Atlas of Musculoskeletal Ultrasound Anatomy

Second Edition

Atlas of Musculoskeletal Ultrasound Anatomy

Second Edition

Dr Mike Bradley, FRCR
Consultant Radiologist,
North Bristol NHS Trust,
Honorary Senior Lecturer,
University of Bristol

Dr Paul O'Donnell, FRCR
Consultant Radiologist,
Royal National Orthopaedic Hospital,
Stanmore, Middlesex,
Honorary Senior Lecturer,
University College,
London

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9780521728096

First published 2010
5th printing 2014

Printed in the United Kingdom by Bell and Bain Ltd, Glasgow

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing-in-Publication Data

Bradley, Mike, Dr.
Atlas of musculoskeletal ultrasound anatomy / Mike Bradley, Paul O'Donnell. – 2nd ed.
p. ; cm.
Includes index.
ISBN 978-0-521-72809-6 (pbk.)
1. Musculoskeletal system–Ultrasonic imaging. 2. Musculoskeletal system–Diseases–Diagnosis–Atlases. 3. Ultrasonic imaging–Atlases. I. O'Donnell, Paul. II. Title.
[DNLM: 1. Musculoskeletal System–anatomy & histology–Atlases. 2. Musculoskeletal System–ultrasonography–Atlases. 3. Musculoskeletal Diseases–ultrasonography–Atlases. WE 17 B8105d 2010]
RC925.7.B73 2010
616.7′07548–dc22

2009034805

ISBN 978-0-521-72809-6 Paperback

Every effort has been made in preparing this publication to provide accurate and up-to-date information which is in accord with accepted standards and practice at the time of publication. Although case histories are drawn from actual cases, every effort has been made to disguise the identities of the individuals involved. Nevertheless, the authors, editors and publishers can make no warranties that the information contained herein is totally free from error, not least because clinical standards are constantly changing through research and regulation. The authors, editors and publishers therefore disclaim all liability for direct or consequential damages resulting from the use of material contained in this publication. Readers are strongly advised to pay careful attention to information provided by the manufacturer of any drugs or equipment that they plan to use.

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Contents

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Foreword

The quality of ultrasonic images has seen radical improvement over the last couple of years, and – as can be appreciated in the new edition of this *Atlas of Musculoskeletal Ultrasound Anatomy* – high frequency applications such as musculoskeletal ultrasound have profited from this development.

Significant advances in ultrasonic probe design and refined manufacturing techniques have resulted in transducers with outstandingly high bandwidth and sensitivity to provide ultrasonic images with both excellent spatial resolution and penetration at the same time. State-of-the-art transducer technology also boosts Doppler performance and supports advanced imaging functions such as trapezoid scan for an extended field of view at no loss of spatial resolution. High frequency matrix transducers make use of genuine 4-D imaging technology to achieve finer and more uniform ultrasonic beams in all three dimensions to deliver the most superb and artefact-free images from the very near to the far field.

Also the dramatic increase of processing power in premium ultrasound systems such as the Aplio XG, with which most of the cases described in this book were acquired, has triggered a quantum leap in image quality. Advanced platforms can process the amount of data worth one DVD each second, which allows us to implement the most complex signal processing algorithms to improve image quality, suppress artefacts and extract the desired information from the ultrasonic raw data in real time.

Uncompromised image quality remains the fundamental merit and to support this in obtaining the fastest and best informed disease management decisions, a *variety* of powerful imaging functions such as Differential Tissue Harmonics, Advanced Dynamic Flow *or* Precision Imaging have been developed. *ApliPure+* real-time compounding, for example, can simultaneously perform spatial and frequency compounding in transmit and receive to enhance both image clarity and detail definition while preserving clinically significant markers such as shadows behind echo-dense objects. These advanced imaging functions work hand in hand with each other to provide the highest resolution and the finest detail. Naturally, they can be combined with virtually any other imaging mode such as colour Doppler or 3D/4D for even greater uniformity within each application.

