EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN.

A dissertation Submitted

in partial fulfillment of the requirements

for the degree of

MASTER OF DENTAL SURGERY

BRANCH – IX

ORAL MEDICINE AND RADIOLOGY

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI – 600 032

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THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

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I hereby declare that this dissertation entitled **"EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN"** is a bonafide and genuine research work carried out by me under the guidance of DR.B.SIVA M.D.S.,PROFESSOR AND HEAD OF THE DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY. BEST DENTAL SCIENCE COLLEGE, MADURAI.

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This dissertation is submitted to the TAMILNADU DR.M.G.R MEDICAL UNIVERSITY in partial fulfilment for the degree of Master of Dental surgery in Branch IX ORAL MEDICINE AND RADIOLOGY

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"YOUR FIRST STEP TOWARDS PERFECTION IS ACKNOWLEDGING YOUR IMPERFECTIONS."

— Wahab h. Butt

'IAM GRATEFUL FOR THE YEARS I'VE HAD, PEOPLE ALONG THE WAY, MISTAKES MADE AND OPPORTRUNITIES TAKEN'

THANK YOU MY ALMIGHTY…

I would like to thank Chairman ***Prof.K.R.Arumugam and vice chairman A.Babu Dhandapani*** *for providing me all the necessary facilities to empower my knowledge.*

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This is to certify that this dissertation work titled **EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN** of the candidate **DR.R.KIRTHIKA** with registration number **241627451** for the award of **MASTER OF DENTAL SURGERY** in the branch of **ORALMEDICINE AND RADIOLOGY**. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **9%** percentage of plagiarism in the dissertation.

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TITLE OF DISSERTATION	EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN.
PLACE OF STUDY	BEST DENTAL SCIENCE COLLEGE, MADURAI – 625104
DURATION OF THE COURSE	3 YEARS
NAME OF THE GUIDE	DR.B.SIVA MDS
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This agreement herein after the "Agreement" is entered into on this day of / / 2018 between the Best Dental Science College represented by its Principal having address at Best Dental Science College, Madurai-625104.(Hereafter referred to as "the college")

And

Mr. DR.B.SIVA., aged 43 years working as Professor and Head of the Department at the college. , having residence address at No 15 staff quarters, ultra's Best Dental Science College,Madurai-625104.Here in after referred to as the Principal Investigator

And

DR.R.KIRTHIKA, aged 27 years studying as postgraduate student in the Department of Oral Medicine and Radiology in Best dental science college. Herein after referred to as the PG/Research student and co-investigator.

Whereas PG/Research student as part of her curriculum undertakes to research "Evaluation Of Serum Testosterone Level And Bone Mineral Density In Post Menopausal Women." for which purpose PG/Principal Investigator shall act as Principal Investigator and the college shall provide requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator.

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ABSTRACT

Aim

To evaluate of serum testosterone level and bone mineral density in post menopausal women by using DEXA spine and Orthopantomography .

Materials and Methods

Only postmenopausal woman aged above 52yrs were enrolled in this study. Blood specimen were obtained by venipuncture. Stored at -80 degrees celcius to evaluate serum testosterone. Bone mineral density was assessed with panoramic radiograph (X- Mind Pano D Plus 100 mA unit) and Dexa spine.

Results

The average mean value of serum testosterone was lesser than the normal range in patients with osteoporosis and osteopenia with similar results in cortical thickness in OPG and density calculated in DEXA spine.

Conclusion

Orthopantomography and serum testosterone should be mandatory advised by oral physicians to identify the patient with low bone mineral density refer the patient to general physician for further diagnosis and management. However, further studies should be carried out in larger population to substantiate the results.

Key words: postmenopausal women, osteoporosis, bone mineral density, panoramic radiography, DEXA spine, serum testosterone ,

LIST OF ABBREVATIONS

ACRONYM	ABBREVIATION
DEXA	DUAL ENERGY XRAY ABSORPTIOMETRY
BMD	BONE MINERAL DENSITY
OPG	ORTHOPANTOMOGRAPHY
ng/dl	NANOGRAM/DECILITER
SD	STANDARD DEVIATION
mm	MILLIMETER
MI	MENTAL INDEX
MCI	MANDIBULAR CORTICAL INDEX
IODC	OSTEOPOROSIS DIAGNOSTIC CENTER
QCT	QUANTITATIVE COMPUTED TOMOGRAPHY

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EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN.

Osteoporosis is a disease characterized by low bone mass and micro-architectural deterioration of bone tissue, leading to bone fragility and enhanced susceptibility to fractures[1]. Postmenopausal osteoporosis is a chronic, progressive disorder in which bone resorption exceeds formation, resulting in decreased bone mass with consequent decreased bone strength and increased susceptibility to fracture[2].

Systemic bone loss results from a decline in estrogen levels in menopause. In women, the function of estrogens is well established, but the function of androgens is not. Androgens a potent inhibitor of bone resorption, has produced sustained reductions in biochemical markers of bone remodeling into the premenopausal range and consistent dose-related increases in bone mineral density in a variety of populations, including elderly women. Evidence suggests that testosterone alone is more effective than estrogen–testosterone or estrogen therapy for the management of osteoporosis in menopausal patients, and it appears safe at pharmacologic doses[4]. Androgens were shown to stimulate proliferation and differentiation of osteoblasts and to inhibit apoptosis[3].

By 2030, an estimated fouty seven million ladies will be undergoing menopause annually[4]. The importance of prevention and early diagnosis is not only in conditions which are incurable but also in conditions which are difficult to treat once they progress. One such condition is osteoporosis which is common disorder of menopause.

The diagnosis of osteoporosis is based on the physical signs and symptoms, x-rays, bone scans and bone mineral density (BMD) assessment. The current gold standard for determining osteoporosis is DEXA (Dual Energy X-ray Absorptiometry) but high cost and

unavailability of this equipment at many diagnostic centers limits its usefulness for screening examination[5]. The advantages of DXA include short scan times, easy set up of patients for scanning, low radiation dose and good measurement precision.

Panoramic radiograph is widely used for dental examination to detect and scrutinize dental diseases and conditions as it is very cost effective as compared to the other advanced imaging modalities. The use of these radiographs for assessing individuals with low skeletal bone mineral density would be very economical and beneficial as the dentists can refer the patient for further examination if required[6].

The purpose of this study was to evaluate bone mineral density in post menopausal women and compare the reliability with the serum testosterone, DEXA spine and OPG.

AIM

To evaluate of serum testosterone level and bone mineral density in post menopausal women by using DEXA spine and OPG.

OBJECTIVES

- Evaluation Of Serum Testosterone Level In Post Menopausal Women
- To estimate bone mineral density using OPG.
- To estimate bone mineral density using DEXA spine.
- To assess whether visual examination of the panoramic radiographs can be used as a screening procedure for diagnosis and referral of patients for further evaluation of osteoporosis.
- To compare both diagnostic procedure DEXA and OPG to detect similar diagnostic performances in identifying post menopausal women with osteoporosis.
- To assess whether serum testosterone level as a indicator of bone mineral density in post menopausal women.
- To advice patient for low cost diagnostic procedure to detect the bone mineral density.

J.Bras et al (1982) Studied the thickness of mandibular angular cortex at gonion on panoramic radiograph in 180 normal patients. The radiographic anatomy of mandible angle was evaluated in 5 year increments before 20 years of age and at interval of 10 years after the age group of 20. The evaluated age groups are sectioned into nine different groups between the age of birth to 69 years. For each age groups panaromic radiographs of 10 males and 10 females were measured at gonion with the marking gauge. None of the 180 patients had bone disease. The study demonstrated that below age group of 10 no significant changes were found in radiographs. Between age groups of 10-14 small cortical layer was infrequently found. In age group of 15-59 thickness of mandibular cortex at gonion was significantly constant and no changes seen between male and female. In age group of 60-69 years no marked difference were found in male groups and in females distinctly low cortical thickness ranging from 0.2-1.2mm were found and they concluded that the decrease in cortical thickness in post menopausal women above 60 years of age can be used as a parameter in evaluating the metabolic bone disease[7].

