

Contemplating the Efficacy Analysis of Quantitative Computed Tomography (QCT) and Dual X-Ray Absorptiometry (DXA) among Suspected Osteoporotic Patients in Pakistan: A Potential Edge of QCT over DXA for Adequate Scrutiny of Disease

Rizwan Uppal, Umar Saeed*, Muhammad Saad Uppal and Waghmah Nasir

Department of Research and Development, Islamabad Diagnostic Center (IDC), Pakistan

*Corresponding author: Umar Saeed, Department of Research and Development, Islamabad Diagnostic Center (IDC), F8 Markaz Islamabad (44000), Pakistan



ARTICLE INFO

Received: 📅 January 06, 2022

Published: 📅 January 18, 2023

Citation: Rizwan Uppal, Umar Saeed, Muhammad Saad Uppal and Waghmah Nasir. Contemplating the Efficacy Analysis of Quantitative Computed Tomography (QCT) and Dual X-Ray Absorptiometry (DXA) among Suspected Osteoporotic Patients in Pakistan: A Potential Edge of QCT over DXA for Adequate Scrutiny of Disease. Biomed J Sci & Tech Res 48(1)-2023. BJSTR. MS.ID.007609.

ABSTRACT

Osteoporosis is one of the major public health concerns, silently propagating in the societies, affecting more women worldwide. Herein we aimed to determine the effectivity analysis of quantitative computed tomography (QCT) and Dual-energy X-ray absorptiometry (DXA scan) or bone mineral density/ bone density (BMD) among suspected osteoporotic patients. A cross sectional study was conducted at Islamabad Diagnostic Center on suspected osteoporotic patients during August 2022- October 2022. Among enrolled participants, the average QCT-T score were significantly lower among 86.7 % of the participants, in comparison to the average DXA-T score. The QCT-T score revealed osteopenia among 93.3% of the subjects, and osteoporosis among 53.3% of the individuals. While the DXA T score analysis on same subjects, at similar positions revealed osteopenia among 60% and osteoporosis among 13.33% of the subjects. Relying only on DXA T score than QCT might not be a suitable option for several physicians, since the loss of inner bone among patients can be masked by the partial deposition of additional layers of mineral to the outside of cortical layer, collectively affecting DXA reading. However, the QCT accurately monitors inner spongy trabecular boney area, which is more critical for assessing disease actual severity. The QCT mediated evaluation of inner spongy bone, might prevent sudden collapse of vertebra among suspected osteoporosis patients since the lower T-score of QCT scan might assist in early diagnosis among osteoporotic patients. The additional advantage of QCT is that it can be adopted at already placed common setups of CT/CAT scan in low- or middle-income countries, while DXA scan requires more cost for installation and management. Current study is important for physicians and world health strategic organizations for prioritizing adequate analysis of osteoporosis among suspected patients across the globe.

Keywords: DXA Scan; Osteoporosis; Osteopenia; QCT; Pakistan

Introduction

Osteoporosis refers to weakening of bones (fragile sponge like with numerous pores) predisposing towards increased risk of fracture [1]. Osteoporosis can affect everyone depending on diet, lifestyle and genetic factors. The center of disease control and prevention (CDC) USA revealed that 12.6% of adults over the age of 50 were osteoporotic, and 43% of adults above 50 showed low bone mass (which may turn into osteoporosis, if remained untreated) [2]. Osteoporotic fractures are usually low trauma fractures, which commonly occur with force equivalent or even less than falling from as low as standing height. The quality of person's life can be severely affected due to osteoporosis and dependence on others [3]. Osteoporosis is a silent condition. Since in most of the osteoporotic patient remained undiagnosed till bone fracture or severe disease progression. After 40 years of age, women suffer from reduced bone mineral density, which occur post-menopause due to fall of estrogen level, hence developing osteomalacia, osteopenia, osteoarthritis and other bone related disorders. Osteoporosis is common among Pakistani women [4]. Calcium deficiency is one of the leading health issues and to resolve it, a number of calcium awareness campaigns are running through television advertisements and other social media networking. In Pakistan approximately 97% women aged 75-84 and 55% women aged 40-54 were susceptible to osteoporosis [5]. Even in developed countries where osteoporosis is widely recognized, the practicing pattern of physicians in screening, diagnosing and then treating fragility fractures with focus on osteoporosis needs a lot to be done. Despite of the major advances in diagnostic equipment, due to poor awareness among the general public, a few patients were diagnosed before the onset of the disease [6].

