

# ROENTGENOGRAPHIC EXAMINATION IN ORTHOPAEDIC DIAGNOSIS

## ESSAY

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Orthopaedic Surgery

BY

Abd El-Rahman Sobhi Soliman Gaafer

617.3  
A.S

## SUPERVISORS

**Prof. Dr. Mamdouh Zaki Saad**

*Prof. of Orthopaedic Surgery  
Faculty of Medicine  
Ain Shams University*

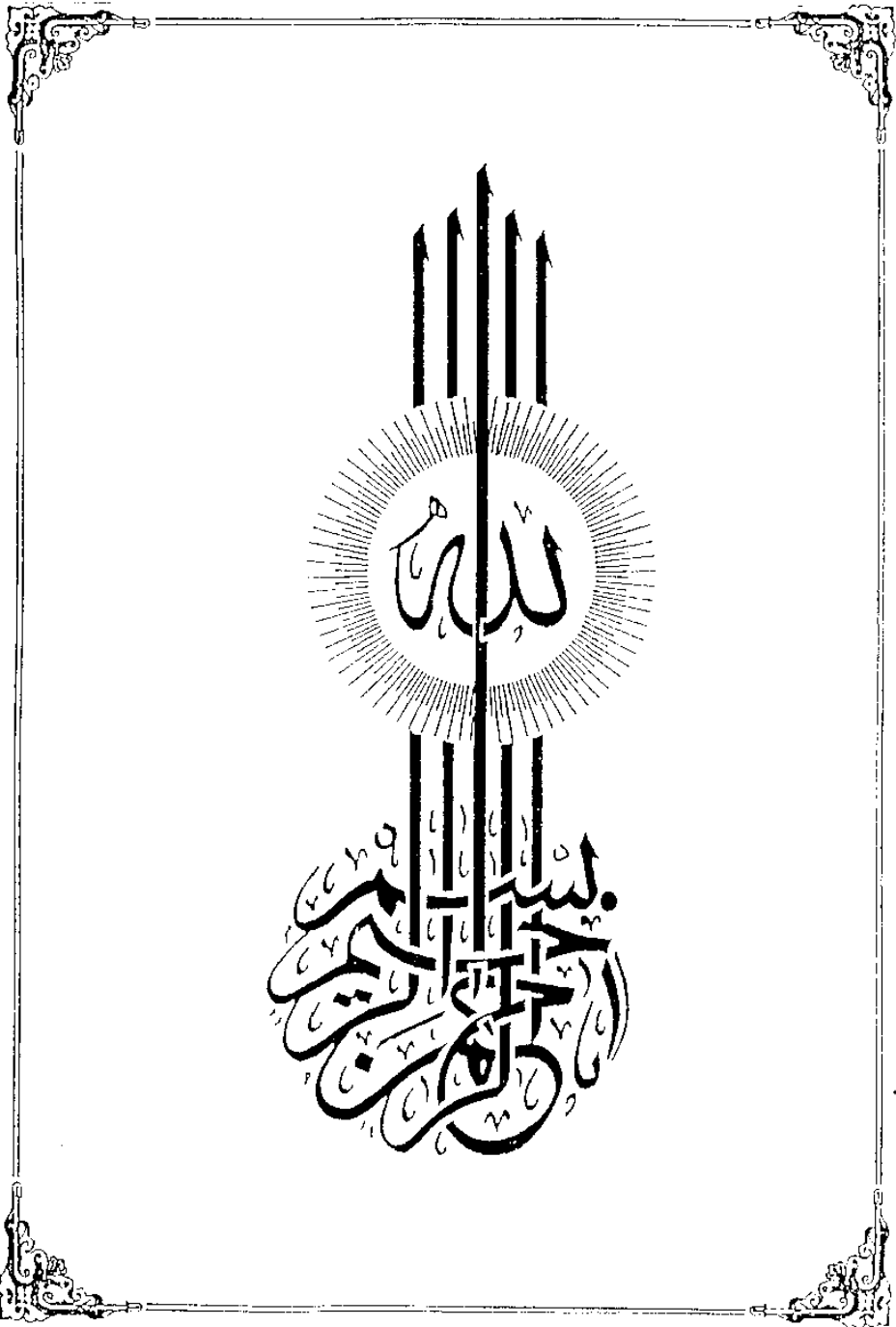
**Dr. Ali Ibrahim Hussein**

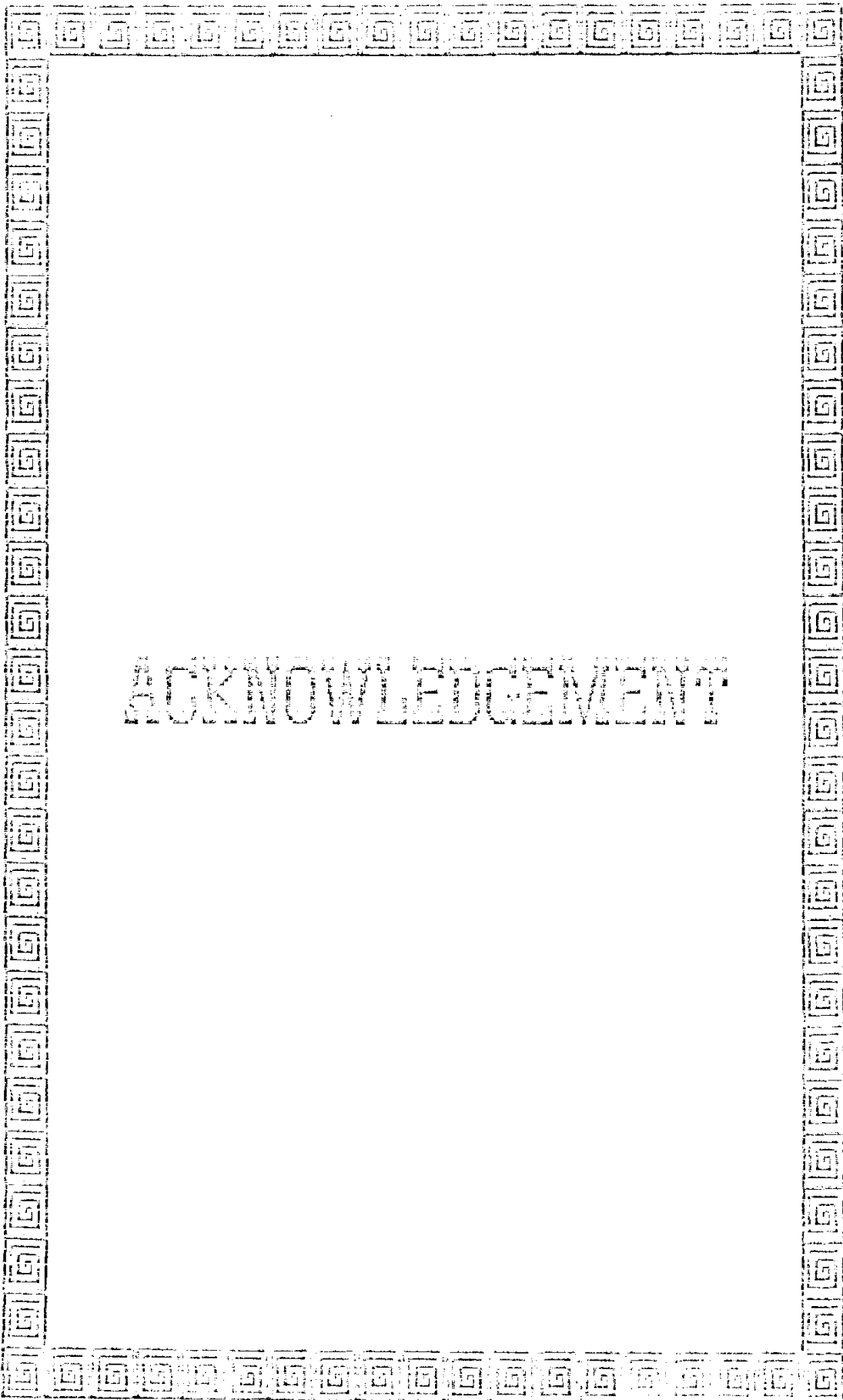
*Lecturer of Orthopaedic Surgery  
Faculty of Medicine  
Ain Shams University*