Nina von wovern et al (1991) analyzed the Bone mineral content loss in denture wearing site of mandible after vestibule-lingual sulcoplasty and correlated this bone mineral content (BMC) value with initial BMC value and also found the age related BMC loss in basal part which is standard site of mandible by using lateral cephalometric radiographs in 25 normal women which have been divided into two groups. A significant negative relationship was found between the initial BMC value in standard site and BMC loss in denture wearing site in both age groups and positive relationship was found between both the side in elderly age groups[8]. This conveys initial mandibular bone mineral content value seems to be dependent on age related mandibular Bone mineral content loss.

Elders PJM et al(1992) assessed the relationship between periodontitis and systemic bone mass in women between 46 and 56 years of age. In order to evaluate this possible relationship, they performed an intra-oral examination and measured lumbar bone mineral density (lumbar BMD) and metacarpal cortical thickness (MCT) in 286 female volunteers. In addition, the alveolar bone height was measured on bite wing radiographs of the dentate subjects. Out of total subjects sixty subjects (21%) were edentulous. Compared to the dentate subjects, the lumbar BMD and MCT of the edentulous women were not significantly different. In the dentate subjects, no significant correlation was observed between the clinical parameters of periodontitis and the bone mass parameters. They therefore suggested that systemic bone mass is not an important factor in the pathogenesis of periodontitis[9].

Esa Klemetti et al (1993) studied the bone mineral density of the trabecular bone of the mandible which was determined by single-energy Quantitative CT for 74 totally or nearly edentulous menopausal women. These results were compared with the bone mineral densities (BMD) of their lumbar area (L2–L4) and femoral collum, measured by dual-energy x-ray transmission, Lunar DPX. The remaining height of the residual ridge at the symphysis of the mandible was measured on computed tomography (CT) lateral projection view, and an index of the residual ridge status was introduced. To determine whether general osteoporosis status affects the remaining height of the residual ridges, they compared these values with all results for bone mineral density[10]. The BMD of the lumbar area and that of the femoral collum correlated well with each other, but the BMD of the trabecular bone of the mandible did not correlate with either of the other two BMD measurements. Measurements of residual ridge height did not correlate with any BMD values. The effect of possible bone loss earlier in life is no longer apparent in mandibular height or trabecular BMD over 20 yr after tooth extractions. They concluded that there was a difference in mandibular height and trabecular

bone mineral density between osteoporotic and healthy women diminished during edentulous years.

Nina con wowern et al (1994) conducted a study to suspect osteoporosis in which the risk factor in periodontal disease in post menopausal women and normal individuals were analysed. In there study 12 female patients with osteoporotic fractures (Group O) and 14 normal women (Group N) were examined clinically for plaque (VPI), gingival bleeding (GBI), and loss of attachment on the 6 Ramfjord index teeth. Bone mineral content (BMC) of the mandible and forearm was determined by dual photon scanning. The two groups were comparable with respect to menopausal age and smoking habits. The osteoporotic women had significantly lower BMC values than controls in the mandible and forearm. No significant differences were found in relation to plaque and gingival bleeding with respect to smoking habit, whereas significantly greater loss of attachment was seen in osteoporotic women and concluded that severe osteoporosis significantly reduces the bone mineral content of the jaw especially in menopausal women[11].

Susan R.Davis et al (1995) investigated the role of androgens in increasing bone density and improving low libido in postmenopausal women, they also studied the long-term effects of estradiol and testosterone implants on bone mineral density and sexuality in a prospective, 2 year, single-blind randomised trial. Thirty-four postmenopausal volunteers were randomised for treatment with either estradiol implants 50 mg alone (E) or estradiol 50 mg and testosterone 50 mg (E&T), administered 3-monthly for 2 years. Cyclical oral progestins were taken by those women with an intact uterus. Out of thirty four women, thirty-two women completed the study. Bone mineral density (DEXA) of total body, lumbar vertebrae (L1–L4) and hip area increased significantly in both treatment groups. BMD increased more rapidly in the testosterone treated group at all sites. A substantially greater increase in BMD occurred in

the E&T group for total body, vertebral L1–L4 and trochanteric measurements. They concluded that in postmenopausal women, treatment with combined estradiol and testosterone implants was more effective in increasing bone mineral density in the hip and lumbar spine than estradiol implants alone and concluded that potential therapeutic role may exist for parentral testosterone in treatment of osteoporosis and fracture prevention[12].

Akira Taguchi et al (1995) studied the relationship between mandibular bone mass and tooth loss in 269 patients grouped into 170 females with average age of 46 and 99 males with average age of 36 who had neither metabolic disease nor local lesions affecting the mandibular cortex were included in the study. In all of the subjects, the outline of the mental foramen was distinctly disclosed on unilateral or bilateral panoramic radiographs. Mandibular bone mass was evaluated by determining the mandibular cortical width in the mental region with the use of panoramic radiographs. The relationships of mandibular cortical width to patient age and sex and the number of teeth present were also investigated. In male subjects, there was no significant correlation between the number of teeth present and the mandibular cortical width. Among women in their seventh decade, those with 15 or more teeth showed significantly greater mandibular cortical width than those with fewer teeth. Decrease of mandibular bone mass was positively correlated with tooth loss in female subjects. They suggested that bone mineral density can be evaluated by Mandibular cortical width by using OPG without the need of metacarpal bone radiography or expansive procedure like QCT[13].

Abdel Rahim Mohammed et al (1996) conducted a pilot study of panoramic film density at selected site in mandible to predict osteoporosis. This retrospective pilot study was designed to determine the strength of association of spinal bone density and the density of selected mandibular sites as determined from panoramic radiographs. Panoramic films of known low bone density for 20 women and high bone density for 22 women between the ages of 50 and

75 were evaluated. Bone density of spine was assessed by DEXA with which diagnosis of low bone density is reported when the degree of bone density is greater than 2SD below normal. The panoramic films were randomized and then converted to digital images for density analysis. Significant differences were noted between the groups in OPG films. Although panoramic images have inherent limitations when used for diagnosis, it may still possible to use these films as a preliminary screening tool to detect early risk of developing systemic disease[14].

D Ledgerton et al (1999) conducted a study to examine the radiomorphometric indices of the mandible on panoramic radiographs in a population of British female patients, to identify their normal ranges and to investigate their relationships with age, dentition and social class. Five indices, cortical width at the gonion (GI) and below the mental foramen (MI), the panoramic mandibular index (PMI), the mandibular cortical index (MCI) and one new index (measurement of cortical width at the antegonion; AI), were measured bilaterally on 500 panoramic radiographs of females by one trained observer. The measurements were analysed for ease of application, repeatability, relationships with age, dentition, social class and interrelationships between the variables. All quantitative indices (GI, MI, PMI, AI), showed a significant, negative correlation with age. MCI showed an age-related distribution. Mandibular dentition exerted a significant influence on some indices, but social class had no influence[15]. Intra-observer repeatability of MI, PMI and AI was fair (precision < 20%) but that for GI was poor.

