Sudan University of Sciences and Technology

College of Graduate Studies

Evaluation of Bone Density using DEXA Scan

تقييم كثافة العظام بإستخدام جهازدكسا

A thesis Submitted for Partial Requirement of the MSc Degree in

Diagnostic Radiologic Technology

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Dedication

I dedicate my research to my Father who taught me and drove me to where I am now. My mother, my family, and friends for their immense support and guidance.

ACKNOWLEDGMENTS

I thanks Sheikh Khalifa Bin Zayed Hospital Ajman, Radiology Department (UAE) for assisting me in the completion of my Master Thesis, MY Supervisor: Dr. Mohamed Mohamed Omer Mohamed Yousef and friends for their immense support and guidance.

ABSTRACT

The main objectives of bones density assessment using theDEXA scanner.

The study subjected 50 patients, 45 females and 5 males to DEXA examination for the spine and hip joints. Researcher found that results of 18 patients were negative, 11 patients suffered from osteopenia and 16 patients from osteoporosis.

On the other hand, the results of 5 male patients showed that the results of 2 patients were normal, while 2 patients suffered from osteopenia and 1 from osteoporosis.

The results of the study showed that the results of 40% of the patients were normal, 34% were diagnosed with osteoporosis and 26% with osteopenia. The study found the females were more affected by osteoporosis than males.

المستخلص

الاهداف الرئيسية لتقييم كثافةالعظام باستخدام الماسح الضوئي ديكسا

اخضعت الدراسة 50 مريضا، 45 انثي و 5 ذكور للفحصباستخدام ديكسا عن العمود الفقر ي ومفاصل الورك. ووجد الباحث ان نتيجة 18 مريضا كانت سلبية، في حين عاني 11 مريضا من قلة كثافة العظام و 16 مريضا من هشاشة العظام . من ناحية اخري ، اظهرت نتائج 5 مرضي من الذكور ان نتائج 2 ممن خضعوا للفحص كانت طبيعية بينما عاني مريضان (2) من قلة كثافة العظام ومريض (1) اخر من هشاشة العظام.

وخلصت الدراسة الي ان النتائج الماخوذة من المسح الذي اجري علي المرضي الذكور والاناث اظهرت ان (40% من المرضي كانت نتائج فحوصاتهم طبيعية ، و 34% تم تشخيصهم بهشاشة العظام و 26% من قلة العظام) .

ووجد الباحث انا الاناث اكثر تضررا من هشاشة العظام من الذكور.

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Abbreviation

US	ultrasound
DEXA	Dual-energy X-ray absorptiometry
P-DXA	Peripheral dual-energy X-ray absorptiometry
WHO	World Health Organization
ISCD	International Society for Clinical Densitometry
IOF	International Osteoporosis Foundation
SXA	single-energy x-ray absorptiometry
DPA	Dual photon absorptiometry
SPA	Single photon absorptiometry
OST	osteoporosis self-assessment tool
ROI	region of interest
VFA	vertebral fracture assessment
BMC	bone mineral content

Chapter One

Introduction

Chapter One

1.1. Introduction

Bone densitometry is used to measure the bone mineral content and density. This measurement can indicate decreased bone mass, a condition in which bones are more brittle and more prone to break or fracture easily. Bone densitometry is used primarily to diagnose osteoporosis and to determine fracture risk. The testing procedure measures the bone density of the bones of the spine, pelvis, lower arm, and thigh.Bone densitometry testing may be done using X-rays, dual-energy X-ray absorptiometry (DEXA or DXA) or by quantitative CT scanning using special software to determine bone density of the hip or spine. These procedures are generally done in a clinic, hospital, or free-standing radiology facility. (Postgrad‹2007)

However, for mass screening purposes, there are portable types of bone densitometry testing. The portable testing is done using either a DEXA (or DXA) X-ray device or a quantitative ultrasound unit. Both types of portable testing may use the radius (one of the two bones of the lower arm), wrist, fingers, or heel for testing. The portable testing, while useful for general screening, is not as precise as the nonportable methods because only one bone site is tested.Standard X-rays may detect weakened bones. However, at the point where bone weakness is obvious on standard X-rays, the bone weakness may be too far advanced for treatment to be effective. Bone densitometry testing can determine decreasing bone density and strength at a much earlier stage when treatment of the bone weakness can be beneficial.

Bone density scanning, also called dual-energy x-ray absorptiometry (DXA) or bone densitometry, is an enhanced form of x-ray technology that is used to measure bone loss. DXA is today's established standard for measuring bone mineral density (BMD).An x-ray (radiograph) is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body. X-rays are the oldest and most frequently used form of medical imaging. (Postgrad،2007)

DXA is most often performed on the lower spine and hips. In children and some adults, the whole body is sometimes scanned. Peripheral devices that use x-ray or ultrasound are sometimes used to screen for low bone mass. In some communities, a CT scan with special software can also be used to diagnose or monitor low bone mass (QCT). This is accurate but less commonly used than DXA scanning. Osteoporosis is a systemic skeletal disease characterized by low bone density and micro-architectural bone tissue deterioration with a consequent increase in bone fragility Approximately 100 million people are affected by osteoporosis worldwide, mostly women in menopause In 2008, about 40% of women in Korea were reported to have osteoporosis As the older age groups in population increase due to an increase of life expectancy, the socioeconomic burden of this disease increases, particularly as bone fracture risk increases four- to six-fold among those with osteoporosis Dual-energy X-ray absorptiometry (DXA), the gold standard for bone mineral density quantification, has become a routine screening in modern medical practice.Measuring bone mineral density by using quantitative computed tomography (CT) was suggested in the 1970. However, shortcomings such as the requirements for a high dose

of ionizing radiation and a relatively long scanning time and introduction of DXA, resulted in quantitative CT usage being confined to musculoskeletal research fields despite its early introduction and accuracy. Recently, diagnostic imaging technology has been advancing rapidly, and the use of CT has been remarkably increasing in clinical fields, both in extent and numbers.

