

# Nuclear Medicine and Radiologic Imaging in Sports Injuries

Andor W.J.M. Glaudemans  
Rudi A.J.O. Dierckx  
Jan L.M.A. Gielen  
Johannes (Hans) Zwerver  
*Editors*



Springer

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# Nuclear Medicine and Radiologic Imaging in Sports Injuries



 Springer

### *Editors*

Andor W.J.M. Glaudemans  
Department of Nuclear Medicine  
and Molecular Imaging  
University of Groningen  
University Medical Center Groningen  
Groningen  
The Netherlands

Rudi A.J.O. Dierckx  
Department of Nuclear Medicine  
and Molecular Imaging  
University of Groningen  
University Medical Center Groningen  
Groningen  
The Netherlands

Ghent University  
Ghent  
Belgium

Jan L.M.A. Gielen  
Department of Radiology  
Antwerp University Hospital  
Edegem  
Belgium

Department of Sports Medicine  
Antwerp University Hospital  
Edegem  
Belgium

Department of Medicine  
Antwerp University  
Edegem  
Belgium

Johannes (Hans) Zwerver  
University Center for Sport  
Exercise and Health, Center for Sports  
Medicine  
University of Groningen  
University Medical Center Groningen  
Groningen  
The Netherlands

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## Foreword

As President of the International Federation of Sports Medicine (FIMS), I am honoured to write a foreword to this interesting and important initiative: "Nuclear Medicine and Radiologic Imaging in Sports Injuries", edited by Andor Glaudemans (coordinating editor), Rudi Dierckx, Jan Gielen and Hans Zwerver. Personally, I have known Jan Gielen now for many years. He is a current member of the FIMS Scientific Commission.

The textbook is current and concise, and is essential to provide the background information for sports medicine physicians required to practice with confidence in emergency and chronic situations. This volume gives insight in the actual importance of the assessment of injuries with the support of radiologic and nuclear medicine imaging techniques. The chapters written by experts in the field give an overview of actual radiological modalities (computed radiography, CT, ultrasound and MRI) and nuclear medicine imaging techniques (including PET-CT and SPECT-CT) for specific indications, pointing out the specific merits of both. The scope is comprehensive with focus on orthopaedic sports lesions.

The medical society is aware that sports medicine is an integrated multidisciplinary field embracing relevant areas of clinical medicine (sports traumatology, medicine of sports, and sports psychiatry), appropriate allied scientific disciplines (including physiology, psychology, and biomechanics), radiology and nuclear medicine in its natural ally. Sports medicine physicians are increasingly aware that the responsibilities of sports medicine involve not only competitive sports but also recreational sports, and consequently, to this respect, I am proud to recognise over the past years that sports medicine has grown in reliability thanks to its efforts in disseminating the principles of the health aspects of all people engaged in sport and physical activity. In this context, the sport medicine physicians' work has to be dedicated to the protection of the athletes' health, including planning of the medical aspects of sport events and medical treatment, in order to allow them to safely compete in national and international sports events.

Already since the beginning, FIMS promotes the publication of educational books and initiatives enforcing continuous professional development, and this textbook really deserves a special attention.

To my colleague and friend Jan Gielen and to my colleagues Andor Glaudemans, Rudi Dierckx and Hans Zwerver go my sincere congratulations.

Lausanne, Switzerland

F. Pigozzi, MD, FIMS President



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## Preface

A physically active lifestyle is widely promoted since it has numerous positive effects on healthy aging. With this focus on an active lifestyle for everyone, patients and athletes, in all ages, beginners and experts and at a recreational and a professional level, more sports- and exercise-related injuries may be expected. To keep these exercisers “on the move,” on the one hand early diagnosis and early therapy decision making are key issues in sports medicine, while on the other hand diagnostic imaging is of increasing importance in successful diagnosis and management of sports injuries, both in recreational and elite athletes.

Sports medicine, as a specialty, has gained much importance in the recent years. Sports and exercise medicine involves the medical care of injury and illness in sports and has a large-scale application in improving the health of the general public and patients with chronic disease, for example, through advice on exercises. However, sports and also “Exercise as a Medicine” may also result in unfavorable side effects on the musculoskeletal system. Optimal management of these injuries requires careful clinical examination, accurate diagnosis, and experience and knowledge of sport-specific movement patterns. The sports medicine specialist treats a wide range of patients from elite sportspersons over recreational people to those who recover from illness and injury. The invaluable importance of this expert area is now increasingly recognized. As an example in 2014, sports and exercise medicine became a new specialty within the Dutch medical community.