Orozco P et al (2000) The relationships among lumbar and femoral bone mineral density (BMD) and different forms of testosterone--total, salivary testosterone and free testosterone index (FTI) calculated with the sex hormone binding globulin (SHBG)--, body mass index (BMI) and body fat distribution (waist-to-hip ratio and breast-to-hip ratio) were analysed in a

cross-sectional study with 66 Spanish premenopausal healthy women aged 42 years and with normal levels of serum testosterone. BMD was measured using dual-energy X-ray absorptiometry (Hologic QDR 1000), and salivary and blood samples were obtained during early follicular phase. In a multiple stepwise regression analysis, lumbar BMD was positively predicted by salivary testosterone and negatively by SHBG adjusted by BMI. The most femoral BMDs were negatively predicted by SHBG and positively by breast-to-hip ratio, but neck BMD was not predicted by any variable. When FTI was entered into the regression model instead of SHBG, it was not an independent predictor of BMD. The waist-to-hip ratio was positively correlated with several femoral BMD sites, but breast-to-hip ratio was better predictor. After adjusting by SHBG, the BMI was only predictor for intertrochanter BMD. All women with elevated salivary testosterone had higher lumbar BMD than those with normal value without differences in other confounding variables. As a conclusion, in premenopausal healthy women of the same age with normal levels of serum testosterone, low levels of SHBG and high levels of salivary testosterone are associated with higher lumbar BMD, whereas low levels of SHBG together with higher breast-to-hip ratio are associated with higher femoral BMD[16].

Grethe jonasson et al (2001) evaluated the alveolar trabecular pattern, the mandibular alveolar bone mass (MABM), the interdental alveolar thickness and forearm for the prediction of the skeletal bone mineral density (BMD). MABM and the coarseness of trabeculation were assessed by using periapical radiographs in 80 dentate women. The interdental alveolar thickness was measured on casts, and BMD of the forearm with dual X-ray absorptiometry. Mandibular alveolar bone mass was measured by photodensitometry. Significant correlations were found between skeletal BMD and MABM as well as the coarseness of the trabeculation. Evaluation of the coarseness of trabeculation of the alveolar bone as seen on intraoral radiographs is a helpful clinical indicator of skeletal BMD and

better than densitometric measurements of the alveolar bone. They concluded that Dense trabeculation is a strong indicator of high BMD, whereas sparse trabeculation may be used to predict low BMD[17].

V Dutra et al (2004) evaluated the changes in the antegonial angle, antegonial depth and gonial angle in edentulous and dentulous patients in 312 panoramic radiographs. The images were grouped into four between fourty to seventy nine years of age. Measurements were made by two observers. No significant differences were observed for the gonial angle regarding age, gender and edentulism. For antegonial angle, the males had significantly smaller values than females irrespective of the dental status. Edentulous individuals had a smaller antegonial angle than dentate and partially dentate individuals . The antegonial depth was significantly greater for males than females. Edentulous individuals had significantly greater antegonial depth than dentate and partially dentate individuals .They concluded that the antegonial region had a resorptive pattern in the edentulous mandible and the morphology of the antegonial region was influenced by gender and dental status[18].

Fatemeh ezoddini ardakani et al (2004) conducted a study to determine the thickness of the mandibular angular cortex on right and left sides of 100 females as well as bone resorption in different age groups using panoramic radiography who did not have history of any systemic disease, hysterectomy or taking hormonal supplements. After analyzing the reports they found that increase in age will increase bone resorption and the process is related to a decrease in sexual hormones of women. Finally they concluded the thickness of mandibular angular cortex can be used as an index of bone resorption[19].

Jonasson G et al (2005) conducted a 5yrs of prospective study in 117 dentate women to detect the changes in the bucco lingual thickness of mandibular alveolar process by using dental cast and skeletal bone mineral density determined by DEXA in distal forearm.

Seventeen two individuals were premenopausal initially and 39 females are still premenopausal at final recording. A decrease in the mean alveolar thickness, was found in 60% of the women and an increase was found in 3% of the individuals. This decrease was 0.22±*0.20*mm in the posterior region and 0.16±0.20mm in the anterior region. The changes in alveolar thickness in the posterior region were significantly correlated to the BMD changes both on the mid-crestal level site and on the cervical level site. They concluded that the bucco-lingual thickness decreases with age in the dentate alveolar process, possibly owing to periosteal resorption related to skeletal bone loss[20].

Kaoru lee et al (2005) conducted a study in 100 post menopausal women with low bone mineral density aged 50-84yrs confirmed with lumbar spine and femoral neck in DEXA. Width of the mandibular cortex was determined in panoramic radiographs by simple visual assessment. The panoramic images were analysed twice by four observers to evaluate mandibular cortex thickness. There results suggest that simple visual estimation of mandibular inferior cortex on OPG may be useful for identifying postmenopausal women with low BMD[21].

Glen M blake et al (2007) in their review article illustrated about Dual energy *x* ray absorptiometry (DXA) scans to measure bone mineral density (BMD) at the spine and hip. It has an important role in the evaluation of individuals at risk of osteoporosis and in helping clinicians for appropriate management of fracture. BMD results can be interpreted using the World Health Organization T-score definition of osteoporosis. Hip and spine DEXA have numerous advantages that include effectiveness of antifracture therapies, and the ability to monitor treatment response[22].

A Taguchi et al (2007) conducted a study to identify the post menopausal women at risk of osteoporosis in 455 women aged 50yrs who visited the dental clinics of 22 trained general

dental practitioners. One sixty eight women diagnosed as having low skeletal BMD revealing cortical erosions in panoramic radiographs. BMD of lumbar spine and femoral neck were measured with DEXA. His results suggested that a high percentage of post menopausal women with undetectable low skeletal BMD as well as spinal fracture may be identified by cortical erosions in panoramic radiographs by trained GDPs analyzing their panoramic radiographs[23].

Nicholas A .Drage et al (2007) conducted a study to investigate the relationship between bone mineral density of jaws and skeletal sites along with habit history, gender and edentulous status. 18 edentulous patients (9 females, 9 males) with mean age of 67.1 years had DEXA scans to assess the BMD of lumbar spine and hip together with ramus, body and symphysis of the mandible and anterior maxilla were assessed. BMD values for the ramus were similar to those for the femur but significantly lower than the lumbar spine. The body and anterior mandible had higher values and the anterior maxilla had lower values than both the femur and ramus. The ramus BMD showed moderately strong relationships with the standard measures of BMD in the spine and hip, but the BMD of other areas of the jaws showed no relationship with skeletal sites. The BMD for both the hip and the ramus showed an inverse relationship with increasing age. They concluded that although the ramus of the mandible may show correlation of BMD with skeletal sites, the areas of the jaws where implants may be placed do not show significant correlation with BMD of skeletal sites. Therefore BMD of the skeletal sites could not be used to predict BMD of the jaws. The BMD of the jaws as measured by DXA showed no relationship with either edentulous area or cigarette smoking[24].

M.R. salamat et al (2008) conducted a study to investigate the magnitude of bone loss on proximal femur and lumbar spine(LS) in pre- and post-menopausal women from Isfahan

Osteoporosis Diagnosis Center (IODC) in 185 pre-menopausal and 174 early post-menopausal women who were selected randomly using DEXA. Mean BMD for femoral neck (FN) and LS in pre menopausal women were 0.859 ± 0.136 and 1.012 ± 0.161 and in post-menopausal women were 0.816 ± 0.119 and 0.919 ± 0.140, respectively. They Concluded that in spite of, the reported lower BMD T-scores for the LS compared with the FN for women, we found that the FN had significantly lower T-score than LS for both pre- and post-menopausal women[25].

Tineke A et al (2009) conducted a cross sectional study to measure the bioavailable serum testosterone and estradiol and their relationship with muscle mass, muscle strength and BMD in 329 healthy post menopausal women aged between 55 and 85yrs. His results found that with advancing age, lean body mass(LBM), Maximum quadriceps extension Strength(MES), maximum handgrip strength (MGS), bone mineral density(BMD), and estrogen(ESR) significantly declined and TUGT(timed up-and-go test) and DPyr (urinary deoxy pyridinoline/creatinine) significantly increased. After age-adjustment, LBM, MES, and BMD in spine and FN were significantly related to bioavailable testosterone and to ESR. Osteocalcin(OC) and DPyr were significantly inversely related to ESR. He concluded that age related loss of LBM, MES and BMD in postmenopausal women is partly dependent on the presence of endogenous bioavailable testosterone and estrogen[26].