DXA is most often used to diagnose osteoporosis, a condition that often affects women after menopause but may also be found in men and rarely in children. Osteoporosis involves a gradual loss of calcium, as well as structural changes, causing the bones to become thinner, more fragile and more likely to break.DXA is also effective in tracking the effects of treatment for osteoporosis and other conditions that cause bone loss.The DXA test can also access an individual's risk for developing fractures. The risk of fracture is affected by age, body weight, history of prior fracture, family history of osteoporotic fractures and life style issues such as cigarette smoking and excessive alcohol consumption. These factors are taken into consideration when deciding if a patient needs therapy.

1.2. Problem of the Study:

Increasing number of Osteoporotic fractures.

1.3. Objectivesof the Study:

1.3.1.General objective:

Early dedication of low bone density patients.

1.3.2. Specific objectives:

1. Prevent Osteoporotic Fractures.

1.3. Overview of the study:

This study was consisted of five chapters; chapter one was include a general introduction, which consists of:An introduction, the objectives of the research, problem of the study, significant of the study and overview of the study. Chapter two:was a literature review which contain general theoretical background and previous study. Chapter three;it deal with the material & methods, Chapter four was the result presentation, Chapter five:Deal with the discussion, conclusion & recommendation in addition to reference and appendices

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Theoretical back ground

2.1.1 Bone Density:

A bone density test measures the density of minerals (such as calcium) in your bones using a special X-ray. This information is used to estimate the strength of your bones. We all lose some bone mass as we age. Bones naturally become thinner (called osteopenia) as you grow older, because existing bone is broken down faster than new bone is made. As this occurs, our bones lose calcium and other minerals and become lighter, less dense, and more porous. This makes the bones weaker and increases the chance that they might break (fracture). Osteoporosis is a condition that is characterized by bones that are less dense than, and thus not as strong as, normal bone. (Kanis J1994‹‹) Osteoporosis increases the risk of breaking a bone with even minor trauma, such as a fall from standing height, or even from a cough or sneeze. In order to understand the role of bone mineral density scanning, it is important to know a little about how osteoporosis occurs. Bone is constantly being remodeled. This is the natural, healthy state of continuous uptake of old bone (resorption) followed by the deposit of new bone. This turnover is important in keeping bones healthy and in repairing any minor damage that may occur with wear and tear. The cells that lay new bone down is called osteoblasts, and the cells responsible for resorption of old bone are called osteoclasts. Osteoporosis occurs as a result of a mismatch between osteoclast and osteoblast activity. This mismatch can be caused by many different disease states or hormonal changes. It is also commonly a result of aging,

change in normal hormones as occurs after menopause, and with diets low in calcium and vitamin D. In osteoporosis, osteoclasts outperform osteoblasts so that more bone is taken up than is laid down. The result is a thinning of the bone with an accompanying loss in bone strength and a greater risk of fracture. A thinning bone results in a lower bone density or bone mass. There are two major types of bone. Cancellous bone (also known as trabecular bone) is the inner, softer portion of the bone, and cortical bone is the outer, harder layer of bone. Cancellous bone undergoes turnover at a faster rate than cortical bone. As a result, if osteoclast and osteoblast activity become mismatched, cancellous bone is affected more rapidly than cortical bone. Certain areas in the body have a higher ratio of cancellous bone to cortical bone such as the spine (vertebrae), the wrist (distal radius), and the hips (femoral neck). Most of a person's bone mass is achieved by early adulthood. After that time, the bone mass gradually declines throughout the rest of a person's life. There is a normal rate of decline in bone mass with age in both men and women. For women, in addition to age, the menopause transition itself causes an extra degree of bone loss. This bone loss is greatest in the first three to six years after menopause. Women can lose up to 20% of the total bone mass during this time. Since women generally have a lower bone mass to begin with in comparison with men, the ultimate result is a higher risk of fracture in postmenopausal women as compared to men of the same age.

The absolute amount of bone as measured by bone mineral density (BMD) testing generally correlates with bone strength and its ability to bear weight. The BMD is measured with a dual energy X-ray absorptiometry test (referred to as a DXA scan). By measuring BMD, it is possible to predict fracture risk .It is important to remember that BMD testing cannot predict

the certainty of developing a fracture. The World Health Organization has developed definitions for low bone mass (osteopenia) and osteoporosis. These definitions are based on a T-score. The T-score is a measure of how dense a patient's bone is compared to a normal, healthy 30-year-old adult.

Normal: A bone BMD is considered normal if the T-score is within 1 standard deviation of the normal young adult value. Thus a T-score between 0 and -1 is considered a normal result. A T-score below -1 is considered an abnormal result.Low bone mass (medically termed osteopenia): A BMD defines osteopenia as a T-score between -1 and -2.5. This signifies an increased fracture risk but does not meet the criteria for osteoporosis.

Osteoporosis: A BMD greater than 2.5 standard deviations from the normal (T score less than or equal to -2.5) defines osteoporosis. Based on the above criteria, it is estimated that 40% of all postmenopausal Caucasian women have osteopenia and that an additional 7% have osteoporosis.Determining a person's BMD helps a doctor decide if a person is at increased risk for osteoporosis-related fracture. The purpose of BMD testing is to help predict the risk of future fracture so that the treatment program can be optimized. With further bone loss, osteopenia leads to osteoporosis. So the thicker your bones are, the longer it takes to get osteoporosis. Although osteoporosis can occur in men, it is most common in women older than age 65. If your bone density is lower than normal, you can increase bone density and strength by exercising, lifting weights or using weight machines,getting enough calcium and vitamin D, and taking certain medicines.