Nuclear medicine and radiology are both expanding medical fields, which are potentially able to satisfy the demands of the sports medicine physician by offering precise diagnosis, insights into pathophysiology, monitoring of rehabilitation, and imaging of treatment outcome. Radiologic imaging techniques, such as X-ray, CT, and MRI, already for years play an important role in sports medicine with, for example, growing possibilities in MRI sequences. The development of hybrid imaging systems with better spatial resolution also have led to an increasing use of nuclear medicine techniques. SPECT/CT, PET/CT, and PET/MRI are important developments bringing anatomy and physiology together.

Although there have been some textbooks on imaging sports injuries, the number of these books is limited and mainly focus on radiological techniques. To the best of our knowledge, this is the first comprehensive textbook that combines the perspectives of sports medicine, radiology, and nuclear medicine in one volume. The editors are working in the field of nuclear medicine (Andor Glaudemans

and Rudi Dierckx), radiology (Jan Gielen), and sports medicine (Hans Zwerver). In order to obtain a high-quality multi-author textbook, they invited international specialists in all three fields.

The basic chapters describe each specialty, their characteristics, strengths, and weaknesses and provide an overview of all possibilities these specialties may offer. The topographic sections of injuries of the head and face, spine, chest, shoulder, elbow and forearm, wrist and ankle, pelvic region, knee, lower leg, ankle and foot, all exist of three chapters: the first describing the sport-specific injuries, the second describing the radiological perspective with many illustrations, and the third describing the nuclear medicine perspective also with illustrations. After this topographic section, the chapters focus on specific characteristics in adolescents, women, dancers, and musicians. A chapter on equine sports injuries, also to be considered a special athlete, is meant to broaden the scope, as is the case in a special chapter dedicated to the heart as a special muscle in athletes and to the effect of anabolic-androgenic steroids on the heart muscle. The last seven chapters describe the expert views in specific sports (tennis, soccer, cycling, running, and boxing) and the experiences with injuries in Olympic and Paralympic athletes.

We realize that this approach resulted in overlap, albeit from different perspectives. We think this was unavoidable because much integration of the knowledge in radiology, nuclear medicine, and sports medicine is still at its beginning. With this regard, we hope this textbook will prove not only to be useful for those involved in patient care, but also may provide a platform for further common research.

We are happy that our book is produced by one of the premier publishers in the field. This guarantees a high quality of reproduction and allows for the inclusion of many color figures, which is essential in the fields of radiology and nuclear medicine. We would like to thank Dr. Sylvana Freyberg from Springer Verlag for her help and support during the development of this book.

We were also intrigued by the enthusiastic response from contributors from all over the world who made this endeavor successful. Although deadlines sometimes had to be postponed because of the many tasks and roles in the medical field we all play, we appreciated the efforts and enthusiasm of all the authors involved. Hence, our sincere thanks for their contributions. The result to us looks a fine compilation of present evidence, knowledge, and expertise. We hope the interested reader may build on this.

Combining the knowledge of all three specialties involved will hopefully enhance interdisciplinary communication for better patient care and joint research. We sincerely hope that this textbook will become a useful and stimulating reference for sports medicine specialists, radiologists, nuclear medicine specialists, and all professionals working in the field, at the benefit of athletes and patients involved.

Groningen, The Netherlands  
Groningen, The Netherlands  
Edegem, Belgium  
Groningen, The Netherlands

Andor W.J.M. Glaudemans  
Rudi A.J.O. Dierckx  
Jan L.M.A. Gielen  
Hans Zwerver

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## The Editors

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### Dr. Andor W.J.M. Glaudemans, MD, PhD

Board certified in nuclear medicine

Nuclear medicine physician at the Department of Nuclear Medicine and Molecular Imaging at the University Medical Center Groningen

Member of the Infection and Inflammation Committee of the European Association of Nuclear Medicine

Author of more than 70 peer-reviewed publications in international journals and 18 book chapters

### Research Fields

- Imaging of infectious and inflammatory diseases (amyloidosis, fungal infections, vasculitis, endocarditis, patients with bacteremia, vascular graft infections, tuberculosis, atherosclerosis, diabetic foot infections, prosthetic joint infections, osteomyelitis, infections in children)
- Hormonal receptor imaging: estrogen receptor (FES-PET) and androgen receptor (FDHT-PET)
- Imaging of oncological diseases
- Imaging of sports injuries
- Radioisotope therapeutic strategies

### Affiliation

Department of Nuclear Medicine and Molecular Imaging, University of Groningen, University Medical Center Groningen, Hanzeplein 1, 9700 RB, Groningen, the Netherlands.