Material and Methods

A cross sectional study was conducted at Islamabad Diagnostic Center on suspected osteoporotic patients during August 2022- October 2022. Effectivity analysis was performed using quantitative computed tomography (QCT) and Dual-energy X-ray absorptiometry (DXA scan) or bone mineral density/ bone density (BMD) test. Pre-test counseling was performed by trained counselors, radiologists and general physicians. All enrolled participants were informed prior to examination and patient's consent was obtained as per standards. The radiological findings were evaluated using internationally approved standardized operating procedures as per recommendations of WHO and

USFDA and potential radiological alterations were examined, using Software installed on CT, GE Optima MR 360 USA (for QCT) and Fan Beam DXA technology, whole body by Hologic, Horizon Bone Densitometry System, MAN 08072-002, USA (for DXA scan).

Results

To examine the osteoporosis among suspected patients, the enrolled participants were independently diagnosed for the quantitative computed tomography (QCT) and Dual-energy X-ray absorptiometry (DXA scan), also called bone mineral density (BMD) or bone density test. Among enrolled participants (20), 66.7% were females and 33.3% were males. The average BMI of males and females were 29.02 and 28.76 respectively. The average QCT-T score were significantly lower among 86.7 % of the participants, in comparison to the average DXA-T score, of the patients under observations. Of note among a few symptomatic suspected osteoporotic patients, who were found normal by DXA scan, the QCT analysis confirmed onset of osteoporosis/ osteopenia. This speculated relatively more sensitivity of QCT towards early diagnosis among suspected osteoporotic patients, which is helpful for early treatment. The analysis of QCT-T score and DXA-T score were comparable among 13.3% of participants. While only 6.67% of the participants revealed higher DXA-T score than QCT-T score. In osteoporotic or osteopenia patients' early treatment onset has major positive benefits in outcome. Overall, the analysis of the QCT-T score data from enrolled participants revealed osteopenia among 93.3% of the subjects, and osteoporosis among 53.3% of the individuals. While the DXA T score analysis on same subjects, at similar positions revealed osteopenia among 60% and osteoporosis among 13.33% of the subjects, as shown in Table 1. The DXA measures bone mineral density of cortical shell and trabecular bone structure, while QCT measures only the inner part, causing lower T-scoring compared to DXA T score. Relying only on DXA T score than QCT might not be a suitable option for several physicians, because the loss of the inner bone among patients (like the termite eating the stem) can be masked by the partial deposition of additional layers of mineral to the outside of cortical layer affecting DXA reading. While the QCT accurately determines critical inner spongy trabecular area, as shown in Figure 1. Therefore, detection via QCT can prevent the sudden collapse of vertebra among suspected osteoporosis patients. The lower T-score of QCT scan might assist in early diagnosis among osteoporotic patients.