*Ways to measure bone density:*Dual-energy X-ray absorptiometry (DXA). This is the most accurate way to measure bone density. It uses two different X-ray beams to estimate bone density in your spine and hip. Strong, dense bones allow less of the X-ray beam to pass through them. The

amounts of each X-ray beam that are blocked by bone and soft tissue are compared to each other. DXA can measure as little as 2% of bone loss per year. It is fast and uses very low doses of radiation. Single-energy X-ray absorptiometry (SXA) may be used to measure heel and forearm bone density, but SXA is not used as often as DXA, Peripheral dual-energy X-ray absorptiometry (P-DXA). P-DXA is a type of DXA test. It measures the density of bones in the arms or legs, such as the wrist. It can't measure the density of the bones most likely to break, such as the hip and spine. P-DXA machines are portable units that can be used in a doctor's office. P-DXA also uses very low doses of radiation, and the results are ready faster than standard DXA measurements. P-DXA is not as useful as DXA for finding out how well medicine used to treat osteoporosis is working, and dual photon absorptiometry (DPA). This test uses a radioactive substance to measure bone density. It can measure bone density in your hip and spine. DPA also uses very low doses of radiation but has a slower scan time than the other methods.

Bone density (or bonemineral density) is a medical term normally referring to the amount of mineral matter per square centimeter of bones. Bone density (or BMD) is used in clinical medicine as an indirect indicator of osteoporosis and fracture risk. This medical bone density is not the true physical "density" of the bone, which would be computed as mass per volume. It is measured by a procedure called *densitometry*, often performed in the radiology or nuclear medicine departments of hospitals or clinics. The measurement is painless and non-invasive and involves low radiationexposure. Measurements are most commonly made over the lumbar spine and over the upper part of the hip. The forearm may be scanned if the hip and lumbar spine are not accessible. There is

a statistical association between poor bone density and higher probability of fracture. Fractures of the legs and pelvis due to falls are a significant public healthproblem, especially in elderly women, leading to much medical cost, inability to live independently, and even risk of death. Bone density measurements are used to screen people for osteoporosis risk and to identify those who might benefit from measures to improve bone strength.

Bone density tests are not necessary for people without risk factors for weak bones. Unnecessary testing is more likely to result in superfluous treatment rather than discovery of a true problem

Indications for testing:

The following are risk factors for low bone density and primary considerations for the need for a bone density test: females age 65, males age 70 and people over age 50 with any of the following:previous bone fracture from minor trauma, rheumatoid arthritis, low body weight and a parent with a hip fracture. Individuals with vertebral abnormalities, Individuals receiving, or planning to receive, long-term glucocorticoid (steroid) therapy. Individuals with primary hyperparathyroidism, Individuals being monitored to assess the response or efficacy of an approved osteoporosis drug therapy and individuals with a history of eating disorders.

Other considerations which related to risk of low bone density and the need for a test include smoking habits, drinking habits, the long-term use of corticosteroid drugs, and a vitamin D deficiency. (J.Clin. Densitom. 2004)

Over testing and treatment

For those people who do have bone density tests, two conditions which may be detected are osteoporosis and osteopenia. The usual response to either of these indications is consultation with a physician.

*Results are often reported in 3 terms:*Measured areal density in g cm^{-2}, z-score, and the number of standard deviations above or below the mean for the patient's age, sex and ethnicity and t-score, the number of standard deviations above or below the mean for a healthy 30 year old adult of the same sex and ethnicity as the patient.

Types of tests:

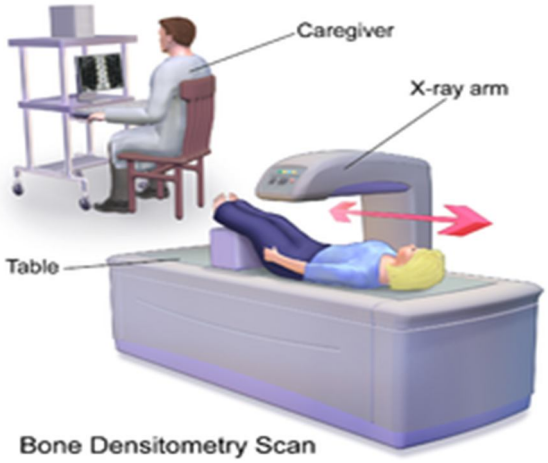


Figure 2.1

Illustrates Bone Densitometry Scan

While there are many different types of BMD tests, all are non-invasive. Most tests differ in which bones are measured to determine the BMD result. These tests include:Dual-energy X-ray absorptiometry (DXA or DEXA), Quantitative computed tomography (QCT), Qualitative ultrasound (QUS), Single photon absorptiometry (SPA), Dual photon absorptiometry (DPA),

Digital X-ray radiogrammetry (DXR), and Single energy X-ray absorptiometry (SEXA). (Wikipedia.org)

DEXA is currently the most widely used, but ultrasound has been described as a more cost-effective approach to measure bone density. The test works by measuring a specific bone or bones, usually the spine, hip, and wrist. The density of these bones is then compared with an average index based on age, sex, and size. The resulting comparison is used to determine risk for fractures and the stage of osteoporosis in an individual.Average bone mineral density = BMC / W [g/cm^2]: BMC = bone mineral content = g/cm, W = width at the scanned line. (Wikipedia.org)

Interpretation:

Results are generally scored by two measures, the T-score and the Z-score. Scores indicate the amount one's bone mineral density varies from the mean. Negative scores indicate lower bone density, and positive scores indicate higher. T-score, The T-score is the relevant measure when screening for osteoporosis. It is the bone mineral density (BMD) at the site when compared to the young normal reference mean. It is a comparison of a patient's BMD to that of a healthy thirty-year-old. The US standard is to use data for a thirty-year-old of the same sex and ethnicity, but the WHO recommends using data for a thirty-year-old white female for everyone. Values for thirty-year-olds are used in post-menopausal women and men over age 50 because they better predict risk of future fracture. The criteria of the World Health Organization are: Normal is a T-score of −1.0 or higher, Osteopenia is defined as between −1.0 and −2.5, and Osteoporosis is defined as −2.5 or lower, meaning a bone density that is two and a half standard deviations below the mean of a thirty-year-old man/woman.(Wikipedia.org).

