The WHO manual of diagnostic imaging

RADIOGRAPHIC ANATOMY AND INTERPRETATION OF THE MUSCULOSKELETAL SYSTEM

World Health Organization
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Radiographic Anatomy and Interpretation of the Musculoskeletal System

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Foreword

Modern diagnostic imaging offers a vast spectrum of modalities and techniques, which enables us to study the function and morphology of the human body in details that approaches science fiction.

However, it should be noticed that even in the most advanced Imaging Department in the economically privileged parts of the world, 70–80% of all clinically relevant questions may be solved by using the two main cornerstones of diagnostic imaging, which are Radiography (X-ray) and Ultrasonography.

It should also be remembered that thousands of hospitals and institutions worldwide do not have the possibilities to perform even these fundamental imaging procedures, for lack of equipment and/or diagnostic imaging skills.

Therefore, WHO in collaboration with The International Commission for Radiologic Education (ICRE) of the International Society of Radiology (ISR) is creating a series of "WHO Manuals of Diagnostic Imaging", developed under the umbrella of The Global Steering Group for Education and Training in Diagnostic Imaging. Among the members of this group are the major regional and global societies involved in Diagnostic Imaging, including the International Society of Radiology (ISR), The International Society of Radiographers and Radiological Technologists (ISRRT), and the World Federation for Ultrasound in Medicine and Biology (WFUMB).

The full series of manuals will primarily cover the examination techniques and interpretation of Radiography, in a later stage also Ultrasonography. It is meant for health care personnel who in their daily work are responsible for producing and interpreting radiographs, be it radiologists or other medical specialists, general practioners, or radiological technologists working in rural areas.

The manuals are authored by authorities in the specific fields dealt within each manual, supported by a group of collaborators, that together cover the experience, knowledge and needs, which are specific for different regions of the world.

It is our sincere hope that the manuals will prove helpful in the daily routine, facilitating the diagnostic work up and hence the treatment, to the best benefit for the patient.

Geneva, Switzerland and Lund, Sweden, May 2002

Harald Ostensen
Holger Pettersson

Preface

To be asked to author one of the WHO Manuals of Diagnostic Imaging is certainly a great honour, for any radiologist in the world. But to create a manual, that should fit the varying needs in vast areas of the world is certainly also a major challenge.

However, with the excellent support of the group of collaborators referred to us by the International Commission for Radiologic Education (ICRE), we have done our best to fulfil the demands from WHO. Thus we have tried to cover, in a manageable format, the information that is essential for the accurate interpretation of the vast majority of those radiographic musculoskeletal examinations that will appear in a General Radiologic Department.

It is our hope that you, the readers, will find this manual useful in your daily routine work. We sincerely hope that it will facilitate your work, and thereby improve the treatment of your patients.

Birmingham, UK, and Lund, Sweden, January 2002

A. Mark Davies
Holger Pettersson

CHAPTER 1

General Principles

- X-rays are the beam of ionizing radiation emitted from the X-ray tube during the exposure. Although "X-ray" is a term frequently used to refer to the image/film produced, radiograph is the correct term.
- the ***radiograph***, irrespective of the projection/view, is a 2-dimensional representation of a 3-dimensional structure. The image produced is therefore made up of multiple overlying structures. Accurate localisation of an abnormality frequently requires two radiographs obtained at right angles to one another e.g. ***anteroposterior (AP)*** and ***lateral projections***. Remember that an object visible on a radiograph may be situated anywhere between the X-ray tube and the film cassette (fig 1.1).
- structures of high density (e.g. bones and metal foreign bodies) will absorb (attenuate) the X-ray beam more than structures of low density (e.g. soft tissues and air).
    - bones will appear white
    - soft tissues will appear grey
    - air/gas will appear black
- remember that ***fluoroscopy*** (X-ray screening) gives a negative image on the TV-monitor or screen. Therefore, the appearances are reversed with bones black and air/gas white.
- most soft tissue structures have an atomic number (density) approximating to that of water and will attenuate (absorb) the X-ray beam to the same degree. Most soft tissues, irrespective of their nature (e.g. muscle, tendon, blood and pus) will appear with the same grey density on the radiograph.
- fat has a density (atomic number) sufficiently less than that of water for it to be distinguished from the remaining soft tissues provided it is present in an adequate amount. It will appear darker than other soft tissues and lighter (greyer) than air/gas. Fat planes will appear on the radiograph as dark linear strands separating soft tissue structures. Displacement or obliteration of the fat planes may be the only sign on the radiograph of a significant soft tissue abnormality. For example;

  Elbow – displacement of the fat pads indicates a joint effusion or haemarthrosis (see Trauma Chapter)

  Pelvis – obliteration of the fat plane around the bladder in trauma indicates free fluid or blood within the pelvic cavity.
- ***foreign bodies*** may be introduced into the body by trauma, ingestion or at the time of surgery. Most will have a density greater than water and will appear whiter than the soft tissues. Metallic foreign bodies will appear white (figs 1.1, 1.2).
- the optimum ***exposure*** of a radiograph of the skeletal system will demonstrate the bones to show

posed radiograph

ambient lighting,

al responsible for