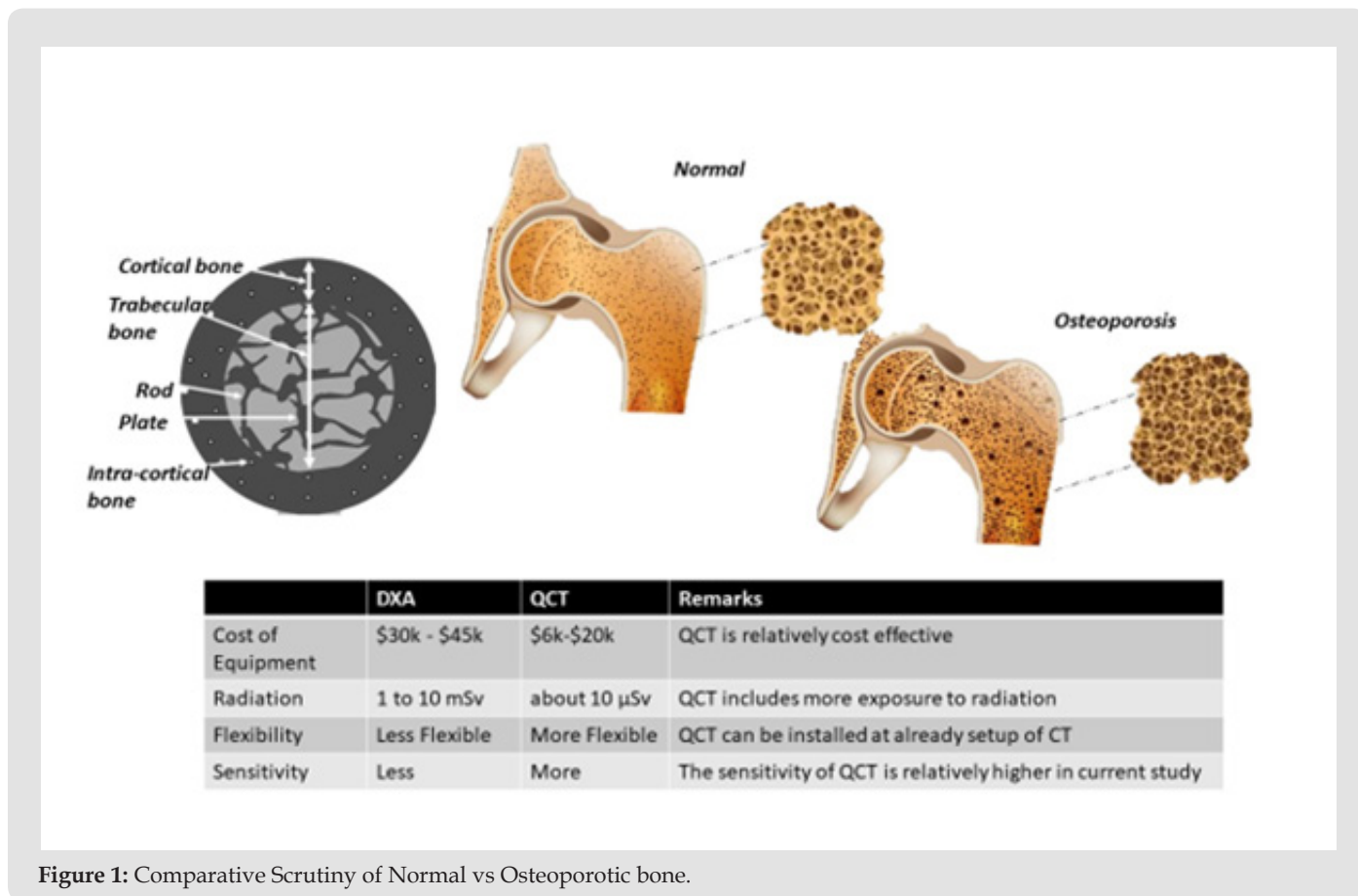


Figure 1: Comparative Scrutiny of Normal vs Osteoporotic bone.

Table 1: Diagnostic evaluation of QCT vs DXA among suspected osteopenia or osteoporosis patients.

Abnormalities	QCT	DXA
Osteopenia	93.3%	60%
Osteoporosis	53.3%	13.33%

Discussion

Although Fan Beam DXA has remained as gold standard for osteoporosis (recommended for >65 years of age typically among those who are suffering from diabetes, taking corticosteroids, or have history of broken bone due to lower impact) which uses low-dose X-rays than QCT to scan the bones (that is, around 1/10th of the radiations of standard Chest X-ray). The QCT based detection is more critical, since it minutely determines the condition of the inner spongy bone of vertebra which is more critical for determining disease severity in real sense [7]. DXA measures the quality of bone in at least two distinct locations in body usually the lower spine and one or both hips. The results of DXA scan are interpreted through standard T score which compares the bone density to that of the age matched subjects [8]. DXA is inexpensive and very low dose of radiations are required for analysis. Through DXA, bone mineral density of both outer shell and inner structure of the bone are monitored, while the QCT usually measures only the inner