Faculty of Medicine  
Ain Shams University

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## ACKNOWLEDGEMENT

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The Merciful and Beneficient

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INTRODUCTION  
AND  
AIM OF THE  
WORK

## I- Introduction and Historical review

The terms roentgenogram, radiograph, x-ray film and x-ray negative are synonymous but the first is preferred. These terms refer to the finished film that has been exposed to roentgen rays and then recording in black and white or in varying shades of gray the structures through which the roentgen ray beam has passed (Paul and Juhl, 1972).

Roentgenographic examination is the end result of an exacting technical procedure to obtain the greatest possible information concerning the anatomic details of the structures for purpose of demonstrating the absence of or the presence and extent of traumatic or pathological changes (local and systematically) (Ballinger, 1986).

Roentgenograph of a bone will only reveal shadows produced by its mineral contents (mainly  $\text{Ca}^{++}$ ) therefore there may be:

- Changes in  $\text{Ca}^{++}$  distribution (as in pathological lesions)
- Changes in structural continuity (as in fractures)
- Changes in position (as in dislocations)
- Changes in shape (as in congenital developmental defects)
- Changes in joint space (as in arthritis).

Localized loss of density with disappearance of the trabeculae is sometimes referred to as bone erosion. Increase of density indicating a high  $\text{Ca}^{++}$  content (as in bone



sclerosis). Changes in  $\text{Ca}^{++}$  distribution appearing in the radiography as alterations in the trabecular structure (as in Paget's disease). New bone formation (as in periosteal new bone or bony outgrowth. So the bone disease frequently depends on a careful considration, of all these possibilities and on the relative intensity of any changes which may be present. For instance much erosion and minimal periostitis will suggest a neoplasm (Simon, 1975).

While imaging with x-rays is based on the relative absorptive properties of the various tissues we can use new imaging modalities to form images utilizing other tissue characteristics such as metabolic, vascular and acoustic properties (Putman and Ravin 1988).

The history of discovery and development of roentgenography is a facinating story, that illustrates very well how can science, mathematics and medical knowledge be formulated together to produce a useful tool in clinical practice.

Roentgen rays (x-rays) discovered by William Conard Roentgen (Prof. of Physics at the University of Wlirburg Germany on Novemeber 8.1895. marked the beginning of a new era in medical science. For the first time it became possible to see through the intact skin and superficial tissues and

to visualize the bones and deeper structures of the body.

Improvements in the crude equipment of the early days followed and with the tremendous interest generated throughout the world by the news of the discovery it was only a short time before methods become available for the study of body cavities and the viscera. The rays that Prof. Roentgen discovered he called x-rays after "x" the unknown. (Paul and Juhl, 1972).

Roentgen deserved the Nobel prize in physics in 1902 for his discovery and was able to produce the first radiographic record (of his wife's hand) on December 22-1896 (fig.1). His preliminary report was submitted for publication within a few days on December 28-1896. The medical profession reacted very quickly. It was recognized that surgery should derive advantage from photographs of bone in vivo, fractures, dislocation, swellings and foreign bodies should be easily recognizable.