Hip fractures per 1000 patient-years			
WHO category	Age 50–64	Age > 64	Overall
Normal	5.3	9.4	6.6
Osteopenia	11.4	19.6	15.7
Osteoporosis	22.4	46.6	40.6

Z-score

The Z-score is the comparison to the age-matched normal and is usually used in cases of severe osteoporosis. This is the number of standard deviations a patient's BMD differs from the average BMD of their age, sex, and ethnicity. This value is used in premenopausal women, men under the age of 50, and in children.(Post grad Med. 2007)

It is most useful when the score is less than 2 standard deviations below this normal. In this setting, it is helpful to scrutinize for coexisting illnesses that may contribute to osteoporosis such as glucocorticoid therapy, hyperparathyroidism,oralcoholism

.(Wiki/Bone density)

Limitations:

Use of BMD has several limitations: Measurement can be affected by the size of the patient, the thickness of tissue overlying the bone, and other factors extraneous to the bones, Bone density is a proxy measurement for

bone strength, which is the resistance to fracture and the truly significant characteristic. Although the two are usually related, there are some circumstances in which bone density is a poorer indicator of bone strength, Reference standards for some populations (e.g., children) are unavailable for many of the methods used and Crushed vertebrae can result in falsely high bone density so must be excluded from analysis

Bone Density Risks

During a bone density scan, you are exposed to a very low dose of radiation. A bone density scan is not recommended for pregnant women because of the radiation exposure to the unborn baby.

Results:

A bone density test measures the density of minerals (such as calcium) in your bones using a special X-ray. Results are usually available in 2 to 3 days.Results of bone density tests can be reported in several ways.

T-score

Your T-score is your bone density compared to the average score of a healthy 30-year-old. It is expressed as a standard deviation (SD), which is a statistical measure of how closely each person in a group is to the average (mean) of the group. The average bone density is determined by measuring the bone density of a large group of healthy 30-year-olds (young adult reference range). Bone density values are then reported as a standard deviation from the mean of this reference group. Almost all 30-year-old people have a bone density value within 2 standard deviations of this mean.

A negative (–) value means that you have thinner bones (lower bone density) than an average 30-year-old. The more negative the number is, the less bone density you have compared with an average 30-year-old, a positive (+) value means that your bones are thicker and stronger than an average 30-year-old.

The following table contains the World Health Organization's definitions of osteoporosis based on bone density T-scores.

T-score

Your T-score is your bone density compared with what is normally expected in a healthy young adult of your sex. Your T-score is the number of units — called standard deviations — that your bone density is above or below the average.

T-score	What your score means
-1 and above	Your bone density is considered normal.
Between -1 and -2.5	Your score is a sign of osteopenia, a condition in which bone density is below normal and may lead to osteoporosis.
-2.5 and below	Your bone density indicates you likely have osteoporosis.

Z-score

Your Z-score is the number of standard deviations above or below what's normally expected for someone of your age, sex, weight, and ethnic or racial origin. If your Z-score is -2 or lower, it may suggest that something other

than aging is causing abnormal bone loss. If your doctor can identify the underlying problem, that condition can often be treated and the bone loss slowed or stopped.

Bone density	
	T-score
Normal:	Less than 1 standard deviation (SD) below the young adult reference range (more than –1)
Low bone mass (osteopenia):	1 to 2.5 SDs below the young adult reference range (–1 to –2.5)
Osteoporosis:	More than 2.5 SDs below the young adult reference range (–2.5 or less)

If your bone density test result is low:You may have osteoporosis. Doctors usually use the lowest T-score to diagnose osteoporosis. For example, if your T-score at your spine is –3 and your T-score at your hip is –2, the spine T-score would be used to diagnosis osteoporosis, you have a higher-than-average chance of breaking a bone. The more negative your T-score, the greater your chances of breaking a bone during a fall or from a minor injury. Every change of 1 SD means a twofold increase in the risk of fracture at that

site. For example, if you have a T-score of –1, your chances of having a broken bone are 2 times greater than if you're T-score was 0.

Low bone density values may be caused by other problems, including:

Taking certain medicines.‹Cancer, such as multiple myeloma‹Cushing's syndrome, hyperthyroidism, or hyperparathyroidism‹Diseases of the spine, such as ankylosing spondylitis‹Premature menopause and Vitamin D deficiency. • (Christiansen 1995)

Z-score

Your bone density value may also be compared to other people of your age, sex, and race. This is called your Z-score. It is given in standard deviations (SD) from the average value for your age group: A negative (–) value means that your bones are thinner (lower bone density) and weaker than most people in your age group. The more negative the number is, the less bone density you have compared with others in your age group, a positive (+) value means that your bones are thicker and stronger than most people in your age group.

What Affects the Test:

Reasons you may not be able to have the bone density test or why the results may not be helpful include:Inability to be correctly positioned during the test, having a broken bone in the past. This can cause falsely high bone density results, Arthritis of your spine. In this case, the changes caused by arthritis in the spine may not make the spine the best place to measure for osteoporosis, Metal implants from hip replacement surgery or hip fracture, having an X-ray test that uses barium within 10 days of the bone density test, Experts disagree about which bones are best to use for bone density measurements. Bones in the lower spine and hip are tested most often. These bones generally havethe most bone loss and are more likely to

fracture. Sometimes bones in the wrist are measured. Ultrasound screening is done on the bone in the heel, a bone density measurement should be done only when the information provided by the test will affect treatment decisions. Bone density does not need to be measured more often than every 2 years to find out how well treatment is working, Using DXA to measure bone density is replacing older methods, such as dual photon absorptiometry (DPA), Regular X-rays cannot detect mild bone loss. A bone must lose at least a quarter of its weight before a regular X-ray can detect the problem and If your bone density is lower than normal, you can increase bone density and strength by exercising, lifting weights or using weight machines, getting enough calcium and vitamin D, and taking some medicines.