Esin hastar et al (2011) evaluated the mental index , mandibular cortical index and panoramic mandibular index on dental panoramic radiographs in 487 elderly dental patients aged 60 to 88 yrs with osteoporosis and without osteoporosis. Their results showed statistically significant differences according to gender and dental status in MCW, MCI and PMI values between patients with osteoporosis and without osteoporosis[27].

Farzaneh agha-hosseini et al (2013) conducted a case control study to compare the salivary flow, serum and salivary testosterone and femur bone mineral density of 60 menopausal women with or without oral dryness by using DEXA and ELISA respectively. Multinomial logistic regression demonstrated that low saliva flow rate, low femur BMD, high stimulated saliva testosterone, high unstimulated saliva testosterone, and high serum testosterone were associated with an increased risk of xerostomia in menopausal women. They concluded that high serum and salivary testosterone and low femur BMD and saliva flow were associated with xerostomia[28].

Sangeetha et al (2013) conducted a pilot study to compare the accuracy of prediction of osteoporosis in digital panoramic radiographs with DEXA scan in 10 postmenopausal women varying in age group between 60 and 75 years of age who were seeking dental treatment. In their study, out of the10 postmenopausal women with no previous diagnosis of osteoporosis, who participated in this study, 3 women (30%) were normal, 1 woman (10%) had osteopenia and 6 women (60%) had osteoporosis on the basis of BMD. There is significant relationship in the width of the mandibular cortex for normal, osteopenic and osteoporosis patients. The mean cortical width of patients with osteoporosis was 2.7 mm, 3.9 mm for osteopenic patients, 4.18 mm for patient without osteoporosis. They concluded that dentists may be able to refer postmenopausal women with undetected low skeletal BMD or osteoporosis to medical professionals for further examination on the basis of incidental findings on dental panoramic radiographs[29].

Huong T.T.Nguyen et al (2014) conducted a cross sectional study to investigate the prevalence of osteoporosis and role of sex hormone levels in determination of bone mineral density and osteoporosis in vietnamase population of women and men. The cross-sectional study involved 269 women and 222 men aged 13–83 years, who were randomly selected

from urban and rural areas in northern Vietnam. Serum concentration of both estradiol and testosterone were analyzed and bone mineral density was detected by using DEXA. They found that the prevalence of osteoporosis in postmenopausal women was 18, 17, and 37 % for the femoral neck, total hip, and lumbar spine, respectively. For men aged 50 years or older, the corresponding values were 8, 7, and 12 %. Determinants of osteoporosis in men for the total hip and lumbar spine were age, weight, and serum concentrations of estradiol and testosterone. In postmenopausal women, age, weight, and residence (urban vs rural) were the most important predictors of BMD and osteoporosis. For all women (including those of reproductive age), serum levels of estradiol were also significant[30]. There data suggested that the prevalence of osteoporosis in the Vietnamese population is high also in men, and that estradiol levels are essential for bone mass in both men and women.

Aanshul aggarwal et al (2015) conducted a radiological study to compare the mandibular cortical index in OPG and bone mineral density in DEXA in 50 north Indian post menopausal population. All the females were subjected to panoramic radiographs and DEXA. The visual analysis was done based on the radiographic appearance of the lower border of the mandible on the left side by two observers who were blinded about DEXA results. Intra/Inter-observer variability was ruled out by visual analysis at two occasions which was followed by comparison of different grades of MCI and BMD statistically.There was significant difference in the three groups of mandibular cortical index of panoramic radiograph as interpreted by the two observers.The intra-observer reproducibility of this index had moderate agreement and the interobserver agreement of this index followed fair reproducibility. Their study concluded that visual examination of panoramic image by using MCI showed significant correlation with bone mineral density of lumbar vertebrae as determined by dual energy x-ray absortiometry. So, visual examination of the panoramic

radiographs can be used as a screening procedure for diagnosis and referral of patients for further evaluation of osteoporosis[31].

Santosh patil et al (2017) conducted a descriptive study to analyse the bone mineral density patterns at lumbar spine and hip using dual energy x-ray absorptiometry in 269 women. Of 269 subjects, 35.32% (n=95) were diagnosed osteoporotic at lumbar spine. 36.8% (n=99) were in the osteopenic range and 27.88% (n=75) were in the normal range. When T score classification of study population at spine & hip are compared, it is observed that 41 participants were diagnosed in osteoporotic range at hip and 95 participants were diagnosed in osteoporotic range at lumbar spine. They concluded that determination of BMD at lumbar spine was more sensitive for diagnosis of osteoporosis and guide therapeutic intervention. Menopausal status was also significant risk factor for discordance[32].

Akshita D et al (2017) conducted a cross sectional study among 43 postmenopausal women aged 45yrs and above by using DEXA and orthopantomogram. Mental index, Mandibular cortical index, panoramic mandibular index, gonial index and antegonial index were compared with t-score obtained from DEXA scan and concluded that MCI had high diagnostic accuracy in identifying post menopausal women with low BMDs[33].

Juliana zigart et al (2017) conducted a cross sectional study to examine the role of panoramic radiographs in diagnosis of low bone mineral density in post menopausal women aged over 40yrs. Two aspects were analyzed in the mandibular panoramic radiograph: a qualitative aspect regarding the shape of the mandibular cortical bone, and a quantitative aspect regarding the width of the mandibular cortical bone. The morphology of the mandibular cortical bone in the digital panoramic radiograph was determined bilaterally by the observation of the bone structure between the mental foramen and the base of the jaw. The mandibular cortical bone was categorized into three groups. The mental index (MI) was

used to evaluate the thickness of the mandibular cortical bone through a perpendicular line drawn from the base of the mandible at the height of the center of the mental foramen, with another line drawn tangent to the inferior border of the mandible, and a third line parallel to the line at the superior border of the mandible. The densities of the lumbar spine and femur were categorized as normal, osteopenia or osteoporosis. There results showed that agreement index between the MI and the BMD of the lumbar spine was good , but the same index between the MI and the BMD of the femoral neck was poor. An excellent agreement occurred when the mandibular cortical index (MCI) was compared with the BMD of the lumbar spine. The agreement between MCI and the BMD in the femur was moderate. They concluded that the radiomorphometric indices evaluated in the mandibular panoramic radiographs are capable of identifying postmenopausal women with low mineral density in mandible and the results can be used to refer these women to appropriate medical investigation or treatment[34].

An observational type of study was carried out to estimate the bone mineral density of post menopausal women using DEXA spine, OPG and serum testosterone in Best dental science college and Aarthi scans, Madurai

ETHICAL CLEARANCE

The synopsis of the proposed Research was prepared and submitted to the Institutional Review Board, Best Dental Science College and Hospital, Madurai for Ethical Approval. (Annexure I).

After the review and scrutiny by the board members, approval was granted to conduct the research. The study was conducted after obtaining informed consent from the participants. (Annexure II)

This study was carried out in 20 postmenopausal women with no history and symptoms of osteoporosis.

They were grouped as follows:

• Group A: 10 patients of age group between 52 to 62.

• Group B: 10 patients of age group between 63 and above.

The standard case history format was followed (Annexure III), clinical diagnosis was established.

ELIGIBILITY CRITERIA

INCLUSION CRITERIA

- Patients with a definitive diagnosis of postmenopausal woman.
- Patients who gave proper informed consent to participate in the study.

EXCLUSION CRITERIA

- Patients who have other systemic disorder associated postmenopausal osteoporosis.
- Patients who are Obese.
- Patients who are not willing to participate in the study.
- Patients who are mentally challenged.