part. Majority of the people with osteopenia or osteoporosis can be missed with DXA alone [9]. Herein, from the research analysis conducted on enrolled participants, the average QCT-T score were lower than the DEXA-T scores obtained from same patients at similar regions. Our data showed that 86.7% of the participants were found more prone towards osteopenia or osteoporosis, as per findings from QCT-T score. Careful analysis revealed that in comparison to QCT-T scoring which showed osteoporosis among 53.3% subjects, the DXA- T scoring revealed osteoporosis only among 13.3%. Similarly, the analysis revealed that in comparison to the QCT-T scoring which showed osteopenia among 93.3% of individuals, through DXA analysis the osteopenia was found only among 60% of the individuals. QCT analysis remained reliable for even those cases who were skipped by DXA scan. American Bone Health Fracture Risk Calculator has been designed for the consumers of > 45 years to access the chances of breaking bone in upcoming 10 years [10].

Conclusion

Current study suggests that for the analysis of osteopenia and osteoporosis among the suspected patients, the QCT scan might be more suitable for early diagnosis, accurately determines the inner spongy bone and more convenient than DXA, since QCT can be adopted at already placed common setups of CT/CAT scan, however DXA scan requires more cost for installation and management. It can be inferred that for general screening of the disease DXA can be used, however for the accurate diagnosis of clinically suspected patients, where DXA is not corresponding, the QCT based analysis is preferred. Current study is important for physicians and world health strategic organizations. Furthermore, it would be critical to determine the impact of multiple drugs on patients post diagnosis through QCT and DXA scoring in future. Also, this study would further open doors of clinical investigations among patients with comorbidities like diabetes and deficiency of vitamins.

Conflict of Interests

The authors declare that they have no conflict of interests.

References

1. Miller PD (2016) Management of severe osteoporosis. *Expert Opin Pharmacother* 17(4): 473-488.
2. (2022) Center of Disease Control and Prevention, USA. Osteoporosis.
3. Srivastava M, Deal C (2002) Osteoporosis in elderly: prevention and treatment. *Clin Geriatr Med* 18(3): 529-555.
4. Rahman R, Usman A, Sheikh A, Baig R (2021) Biomarkers for Impending Risk of Osteoporosis in Premenopausal Women. *J Coll Physicians Surg Pak* 31(8): 910-915.
5. Khan AH, Jafri L, Ahmed S, Noordin S (2018) Osteoporosis and its perspective in Pakistan: A review of evidence and issues for addressing fragility fractures. *Ann Med Surg (Lond)* 29: 19-25.
6. Sabzwari S, Fatmi Z, Khan AA (2020) Elderly musculoskeletal disease burden in Karachi, Pakistan: Associations and implications for developing countries. *Aging Med (Milton)* 4(1): 19-25.
7. Milisic L, Vegar-Zubovic S, Valjevac A, Hasanovic-Vučković S (2020) Bone Mineral Density Assessment by DXA vs. QCT in Postmenopausal Females with Central Obesity. *Curr Aging Sci* 13(2): 153-161.
8. Malekzadeh M, Asadi M, Abbasi-Rad S, Abolghasemi J, Hamidi Z, et al. (2019) MDCT-QCT, QUS, and DXA in healthy adults: An intermodality comparison. *Med J Islam Repub Iran* 33: 156.
9. Chewakidakarn C, Yuenyongviwat V (2021) Comparison of Bone Mineral Density at Hip and Lumbar Spine in Patients with Femoral Neck Fractures and Pertrochanteric Fractures. *Ortop Traumatol Rehabil* 23(1): 45-49.
10. Luo Y, Yang H (2019) Comparison of femur stiffness measured from DXA and QCT for assessment of hip fracture risk. *J Bone Miner Metab* 37(2): 342-350.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2023.48.007609

Rizwan Uppal, Umar Saeed. *Biomed J Sci & Tech Res*



This work is licensed under Creative Commons Attribution 4.0 License

Submission Link: <https://biomedres.us/submit-manuscript.php>



Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles

<https://biomedres.us/>