Previous studies:

- Kanis J. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: synopsis of a WHO report. WHO Study Group. *Osteoporos Int* 1994*;*4*:*368-81.
- Writing Group for the ISCD Position Development Conference. Indications and reporting for dual-energy x-ray absorptiometry. *J Clin Densitom* 2004*;*7*:*37-
- Fundamentals and pitfalls of bone densitometry using dual-energy X-ray absorptiometry (DXA).*Osteoporos Int* 2004*;*15*:*847-54.

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

1.1 Materials:

3.1.1DEXA Scan Machine:-

OSTEOCORE 3, MEDILINK:-modelosteocore 3, scan parameters BMD; BMC; fat, lean, calcic mass; areas, overall, regional body composition, power needed, VAC, Hz (test capability) 100/110, 50/60, 20a; 220/240, 50/60, 10a, dimensions (HXWXD) cm, (in) (display), scanner table (dimensions (hxwxd) cm, (in)) 260 x 130 (102.4 x 51.2), weight, kg (lb) (display), accuracy; hip (accuracy) 1.5/5 USV, AP spine (accuracy)1.3/8 USV, active scan area, cm (dimensions (HXWXD) cm, (in)), 20 x 20 multisite, 200 x 65 total body, printer (external beam), professional HP DESKJET, duration of scan,min (software) 1.5 sec spine AP, hip, forearm; 1 HFC (hip flash comparison), 3 whole body.

DEXA T-scores were obtained from the bilateral femoral necks and lumber spine and averaged. Giving each patient an overall T-scores value.

3.1.2 Study Population:-

This is a retrospective study reviewing 50 patients (45 adult women and 5 men) that were older than forty-years of age from UAE at Sheikh Khalifa Bin Zayed Hospital Ajman.This study was performed within 6 months. Patients who underwent prior spinal or hip surgeries or had invalid DEXA results due to spinal degeneration, fracture

3.2. Methods:

3.2.1 Technique Used:

The main purpose of the DXA scan image is to check if the patient is positioned correctly, something that the technologist must determine before the patient leaves the testing center. Positioning should also be doublechecked by the clinician who interprets the test.7 there are many available resources for BMD technologists and physicians training, such as ISCD or International Osteoporosis Foundation (IOF) courses.A scan with correct positioning of the spine is shown in Figure 1a the patient is straight on the table (spine is straight on the image), not rotated (spinous processes are centered), and centered in the field (roughly equal soft tissue fields on either side of the spine). Patients with scoliosis cannot be positioned with the spine straight on the table; moreover with severe scoliosis degenerative changes can occur that invalidate the spine measurement. The scan should extend up sufficiently far to include part of the lowest vertebra with ribs (which is usually T12) and low enough to show the pelvic brim (which is usually the level of the L4–L5 interspace). Most testing centers will elevate the patient's knees with a foam block (hip at a 90° angle to the spine) to try to partially flatten the normal lumbar lordosis. For proper positioning of the hip, the patient should have the femur straight on the table (shaft parallel to the edge of the picture), with 15–25° of internal rotation, which can be achieved by the use of positioning devices. Internal rotation may be improved by having the patient flex the foot before doing the internal rotation, and then relaxing the foot after the strap is in place. This amount of internal rotation presents the long axis of the femoral neck perpendicular to the X-ray beam, providing the greatest area and the lowest BMC (and the

lowest BMD), and is confirmed on the scan by seeing little or none of the lesser trochanter (Figure 1b) If the desired amount of internal rotation cannot be achieved, as is often the case in patients with hip arthritis or short femoral necks, the technologist should place the patient comfortably in a position that is likely to be reproducible in a subsequent scan.

3.2.2 Interpretation:

Results are generally scored by two measures, the T-score and the Z-score. Scores indicate the amount one's bone mineral density varies from the mean. Negative scores indicate lower bone density, and positive scores indicate higher. T-score, The T-score is the relevant measure when screening for osteoporosis. It is the bone mineral density (BMD) at the site when compared to the young normal reference mean. It is a comparison of a patient's BMD to that of a healthy thirty-year-old. The US standard is to use data for a thirty-year-old of the same sex and ethnicity, but the WHO recommends using data for a thirty-year-old white female for everyone. Values for thirty-year-olds are used in post-menopausal women and men over age 50 because they better predict risk of future fracture. The criteria of the World Health Organization are: Normal is a T-score of -1.0 or higher, Osteopenia is defined as between -1.0 and -2.5, and Osteoporosis

is defined as −2.5 or lower, meaning a bone density that is two and a half standard deviations below the mean of a thirty-year-old man/woman.