Radiographic anatomy forms a bridge between the preclinical studies and the clinical subspecialties; it teaches students to systematically apply their knowledge of gross anatomy in the interpretation of radiographic images. Gross anatomy consists primarily of a three dimensional approach to color differentiated preparations and models of the human

body, whereas radiologic anatomy teaches students to correlate the gross anatomic structures with the density variations of two dimensional images. Special diagnostic procedures must be mastered in order to discern the individual organs and structures within the human body (Ballinger, 1986 and Taylor 1987). The need to inspect various depths of internal structure and to construct a three-dimensional information about these structures was the basis on which tomography was established for clinical application (1921 to 1932). The origin of tomography can not be attributed to any one particular person. In fact tomography was developed by several different gifted men experimenting in different countries at about the same time without any knowledge to each other's work. Tomography was invented in the United States in (1928) by Jean Kieffer, a radiologic technologist who developed the special radiographic technique to demonstrate a form of tuberculosis that he had. His process was termed, "laminagraphy" by another American J. Robert Andrews, who assisted Kieffer in the construction of his first tomographic device the laminagraph (Ballinger, 1986). In 1917 Radon an Austrian mathematician proved that it was possible to reconstruct a three-dimensional image from object from the infinite set of all its

projections, a concept that formed the basis for the development of computed tomography in medical practice later on. The actual breakthrough in making computed tomography was made by Hounsfield in 1967. It was not before 1971, however that the first working model was installed and ready for clinical trials. The use of computed tomography has expanded rapidly since 1971 and new developments are being made almost overnight (Snopek, 1984).

Discography has been used since the late forties for the experimental and clinical evaluation of disc disease in both the cervical and lumbar regions of the spine, Lindblom first described discography in 1948. Wood, G. quoted by (Campbell, 1992).

Yaghmai, (1979) mentioned that the first experiments in arteriography, were concerned with the differential diagnosis of bone neoplasm the work of Dos-santos in 1934, Caldas in 1934 and Farinas in 1937, provided the major impetus in the development of modern selective arteriography. The use of bone seeking isotopes (scintigraphy) for imaging began with the use strontium-85 in 1961 (Putman and Ravin, 1988).

Special modalities and techniques and other special modern equipments are developing which are used in many cases

including imaging of the soft tissues and other tissues characteristics. The fascinating story of Prof. Roentgen's discovery and of the many other scientific advances that preceded it and made it possible is beyond the scope of this book they have been the subject of numerous articles and books and every student is urged to read the complete story (Paul and Juhl, 1972).

#### Aim of the study

To demonstrate the value of roentgenographic examination as a guide for diagnosis of orthopaedic problems whether traumatic or pathological and whether local or systemic.

## II. Roentgenographic modalities

### 1. Plain roentgenography:

- A. Conventional roentgenographic plain film.
- B. Plain roentgenography with special techniques.
  - a. Fluoroscopy
  - b. Magnification techniques.
  - c. Xeroradiography.
  - d. Low kilovoltage (K.V) techniques.
  - e. Stereoradiography.

### 2. Tomography:

- a. Conventional tomography.
- b. Computed tomography.

### 3. Roentgenography with contrast media:

- a. Myelography and radiculography.
- b. Arthrography.
- c. Discography.
- d. Tenography.
- e. Angiography.
- f. Sinography.

### 4. Scintigraphy.

### 1- Plain Roentgenography.

They are routine radiographs made directly without resorting to any use of contrast material and therefore are solely produced by differential beam absorption in various organs. The absorption is dependent upon the tissue density (gram/cc). Bones have approximately density of 1.9 and produce a skeletal dense shadows on the x-ray image, this appear dark on a fluoroscopic image and light on a plain film (-ve) (fig. 2 A & B). Soft tissues (as muscle, cartilage, fat, blood) have a density of 1.0, so the x-rays are fairly evenly absorbed producing a grayish shadow in the fluoroscopic image and on the film. Air has the lowest density (0.0013) producing a light area on the picture screen and a darkening on the (-ve) film (as lung, tracheal lumen, paranasal sinuses, intestinal gases) (Taylor, 1987).

To develop the ability to properly analyze radiographs and to correct or prevent errors in technique, the technologist should study radiographs from the following standpoints:-

- a- The relationship of the structural shadows as to size, shape, position and angulation must be reviewed.
- b- Each anatomic structure must be compared with that of adjacent structures.