SAMPLE SIZE CALCULATION

- This is an observational study to estimate the serum testosterone level and bone mineral density of post menopausal women
- The authors Agha Hosseini et al had conducted a study and had reported the following figures in menopausal women.

BMD with xerostomia	=	0.69 ± 0.01
BMD without xerostomia	=	0.75 ± 0.03
Estimated standard deviation	=	0.05

- The sample size $n = \frac{2 \times \{z_{(1-\alpha/2)} + z_{(1-\beta)}\}^2}{\Delta^2}$

Where $z_{(1-\alpha/2)}$ is the alpha error whose value for confidence level of 95% (error of 5%) , is 1.96 and $z_{(1-\beta)}$ is the beta error or power of the study whose value for power of 95 % is 1.6449

Δ = $\frac{\text{Difference in means}}{\text{S.D}}$

= $\frac{0.69 - 0.75}{0.05}$

= 1.2

Alpha error at 5 % significance level = 1.96

Beta error (power) at 95 % = 1.6449

Sample size n = $\frac{2\,(1.96 + 1.6449)}{1.2^2} = \frac{2(3.6049)^2}{1.44}$

= $\frac{25.9706}{1.44}$

= 18.03 rounded off to 18

The number of participants required is 18 for a significance level of 95%and power of 95%.

STUDY POPULATION

Patients who were post menopausal women were included in the study. Patients from all the groups were thoroughly examined clinically. Each patient history was taken and recorded.

Sampling Methodology

Convenience sampling was done.

Collection of data

This study was conducted in which case history format was developed and designed by considering the other previous studies. The participants were assured about the confidentiality of their personal information.

Blood sample collection

- Under aseptic conditions 3 ml venous blood is withdrawn from twenty patients of post menopausal women using sterile disposable syringe in antecubital fossa. Later, transferred to plastic test tubes and kept standing for 30 minutes at room temperature. Then the serum was separated by centrifugation (R4A centrifuge machine) at 3000 rpm for 15 minutes. Haemolysed samples were excluded. Precautions were taken to prevent the contamination of samples by other elements.
- Serum testosterone is to be detected by colorimetric method using semi-automated analyser, 'Erba Chem-5 plus' of Aarthi's diagnostic Laboratory. Procedure was performed as per manufacturer's instructions with biological reference interval of 14 – 70 n/dl.

FIG 1 : WITHDRAWAL OF BLOD FROM ANTECUBITAL FOSSA

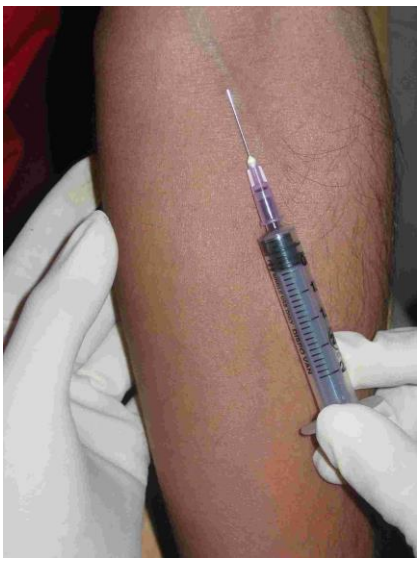


FIG 2 : SEMI-AUTOMATED ANALYSER

RADIOLOGICAL EXAMINATION – OPG AND DEXA SPINE

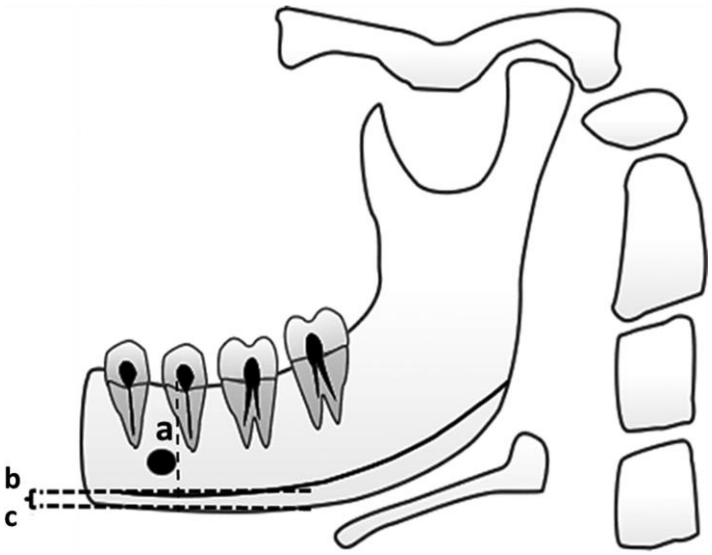
- OPG were performed in patient reported to Department of Oral Medicine and Radiology aged above 52 by using OPG unit (X-mind pano cephD+) with default parameters (73kV and 4.0mA,time 11.3seconds , imaging field of view 8x10cm).The patients were positioned in OPG machine according to the manufacturer's instructions and images have been recorded.

FIG 3 OPG MACHINE

FIG 4 PATIENT TAKING OPG

The mental index (MI) was used in the present study to evaluate the thickness of the mandibular cortical bone through a perpendicular line drawn from the base of the mandible (a) at the height of the center of the mental foramen; another line (b) is drawn tangent to the inferior border of the mandible, and a third line (c),which is parallel to the second one (b), is drawn at the superior border of the mandible. The measurement of the cortical bone thickness (mental index) is made along horizontal lines b and c (Ledgerton et al, 1997). The data are expressed in millimeters, with a normal value ≥3.0 mm. It is measured bilaterally and mean value was calculated.

FIG 5 Mental index. One line (B) is tangent to the lower border of the mandible, and another line is perpendicular (A) to the first one, passing through the center of the mental foramen. The measurement of the cortical bone thickness (mental index) is made along the horizontal line (C).



DEXA SPINE

- DEXA spine were performed in Aarthi scans Madurai using LUNAR DPX machine manufactured by GE healthcare systems.
- The most common way of interpreting BMD is to adopt the WHO definition for osteoporosis, based on BMD T-Score.
- The WHO classification of BMD into categories of

  normal (T-score>-1),

  osteopenia (-1<T-score<-2.5),

  osteoporosis (T-score<-2.5), and have widely been used since their introduction in 1994.

- This classification has been based on the T-score, which is calculated according to the following equation, with BMD values expressed as g/cm2.

T - score = (Subjects BMD value -Mean young normal BMD value)

(1SD young normal BMD)