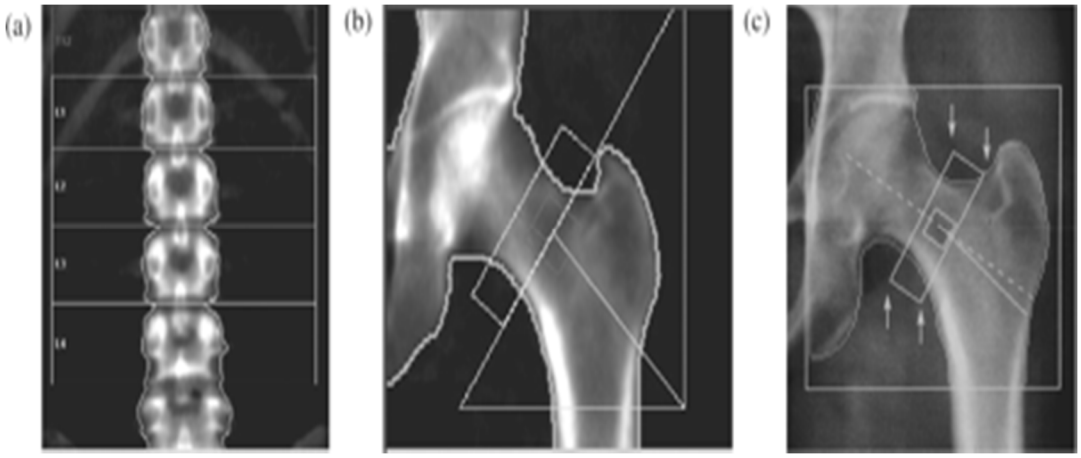


Figure 1

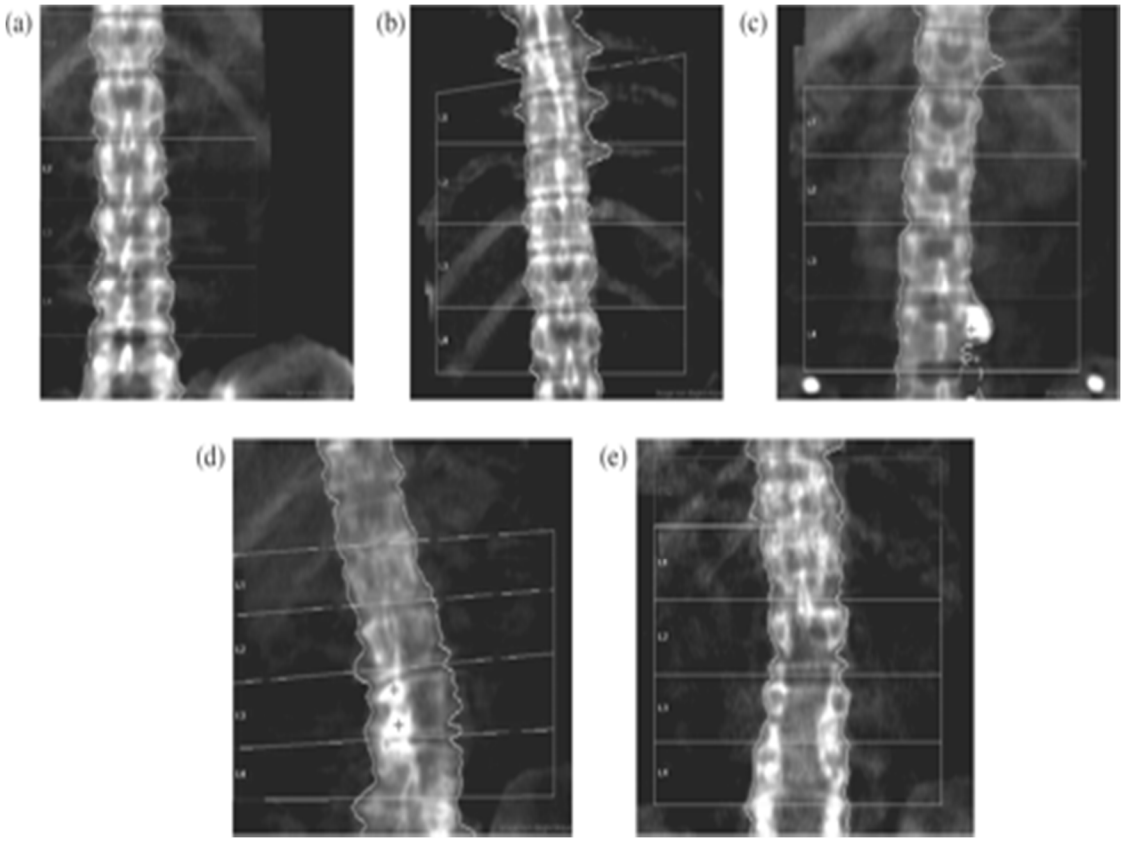


Figure 2.

Examples among some common spine scanning problems: a the spine is too close to the right side of the image b Vertebral levels are mis-identified c Metal button over L4 d Scoliosis and osteophyte at L3–L4 e Laminectomy.

Finally, physicians must keep in mind to actively look for secondary osteoporosis in front of low BMD value, either by thorough history taking or with biochemical studies before stating about postmenopausal osteoporosis.

