The Integrated Imaging Approach to Evaluatation of Bone Mineral Density

Essay

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Key words

- osteoporosis
- Bone mineral density
- Dual x-ray absorptiometry

Abstract

The radiologists have several importantroles and responsibilities in the imaging ofosteoporosis: We need to *(a)* diagnose osteoporosis, *(b)* alert clinicians to increased fracture risk, *(c)*monitor treatment, and *(d)* correctly interpret fragility fractures. In addition we need to ensure that the proper imaging modality is used whenever possible—that is, if DXA has limitations, an attempt should be made to use quantitative CT, and if this is not possible we need to indicate the limitations in our report to the referring clinician. Also, we are responsible for quality assuranceof quantitative measurements and we should be a driving force in developing new techniques to analyze bone quality. In recent years, new imaging modalities such as micro-CT and high-resolution magnetic resonance imaging have been developed in an attempt to help diagnose osteoporosis in its early stages, thereby reducing social and economic costs and preventing patient suffering.

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LIST OF ABBREVIATIONS

- **µSv:** micro sievert
- **BMD:** Bone Mineral Density
- **CV:** Coefficient of Variation
- **DEXA** Dual energy x-ray absorptiometry**.**
- **DPA** Dual photon absorptiometry**.**
- **DXA:** Dual x-ray Absorptiometry
- **NOF:** National Osteoporosis Foundation
- **pDXA:** Peripheral DXA
- **PQC** peripheral quantitative computed tomography**.**
- **pQCT:** Peripheral QCT
- **QCT** Quantitative computed tomography**.**
- **QCT**: Quantitative CT
- **QUI:** Quantitative Ultrasound Index
- **QUS:** Quantitative Ultrasound
- **RA:** Radiographic Absorptiometry
- **ROI:** Region Of Interest
- **SD:** Standard Deviation
- **SPA** Single photon absorptiometry**.**
- **SXA** Single x-ray absorptiometry**.**
- **WHO:** World Health Organization
- **DXR :** digital x-ray radiogrammetry **.**
- **PMO :** Postmenopausal osteoporosis
- **GnRH :** gonadotropin-releasing hormone
- **LHRH :** luteinizing hormone-releasing hormone
- **SSRIs :** Selective serotonin reuptake inhibitors
- **RANKL :** The receptor activator of nuclear factor-kappa B ligand

List Of Abbreviations

- **OPG :** osteoprotegerin
- **SSRIs:** Selective serotonin reuptake inhibitors
- **BSUs :** bone structural units
- **OCN :** osteocalcin
- **SIBLINGS** : (Small Integrin-Binding Ligand, N-linked Glycoprotein)
- **ECM :** extracellular matrix
- **(Ce) :** cerium
- **(Sm) :** samarium
- **BMC :** bone mineral content
- **LSC:** least significant change
- **SERAM :** Spanish Society of Medical Radiology
- **OPUS :** osteoporosis-US
- **UTE :** ultrashort-echo-time
- **HR-pQ CT:** High Resolusion pQCT

Introduction

INTRODUCTION AND AIM OF WORK

Osteoporosis is the most common of all metabolic bone disorders. It is characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fractures. Because of the increasing aging of the world population, the number of persons affected by osteoporosis is also increasing) (**Guglielmi, et al, 2011)** .In the medical literature, osteoporosis is currently presented as a major global public health problem, one that has already been proposed as the disease of the twenty-first century (**Clark 2002**). As a consequence of its current medical definition, approximately 200 million women worldwide are described as having osteoporosis **(Lane, 2006) (Santora and Skolbekken, 2011).**

Most individuals with osteoporosis are asymptomatic, undiagnosed, and untreated. In the National Ambulatory Medical Care Survey, investigators found that primary care physicians diagnosed osteoporosis in fewer than 2 per cent of women over 60 years old, even though the expected prevalence in this population is 20 to 30 per cent. Men appear to be diagnosed and treated less often than women. Complications related to osteoporosis can create social and economic burdens (**Guglielmi , et al, 2011**).

Not only has osteoporosis been attributed an important role in the causation of fractures but it is also seen as a major killer. This is because hip fractures are perceived as causing what in medical terms is described as an excess mortality among the aged (Consensus Development Conference 1991)(**Santora and Skolbekken, 2011).**

For these reasons, the early diagnosis of osteoporosis is crucial **(Guglielmi, et al, 2011).**

Dual x-ray absorptiometry is currently the state-of-the-art technique to measure bone mineral density and to diagnose osteoporosis according to the World Health Organization guidelines. Motivated by a 2000 National Institutes of Health consensus conference, substantial research efforts have focused on assessing bone quality by using advanced imaging techniques. Among these techniques aimed at better characterizing fracture risk and treatment effects, high-resolution peripheral quantitative computed tomography (CT) currently plays a central role, and a large number of recent studies have used this technique to study trabecular and cortical bone architecture. Other techniques to analyze bone quality include multidetector CT, magnetic resonance imaging, and quantitative ultrasonography. In addition to quantitative imaging techniques measuring bone density and quality, imaging needs to be used to diagnose prevalent osteoporotic fractures, such as spine fractures on chest radiographs and sagittal multidetector CT reconstructions. Radiologists need to be sensitized to the fact that the presence of fragility fractures will alter patient care, and these fractures need to be described in the report **(Link, 2012).**

Key words

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Aim of the work

The aim of this work is to highlight and clarify the role of new imaging modalities in measurement of bone mineral density in an attempt to help diagnose osteoporosis in its early stages, thereby reducing social and economic costs and preventing patient suffering.

Anatomy Of Bone