In spite of all this technical development, we must not forget that the result of an ultrasound scan is highly dependent on the examiner's skills. Only the combination of technological excellence with the dedication and expertise of ultrasound enthusiasts such as the authors of this atlas makes ultrasonic images of outstanding diagnostic value as shown in this book a reality.

Joerg Schlegel

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Principles and pitfalls of musculoskeletal ultrasound

High resolution – best results are obtained using a high frequency linear probe on a matched ultrasound system. Power Doppler is often helpful for pathological diagnosis as well as in the identification of normal anatomy.

Anisotropy – this phenomenon produces focal areas of hypo-echogenicity when the probe is not at 90° to the linear structure being imaged. This is particularly noticeable when imaging tendons resulting in simulation of hypo-echoic pathological lesions within the tendon. The sonographer can compensate for this by maintaining the 90° angle or by using compound imaging.

Anatomy – knowledge of the relevant anatomy is essential for accurate diagnosis and location of disease.

Symmetry – The sonographer can often compare anatomical areas for symmetry helping to diagnose subtle echographic changes.

Dynamic – ultrasound successfully lends itself to scanning whilst moving the relevant anatomy, either passive or resistive. This can help to demonstrate abnormalities which may be accentuated by movement.

Palpation – the sonographer has the opportunity to palpate the abnormality or anatomy linking the imaging directly with the symptomatology, in a manner not possible with other types of cross-sectional imaging.

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Cambridge University Press
978-0-521-72809-6 - Atlas of Musculoskeletal Ultrasound Anatomy: Second Edition
Dr Mike Bradley and Dr Paul O'Donnell
Frontmatter
More information

Echogenicity of tissues

Echogenicity may vary somewhat with different ultrasound probe frequencies and machine set-up. This section describes these tissues using the common musculoskeletal presets and high frequency transducers. Surrounding tissue also influences echogenicity due to beam attenuation.

Fat – pure fat is hypo-echoic/transonic but the echogenicity varies in different anatomy and pathology. Fatty tumours such as lipomas contain areas of connective tissue creating the characteristic linear hyper-echoic lines parallel to the skin. Other fatty areas may vary in echogenicity depending on their structure and surrounding tissue.

Muscle – muscle fibres are hypo-echoic separated by hyper-echoic interfaces. Hyper-echoic fascia surrounds each muscle belly delineating the muscle groups.

Fascia – hyper-echoic thin, well-marginated soft tissue boundaries.

Tendon – the hyper-echoic tendon consists of interdigitated parallel fibres running in the long axis of the tendon. The tendon sheath is hyper-echoic separated from the tendon by a thin hypo-echoic area.

Para-tenon – some tendons do not have a true tendon sheath but are surrounded by an hyper-echoic boundary, the para-tenon, e.g. the Tendo-achilles.

Ligament – hyper-echoic, similar to tendons. Fibrillar pattern may vary in multilayered ligaments.

Synovium/Capsule – these structures around joints are not usually separately distinguishable on ultrasound, both appearing hypo-echoic and similar to joint fluid.

Hyaline cartilage – hypo-echoic/transonic cartilage is seen against highly reflective cortical bone.

Costal cartilage – hypo-echoic well defined. Well marginated from the hyper-echoic anterior rib end. The echogenicity varies depending on how much calcification it contains.

Fibrocartilage – hyper-echoic triangular-shaped cartilage with often internal specular echoes, e.g. the menisci.

Bone/Periosteum – this is indistinguishable in normal bone. Highly reflective hyper-echoic linear/curvi-linear line with acoustic shadowing.

Pleura – hyper-echoic parietal pleura is usually seen in the normal intercostal area. Aerated lung deep to this.

Air/gas – this is also highly reflective and creates characteristic 'comet tail' artefacts. Small gas bubbles in tissue may give small hyper-echoic foci whilst aerated lung is diffusely hyper-echoic with comet tails.

Nerve – hypo-echoic linear nerve bundles separated by hyper-echoic interfaces: appearances similar to tendons.