FIG 6 – DEXA LUNAR DPX MACHINE

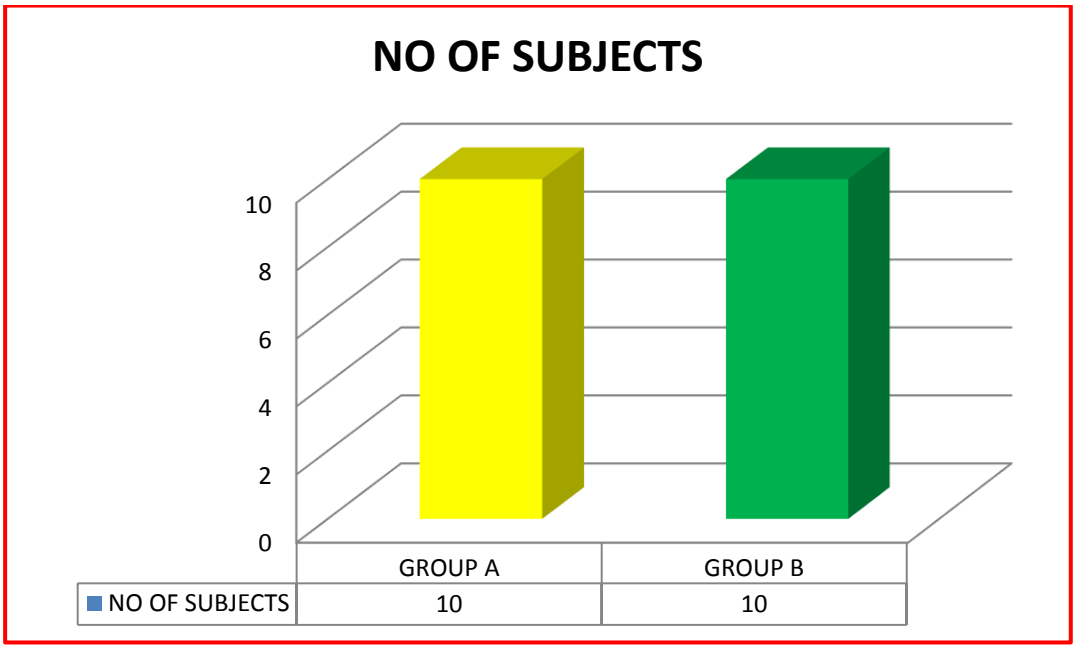
FIG 7 – PATIENT TAKING DEXA SPINE

STATISTICAL ANALYSIS

- The information collected regarding all the selected cases were recorded in a Master Chart in Excel sheet. (Annexure IV).Data analysis was done with the help of computer using the software Statistical Package for Social Sciences (SPSS version 20.0 for Windows).
- Using this software range and mean were calculated
- Both quantitative and qualitative analysing was done in both the groups.
- Spearman's Correlation Coefficient were calculated between DEXA spine , OPG and serum testosterone in both the age groups and +0.5000 considered as positive correlation . All 'p' values of 0. 05 or below were considered significant.

The total sample consisted of 20 postmenopausal women, with age range of 52 – 72 years. They were divided into two groups. Group A includes 10 patient between age group of 52 to 62 and group B includes 10 patient between age group of 63 and above. The present study has assessed the comparison between the bone mineral density obtained by DEXA , the index (mental index) of the panoramic radiograph and value of serum testosterone .

Graph 1 Distribution of the study participants in two groups



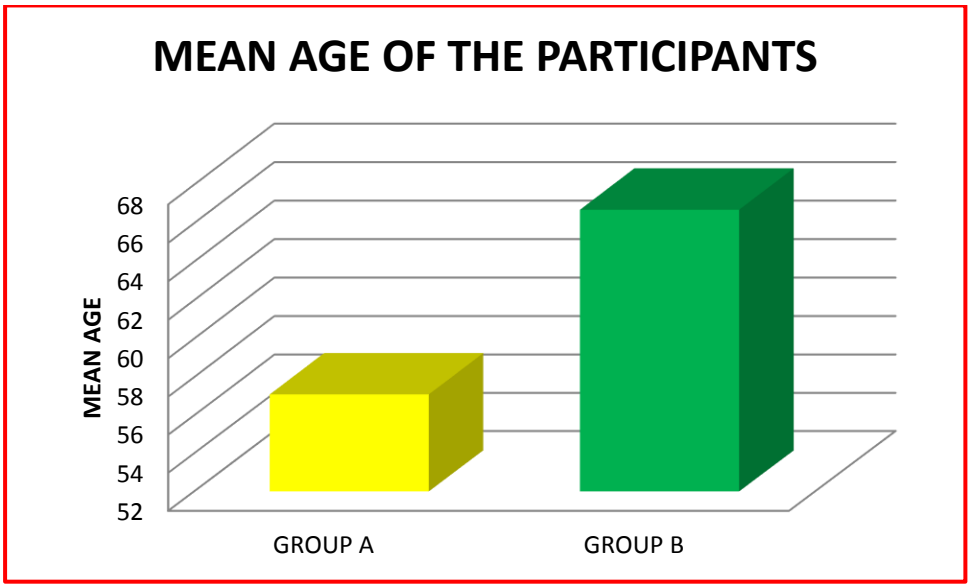
AGE DISTRIBUTION

The mean age of patients in group A was 57.1 and group B was 66.7.

TABLE 1 SHOWS AGE DISTRIBUTION OF THE STUDY PARTICIPANTS

GROUPS	MEAN	RANGE
GROUP A	57.1 ± 4.12	52.0 – 62.0
GROUP B	66.7 ± 3.40	63.0 – 72.0

GRAPH 2: AGE DISTRIBUTION OF THE PARTICIPANTS



ESTIMATION OF BONE MINERAL DENSITY BY OPG

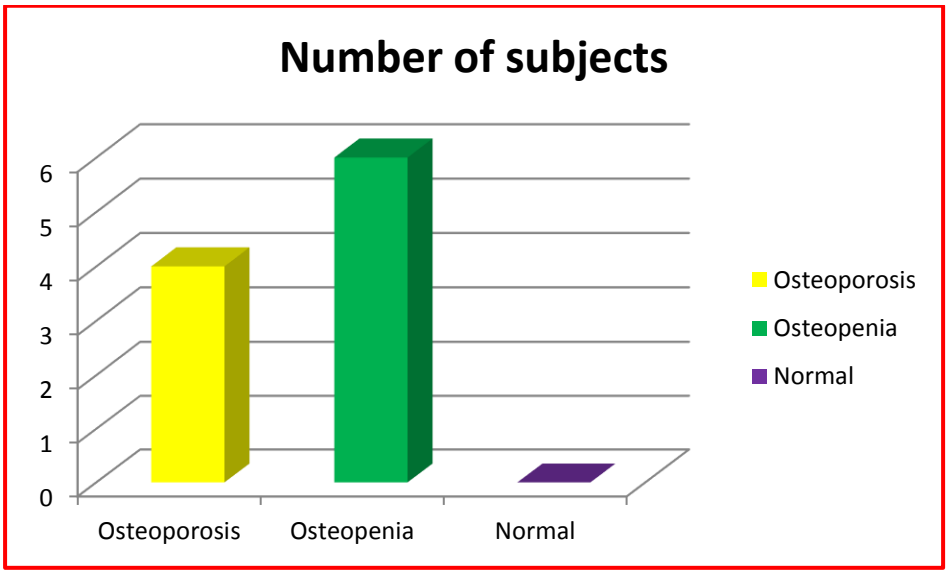
- Normal Bone density by OPG > 4 mm.
- Osteoporosis <3 mm.
- Osteopenia 3- 4 mm.

Similar to other studies the cortical thickness below the mental foramen was measured by using mental index .measurement of 4mm was taken as normal cortical thickness and below 3mm for osteoporosis patients and between 3- 4 mm for osteopenia patients.

TABLE 2: Bone Mineral Density by OPG

Bone Density by OPG*	Frequency (n) in Group A	Frequency (n) in Group B
Normal	0	2
Osteoporosis	4	5
Osteopenia	6	3

Graph 3: Number of participants according to bone mineral density by opg in group A



Number of participants in group A was nil normal subjects and four in osteoporosis and 6 in osteopenia. In group B there was two normal subjects and five in osteoporosis and three in osteopenia.

