Y. Woo between 1994 and 1995.

He was elected as a Professor of Orthopedic Surgery and Arthroscopy at the faculty Medical School and faculty School of Sport Science and Health, Technical University Munich, to serve as director and chairman of the Department of Orthopedic Sports Medicine from 1996.

Professor Imhoff is an active member of the AGA (German Society of Arthroscopy and Joint Surgery) which currently has 4500 members. He was a founder in 1983, congress chairman 1999, president 2000–2003, general secretary, and is now still a member of the executive board. He is again congress chairman in 2017.

He has been on the board of directors of the DGOOC (German Society of Orthopaedics), DGOU (German Society of Orthopaedics and Traumatology) since 1996. He is also member of ISAKOS (International Society of Arthroscopy, Knee Surgery, and Orthopedic Sports Medicine), started as a founding member of the IAA/ISK in October 1994, and has been a member of the board and different committees since 1996. He has also been chairman of the ISAKOS shoulder committee since 2015. He was awarded as Corresponding member by the ASES (American Shoulder

and Elbow Society) in 2004, where he is actually working in the program committee and the research committee. He is a member of several societies, including the SGO (Swiss Society for Orthopaedics), ESSKA (European Society of Sports Traumatology, Knee Surgery, and Arthroscopy), SECEC (European Society for Surgery of the Shoulder and the Elbow), AOSSM (American Orthopedic Society for Sports Medicine), DVSE (German Society for Shoulder and Elbow), DGU (German Society for Traumatology), SICOT (Société Internationale de Chirurgie Orthopédique et de Traumatologie), and has been a member of the board of AFOR (Association of Orthopedic Research) since 2010, and of DKG (German Knee Society) since 2012.

Professor Imhoff has received many awards from different countries all over the world since 1999, and he has edited 34 books and published over 365 journal articles, cited in Pubmed. He was awarded and listed by the FOCUS company every year since 2010. As one of the Top Surgeons in Shoulder, Knee and Sportsorthopaedics in Germany.

He has been an honorary member of the AANA (Arthroscopy Association of North America) since 2004, Miembro Honorario of the Sociedad Argentina de Cirurgia de Hombro y Codo since 2006, he received the Malaysian Federal Honorary Award in 2010, has been an honorary member of AGA since 2013, and an honorary member of IAS (Indian Arthroscopic Society) since 2014.

Professor Imhoff serves as an editor of journals including *Arthroscopy*, *Operative Orthopaedics and Traumatology*, *Journal of Shoulder and Elbow Surgery*, *Knee Surgery*, *Sports Traumatology*, *Arthroscopy (KSSTA)*, *American Journal of Sports Medicine (AJSM)* and the *Open Access Journal of Sports Medicine* as Editor-in-Chief.



Jonathan B. Ticker, MD, is an Assistant Clinical Professor of Orthopaedic Surgery at the College of Physicians and Surgeons of Columbia University, New York. Dr. Ticker is Chair of the Board of Trustees of the American Shoulder & Elbow Surgeons Foundation, and is a past member of the Executive Committee of ASES. He has been Co-Chair of the Industry and

Program Committees for ASES, as well as Chair of the Research Committee for the Arthroscopy Association of North America. His academic endeavors have included research on the shoulder in basic science and clinical subjects. These interests have resulted in numerous peer-reviewed journal publications, as well as book chapters. In addition, Dr. Ticker has co-edited two shoulder texts: *An Atlas of Shoulder Surgery* and *An Atlas of Shoulder Arthroscopy*, along with Freddie Fu and Andreas Imhoff. He edited *American Shoulder & Elbow Surgeons 25th Anniversary*, a book devoted to the history of this Society. His emphasis on education includes instructing at international, national, regional, and local meetings and courses, with didactic and technique-oriented efforts, as well as orthopedic residency training at Northwell Health's Long Island Jewish Medical Center. Dr. Ticker is in private practice on Long Island, New York, with Orlin & Cohen Orthopaedic Group. His clinical and operative practice is exclusive to the shoulder (www.LIshoulder.com). He has been married for over 30 years, with two wonderful children.