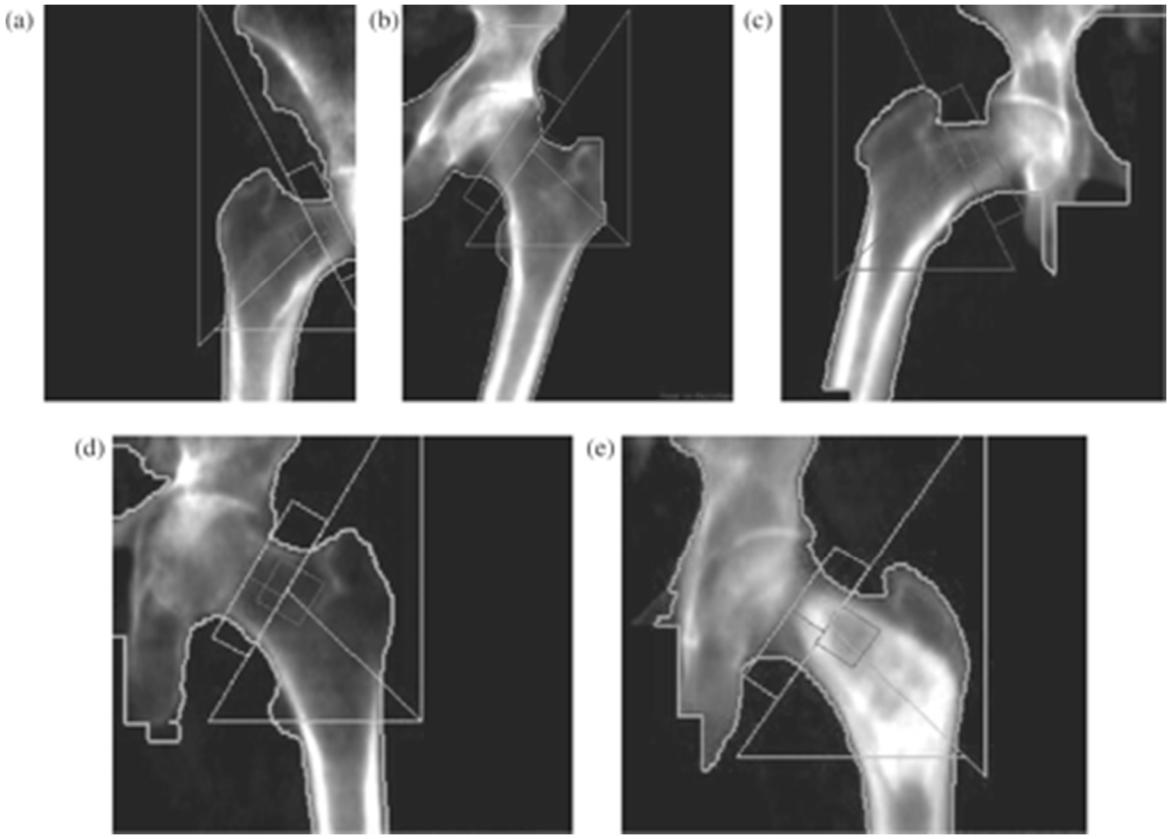


Figure 3.

Examples among some common hip scanning problems: a The scan did not go far enough laterally and part of the femoral head is missing b The femur is adducted the femur is abducted d Suboptimal internal rotation (too much of the lesser trochanter is showing) e Abnormal bone (history of hip fracture and osteosynthesis).

3.2.3 Data Analysis:

- SPSS
- MICROSOFT EXCEL 2007

Chapter four

Results

Chapter four

Results

Table (4.1) Demonstrates Age Group:

Age groups	Frequency	Percent
30-39	1	2.0
40-49	4	8.0
50-59	14	28.0
60-69	17	34.0
70-79	10	20.0
80-90	4	8.0
Total	50	100.0

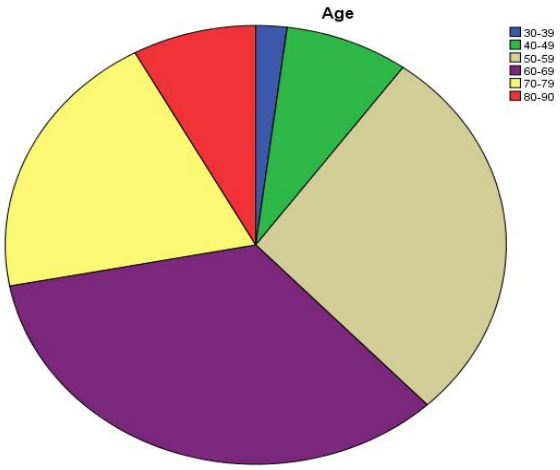


Figure (4.1) Shows Age Group

Table (4.2) Demonstrates Gender Distribution:

Gender	Frequency	Percent
female	45	90.0
male	5	10.0
Total	50	100.0

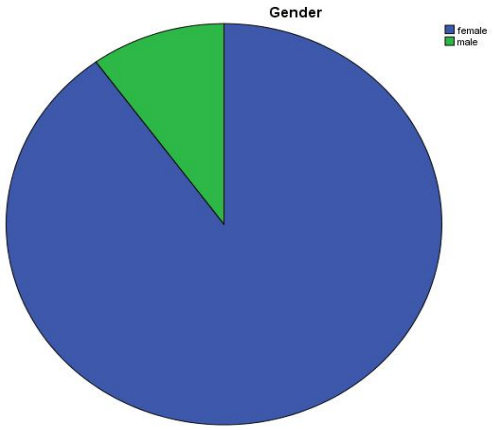


Figure (4.2) Demonstrates Gender Distribution

Table (4.3) Demonstratesby BMD Results

Result	Frequency	Percent
normal	20	40.0
osteoporosis	17	34.0
osteopenia	13	26.0
Total	50	100.0