E-mail: [a.w.j.m.glaudemans@umcg.nl](mailto:a.w.j.m.glaudemans@umcg.nl)

**Prof. Dr. Rudi A.J.O Dierckx, MD, PhD, MBA**

Board certified in neuropsychiatry and nuclear medicine

Head of the Department of Nuclear Medicine and Molecular Imaging at the University Medical Center Groningen

Head of the Medical Imaging Center at the University Medical Center Groningen

Author of more than 500 peer-reviewed publications in international journals, editor of 9 textbooks

**Research Fields**

Broad interest in nuclear medicine, focus on neuroscience and oncology

- SPECT/conventional nuclear medicine
- PET: research and clinical applications
- Development of novel radiotracers
- Rodent models of human disease
- Medical physics
- Quality, ethics, and economics

**Affiliations**

Department of Nuclear Medicine and Molecular Imaging, University of Groningen, University Medical Center Groningen, Hanzeplein 1, 9700 RB, Groningen, the Netherlands

Ghent University, De Pintelaan 185, 9000 Ghent, Belgium

E-mail: r.a.dierckx@umcg.nl

---

**Prof. Dr. Jan L.M.A. Gielen, MD, PhD**

Board certified in radiology (1988)

Board certified in insurance medicine and medico-legal expert medicine (2009)

Vice head of the department of radiology

Medical coordinator Sports medicine, Antwerp University and University Hospital

Author of 100 peer-reviewed publications in international journals, editor of 4 textbooks and >25 book chapters

**Research Fields**

- Radiological imaging and sports medicine
- Gait lab studies in sports and art performers
- Developing skeleton and height prediction
- Imaging and imaging-guided interventions in MSK and sports
- Imaging and imaging-guided interventions of bone and soft tissue tumors



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## Affiliations

Antwerp University and University Hospital, Department of Radiology, Department of Sports Medicine, Wilrijkstraat 10, B-2650, Edegem, Belgium  
E-mail: Jan.Gielen@uza.be

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## Dr. Johannes (Hans) Zwerver, MD, PhD

Board certified in sports medicine  
Staff member at the Center for Sports Medicine of the University Medical Center Groningen  
Member of the Sport Science Institute of the University of Groningen  
Chief editor of the Flemish/Dutch Journal of Sports Medicine  
Author of more than 40 peer-reviewed publications in international journals and 10 book chapters

## Research Fields

Broad interest in sports and exercise medicine, focus on musculoskeletal injuries

- Tendinopathy
- Overuse injuries in sports
- Exercise-related injuries in chronic disease
- Exercise and healthy aging

## Affiliation

Center for Sports Medicine, University of Groningen, University Medical Center Groningen, Hanzeplein 1, 9700 RB, Groningen, the Netherlands.  
E-mail: j.zwerver@umcg.nl

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## Part I

### Basics





Johannes (Hans) Zwerver

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Abstract

Sports and exercise medicine deals with the medical care of the exercising individual. Strong evidence shows that physical *in*activity increases the risk of many adverse health conditions, including major noncommunicable diseases such as coronary heart disease, type 2 diabetes, and breast and colon cancers and shortens life expectancy. Therefore, exercise is increasingly prescribed by physicians and promoted through government-based health campaigns to prevent the morbidity and mortality caused by inactivity. A side effect is an increasing number of sports- and exercise-related injuries. For optimal management of these conditions, often imaging is necessary to establish a precise diagnosis from the start and to plan the best treatment and rehabilitation strategy.

Dealing with elite athletes, often under time pressure for the next game or an upcoming tournament, poses specific challenges to the medical personnel involved. Good communication between the sports medicine physician and imaging specialist, exchange of relevant information and adequate knowledge of musculoskeletal imaging, and some feeling for what is going on in the athlete are important factors for optimal management.

J (Hans). Zwerver, MD, PhD  
University Center for Sport, Exercise and Health, Center for Sports Medicine, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands  
e-mail: j.zwerver@umcg.nl