GRAPH 4: Number of participants according to Bone Mineral Density by OPG in Group B

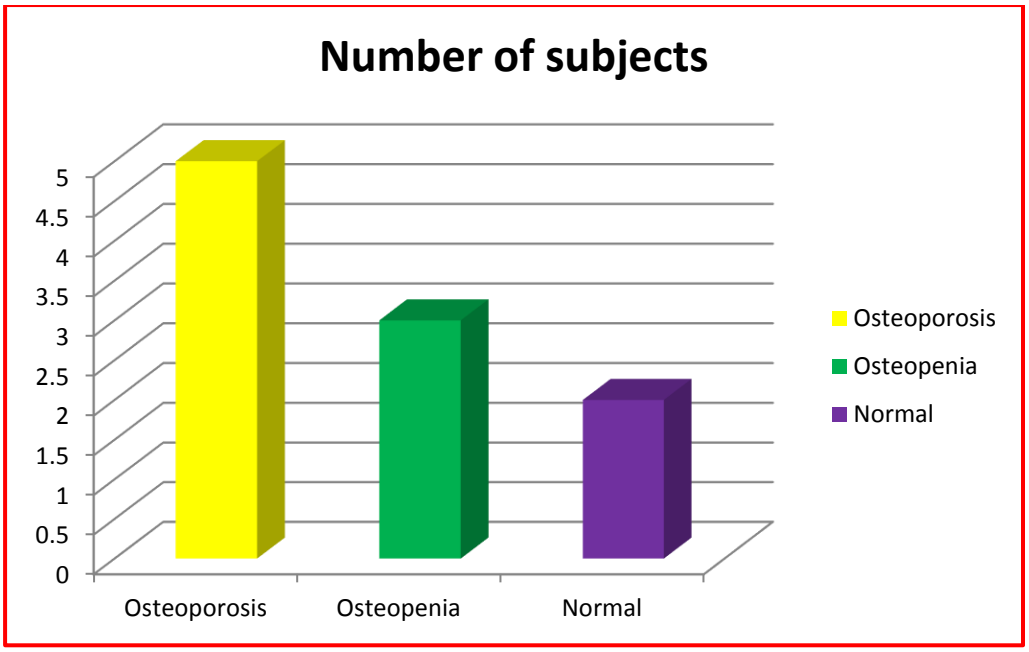
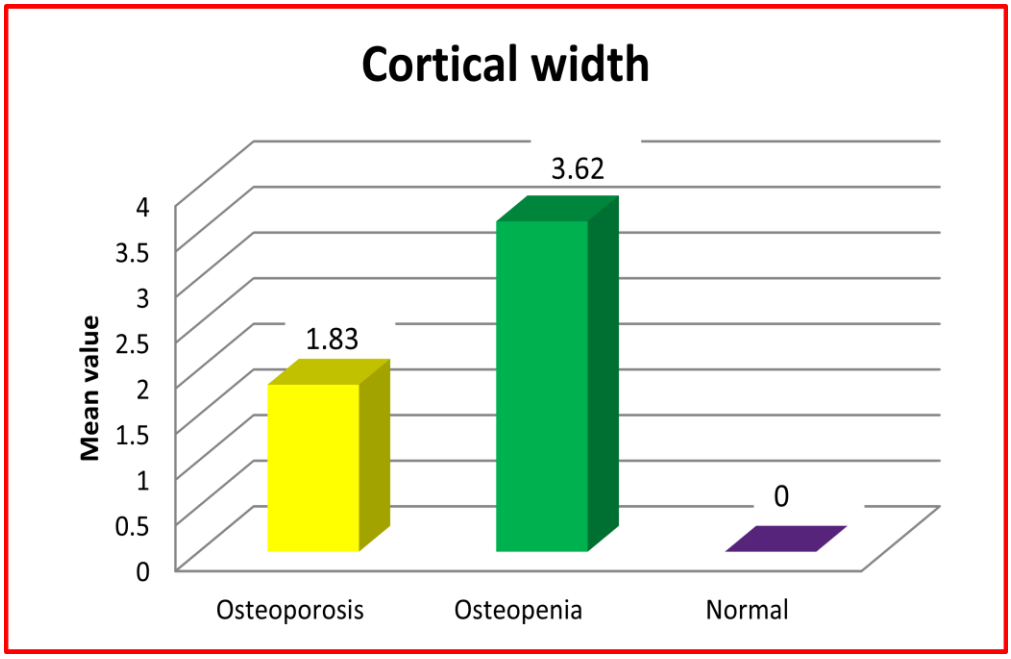


TABLE 3: Mean width of the mandibular cortex for normal, osteopenic and osteoporosis patients

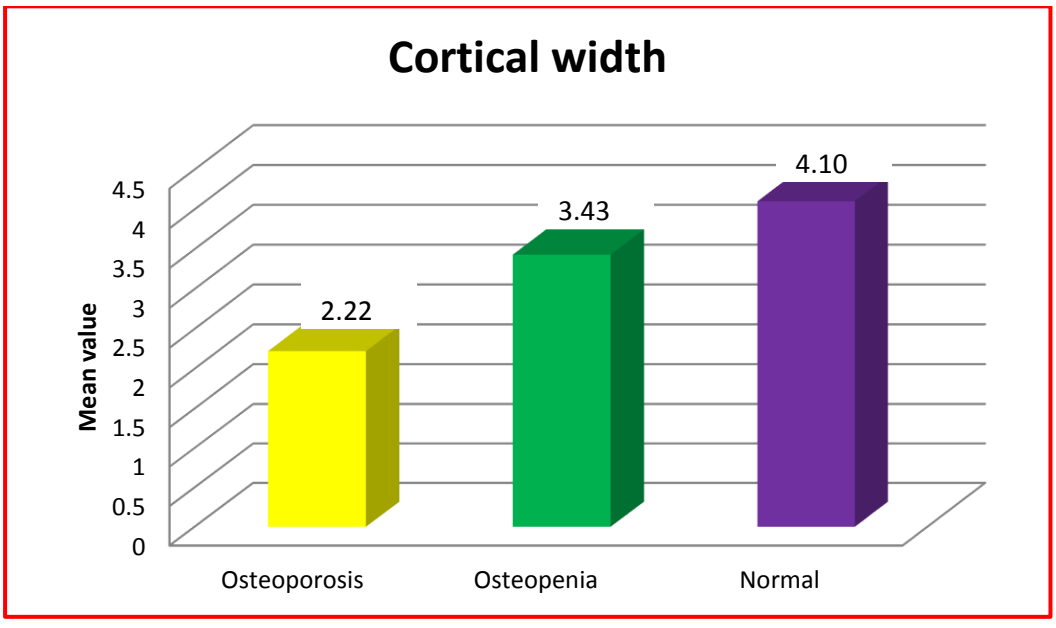
Mean Bone Density by OPG*	**Group A (Mean ± SD)**	**Group B (Mean ± SD)**
Osteoporosis	1.83 ± 0.59	2.22 ± 0.36
Osteopenia	3.62 ± 0.22	3.43 ± 0.40
Normal	0	4.10 ± 0.14

The mean cortical width of osteoporosis patients was 1.83 ± 0.59 in Group A and 2.22 ± 0.36 in Group B patients. For osteopenic patients the mean value was 3.62 ± 0.22 in group A and 3.43 ± 0.40 group B and in case of normal patients it is 4.10 ± 0.14 in group B and 0 in group A since no normal patients were found in group A.

GRAPH 5: Correlation of width of the mandibular cortex for normal, osteopenic and osteoporosis patients in Group A



GRAPH 6: Correlation of width of the mandibular cortex for normal, osteopenic and osteoporosis patients in Group B



ESTIMATION OF BONE MINERAL DENSITY BY DEXA SPINE

Diagnostic criteria

T-score of -2.5 or less at any of the skeletal site measured is diagnosed as osteoporosis.