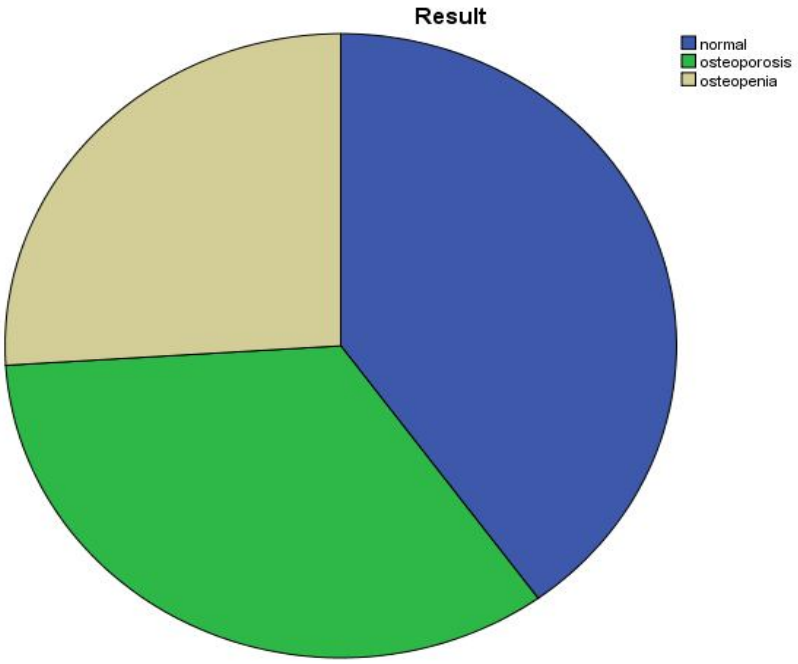
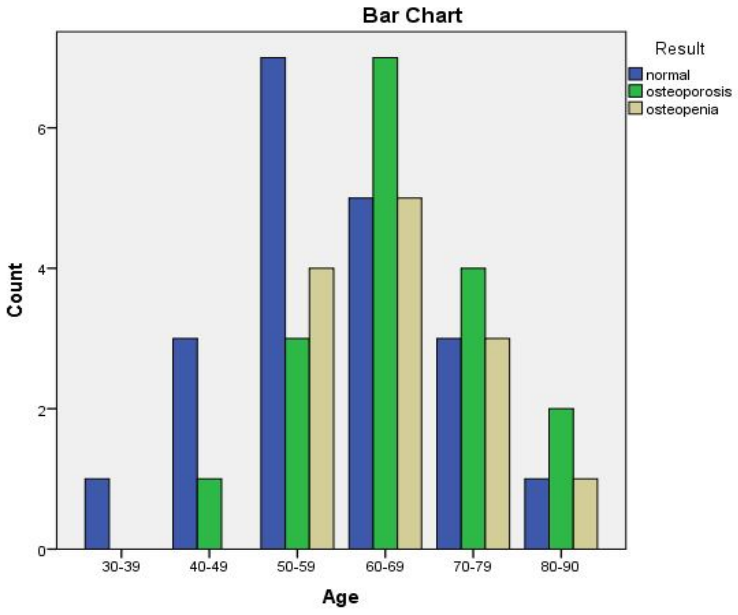
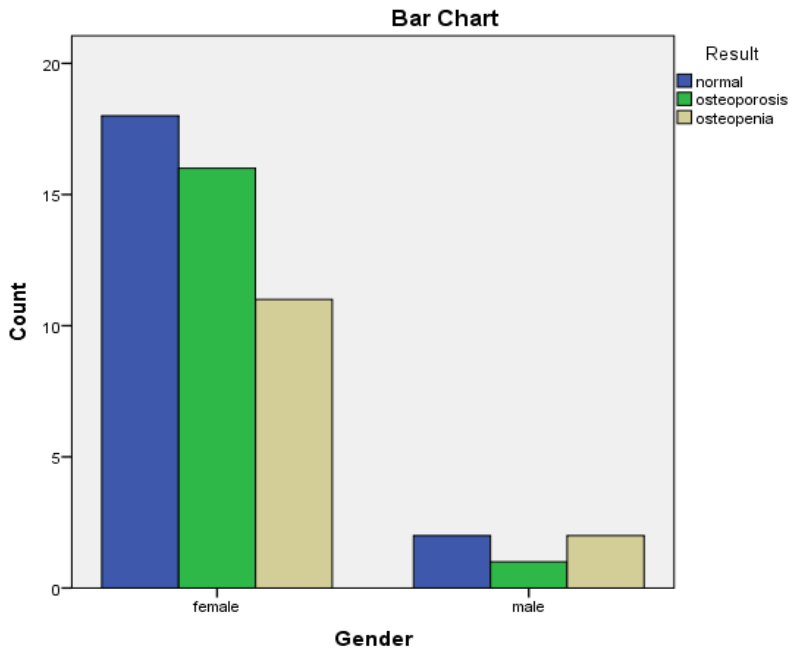


Figure (4.3) Demonstrates by BMD Results

Age * Result		Result			Total
		normal	osteoporosis	osteopenia	
Age	30-39	1	0	0	1
	40-49	3	1	0	4
	50-59	7	3	4	14
	60-69	5	7	5	17
	70-79	3	4	3	10
	80-90	1	2	1	4
Total		20	17	13	50
Correlation is significant at p<0.05, p= 0.758					



Gender * Result		Result			Total
		normal	osteoporosis	osteopenia	
Gender	female	18	16	11	45
	male	2	1	2	5
Total		20	17	13	50
Correlation is significant at p<0.05, p= 0.691					



Chapter Five

Discussion, Conclusion and Recommendation

Chapter Five

Discussion, Conclusionand Recommendation

5.1 Discussion:

"Results of a DXA scan

The results of the scan are given as a T-score. This is a measure of how your bone density compares with the normal average for young, healthy adults.

A T-score of between 0 and -1 means your bone density is normal.

If your T-score is between -1 and -2.5, you’re classed as having osteopenia. This means your bone density is lower than normal, but you don't yet have osteoporosis.

A T-score below -2.5 is classed as osteoporosis.

If your T-score indicates that you may have osteopenia or osteoporosis, your GP will give you advice about treatment options. You may be referred to see a specialist, such as a rheumatologist. Your GP will consider both the T-score and other risk factors when he or she gives you advice about treatment to help prevent fractures."

5.2 Conclusion:

In conclusion:-

This study based on randomized patients sample referred from Orthopedic clinic to Radiology department for BMD study found the percentage of osteoporosis in female is 35.5%(16 out of 45 females) compared to males 20% (1 out of 5 males) in mean age group of 60 years old .

According to the result 40% showed normal diagnosis, 34% were diagnosed with osteoporosis and 26% were osteopenia.

The study found the females were more affected by osteoporosis than males.

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5.3 Recommendation

BMD Testing Recommendations

1-Patients at mean age of 60 years old need BMD study every 2 years to discover any changed in Bone density as early as possible to avoid osteoporotic fractures.

2-Patients at mean age of 60 years old who complain from back pain or hip pain need to be evaluated by Dexa scan.

3- Bone density needed to be evaluated in larger scale of patients for better understanding of possible complications and side effects that may happen.

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Appendices

Appendices

Appendix (A)

Data sheet:

- Table (4.1) Demonstrates Age Group.
- Table (4.2) Demonstrates Gender Distribution.
- Table (4.3) Demonstrates by BMD Results.

AGE	GENDER	RESULTS		
		NORMAL	OSTEOPENIA	OSTEOPOROSIS

Appendix (B)

Images