Professor Augustus D. Mazzocca, MS, MD, is the Director of the UConn Musculoskeletal Institute and Chairman, Department of Orthopedic Surgery, at the University of Connecticut Health Center. He is the Director of the University of Connecticut Human Soft Tissue Research Laboratory, which consists of integrated transla-

tional laboratories incorporating cell and molecular biology, histology, biomechanics, and clinical outcomes research. He is also the Director of the University of Connecticut Bioskills Laboratory and holds the Harry and Helen Gray, Harry R. Gossling, MD Chair in Orthopaedic Surgery. Professor Mazzocca also holds a joint faculty appointment at the University of Hartford in the Department of Civil, Environmental, and Biomedical Engineering, College of Engineering Technology and Architecture.

International collaboration in both education and research is a top priority for Professor Mazzocca bridging six countries, including Brazil, Japan, Austria, Germany, Italy, and France and five of the seven continents. He has had several international sports medicine research fellows in his laboratories, and he is internationally renowned for his work in the following areas: biceps tenodesis, distal biceps for the elbow, anatomic coracoclavicular reconstruction for the treatment of chronic acromioclavicular separation, and biologic augmentation of failed rotator cuff repair using concentrated bone marrow and platelet rich plasma. The extent of this research has led to 70 book chapters, 138 abstracts, posters, 162 peer reviewed journal articles, and 252 invited national and international talks.

Professor Mazzocca has also held many important positions. He was the Program Director for the American

Orthopaedic Society for Sports Medicine (AOSSM) for the 2015 International Meeting, and a member at large for the AOSSM Nominating Committee from 2014–2015. In 2014 he served on the Upper Extremity Program Committee for Specialty Day. Professor Mazzocca has been a part of the American Shoulder and Elbow Society (ASES) Continuing Education Committee since 2009, and has been a member of the Closed Meeting Committee for 2015 and 2016. He has also been a member of the Arthroscopy Association of North America (AANA) Research Committee since 2010. In 2003, Professor Mazzocca was a founder of the New England Shoulder and Elbow Society (NESES) and continues to be part of its executive governing board. He remains an active member of AOSSM, ASES, AANA, and NESES, as well as the following professional societies: American Academy of Orthopaedic Surgeons (AAOS), International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS), The American Orthopaedic Association (AOA), Orthopaedic Research Society (ORS), European Society for Surgery of the Shoulder and Elbow (ESSE), American College of Sports Medicine Member (ACSM), and the Connecticut Academy of Science and Engineering (CASE).

Professor Mazzocca has served on the editorial board of several orthopaedic publications including: *Orthopedics Today*, Basic Science & Technology Section Editor 2014, *Orthopedics Today* Editorial Board from 2013 to present, *Techniques in Shoulder and Elbow Surgery*, Editorial Board from 2010 to present, Associate Editor of the *Journal of Bone and Joint Surgery—Shoulder and Elbow Newsletter* from 2011 to present, Section Editor—Arthroscopy Section for the *AAOS Orthopaedic Knowledge Update 4th Edition* in 2011, co-editor of the *AAOS Monograph Disorders of the Proximal Biceps Tendon* in 2011. He has also received more than 50 awards, honors, and grants.



Andreas Voss, MD, is a resident in training to become an orthopaedic and trauma surgeon, and also works at the Department of Orthopedic Sports Medicine at the Hospital Rechts der Isar of the Technical University of Munich. During his training at the Department of Orthopedic Sports Medicine he spent one year as a Sports Medicine

Research Fellow at the University of Connecticut (Farmington, CT, USA), focusing on shoulder research and surgery. In addition to receiving his medical degree from the University of Regensburg (Germany), he also graduated from the SRH University of Riedlingen as a health economist, specializing in hospital management.

He is a member of the following professional associations: Association for Arthroscopy and Joint Surgery (AGA), German Association for Shoulder and Elbow Surgery (DVSE), European Society of Sports Traumatology, Knee Surgery, and Arthroscopy (ESSKA),

and the International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine (ISAKOS). Within the ISAKOS he works as a guest member in the shoulder committee.

Besides his enthusiasm for and interest in research, he also greatly supports medical education. Therefore, he was one of the founding members of a special student's board within the AGA. Using a unique step-by-step

curriculum, the medical students are taught in the basic principles of joint surgery to spark their interest in orthopedic surgery. He also holds the certificate of higher education of Bavaria, and has received several grants and awards (e.g., co.don Research Award, German Research Foundation grant, German Society of Orthopedics and Traumatology grant, Bavarian Research Alliance grant).



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SECTION I

Basics of Shoulder Arthroscopy



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Anatomy and biomechanics of the shoulder

LUCCA LACHETA and BASTIAN SCHEIDERER

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INTRODUCTION

Pathologies of the glenohumeral joint frequently require surgery. Therefore, knowledge of the anatomy and its biomechanical impact is essential for orthopedic surgeons in order to treat patients most effectively. This chapter provides an overview of structures surgeons should take into consideration pre-, intra-, and postoperatively.

The mobility of the upper extremity is based on the anatomy and functional interaction of the shoulder complex, which enables the widest range of motion of all joints in the human body.

The bony shoulder complex consists of scapula, clavicle, and humerus. These bones form the glenohumeral (GH) joint, the acromioclavicular (AC) joint, and the sternoclavicular (SC) joint.¹

The osteoarticular configuration of the glenohumeral joint offers six degrees of freedom—three in rotation and two in translation. The extent of translation varies in individuals, mainly depending on stiffness and laxity of the soft tissue (capsule and ligaments) and less so on the muscularly setting.

In the following the important anatomical structures and their biomechanical relevance for motion and stability are described.

LANDMARKS

Even experienced shoulder surgeons identify and point out the important anatomical landmarks prior to surgery. These relevant bony structures are the acromion, the spine of scapula, the AC joint, the clavicle and the coracoid process (Figure 1.1).

Acromioclavicular joint

The AC joint with the clavicle in prolongation, is the only connection between scapula and bony thorax. It is a diarthrodial joint with a disc in between the joint partners.²

Superiorly the AC joint is covered by the insertion of trapezius and deltoid muscles. Inferior it is characterized by



Figure 1.1 Right shoulder. Anatomical landmarks: clavicle (CL), acromioclavicular joint (AC), acromion (A), spina scapulae (S), and coracoid process (C).

the coracoclavicular ligaments originating from the coracoid process, inserting to the lateral part of the clavicle. The coracoclavicular ligaments are divided into conoid band medially and trapezoid band laterally. The mean distances between the lateral edge of the clavicle to the insertion site of the conoid ligament are 24.9 ± 3.8 mm (range 18.3–31.8 mm) and 46.3 ± 5.1 mm (range 21.9–43.9 mm) to the conoid tuberosity.³

Beside the coracoclavicular ligaments, which stabilize the clavicle in the vertical direction, the acromioclavicular ligament strengthens the AC-capsule, preventing enhanced horizontal translation.⁴ The AC ligament can be separated into a superoposterior bundle and the anteroinferior bundle. The superoposterior bundle runs posteriorly toward the distal clavicle from the acromion at an average angle of 30° to the joint surface.⁵

Acromion

The acromion forms the “roof of the shoulder.” The mean distance between the apex of the humeral head and the acromion is 9–10 mm on anteroposterior (a.p.) radiographs.⁶ An acromiohumeral interval of less than 6 mm is pathological, indicating a rotator cuff tear.⁶

Anatomical variations of the acromial arch were described by Bigliani et al.^{7,8} They distinguish three morphologic types on outlet radiographs: type I “flat,” type II “curved,” and type III “hooked.” Type III acromion spurs were found to be associated with superior rotator cuff disease in 70% of cases.⁷

Coracoid process

The coracoid process originates from the anterior superior neck of the scapula. Its horizontal part curves lateral and can be palpated in the deltopectoral groove. The coracoid apex gives insertion to the conjoined tendons (short head of the biceps brachii, coracobrachialis) (Figure 1.2). Lateral at the horizontal portion the coracoacromial ligament is attached, medially the pectoralis minor muscle inserts. Located close to the coracoid base, the coracoclavicular ligaments originate at an average distance of 28.5 mm from the anterior tip.⁹ The vertical part of the coracoid process is supplied by the supra-scapular artery and the horizontal part by branches of the axillary artery. It was thought that preservation of the axillary artery branches could be a possible solution to prevent non-union and lysis of the bone transfer in the Latarjet procedure.¹⁰

GLENOHUMERAL JOINT

Humerus and glenoid

The humeral head has an articular surface of approximately 24 cm^2 and is 2.5 cm in radius (a.p.-front).¹¹