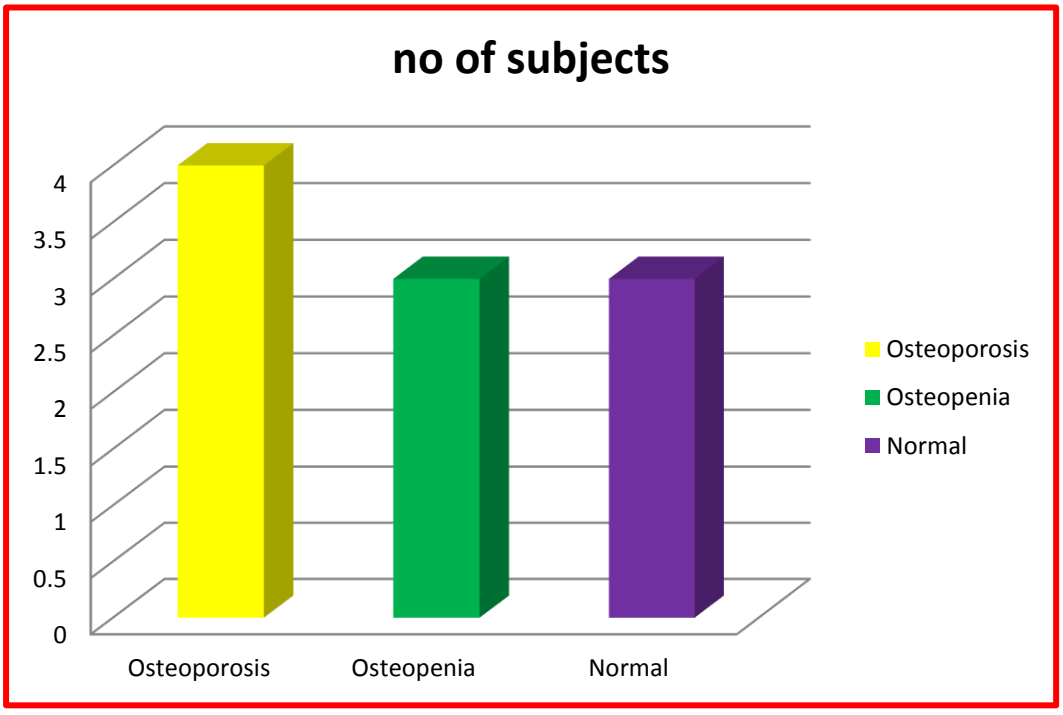
T score between -1 & -2.5 is diagnosed as osteopenia.

T- score not less than -1 was considered normal.

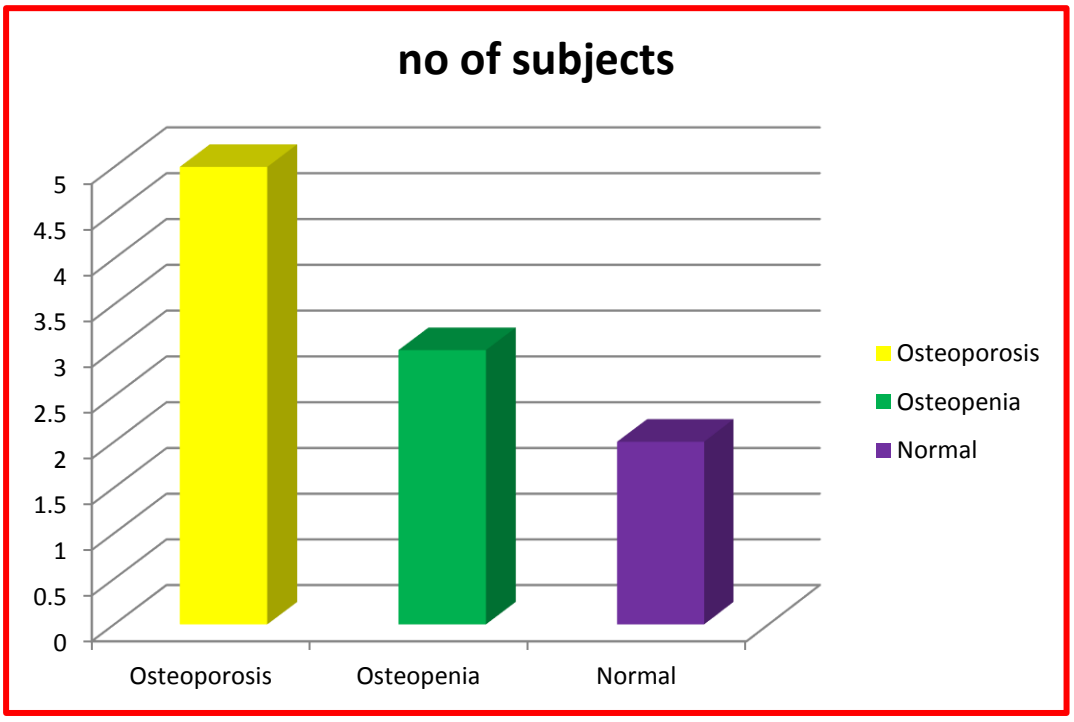
TABLE 4: Bone Mineral Density by DEXA

DEXA Diagnosis	Frequency (n) in Group A	Frequency (n) in Group B
Normal	3	2
Osteopenia	3	3
Osteoporosis	4	5

GRAPH 7: Number of participants according to Bone Mineral Density by DEXA in Group A



GRAPH 8: Number of participants according to Bone Mineral Density by DEXA in Group B



According to diagnostic criteria of dexa spine group A has 3 normal patients, 3 osteopenic patients and 4 osteoporosis patients. In group B there are only 2 normal patients, 3 osteopenic and 5 osteoporosis patients .Thus the frequency of osteoporotic patients are increased as the age advances. Graph 7 and 8 describes the number of participants in group A and B who were normal, osteopenia and osteoporosis.

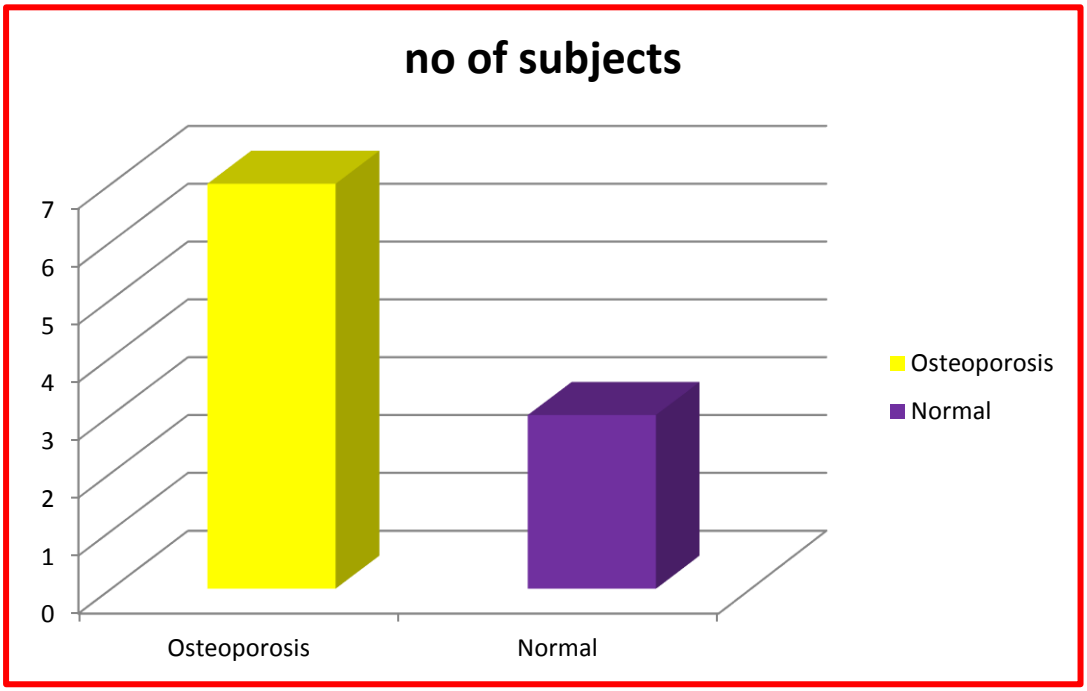
ESTIMATION OF BONE MINERAL DENSITY BY SERUM TESTOSTERONE

- Normal serum testosterone value – 15-70 ng/dl.

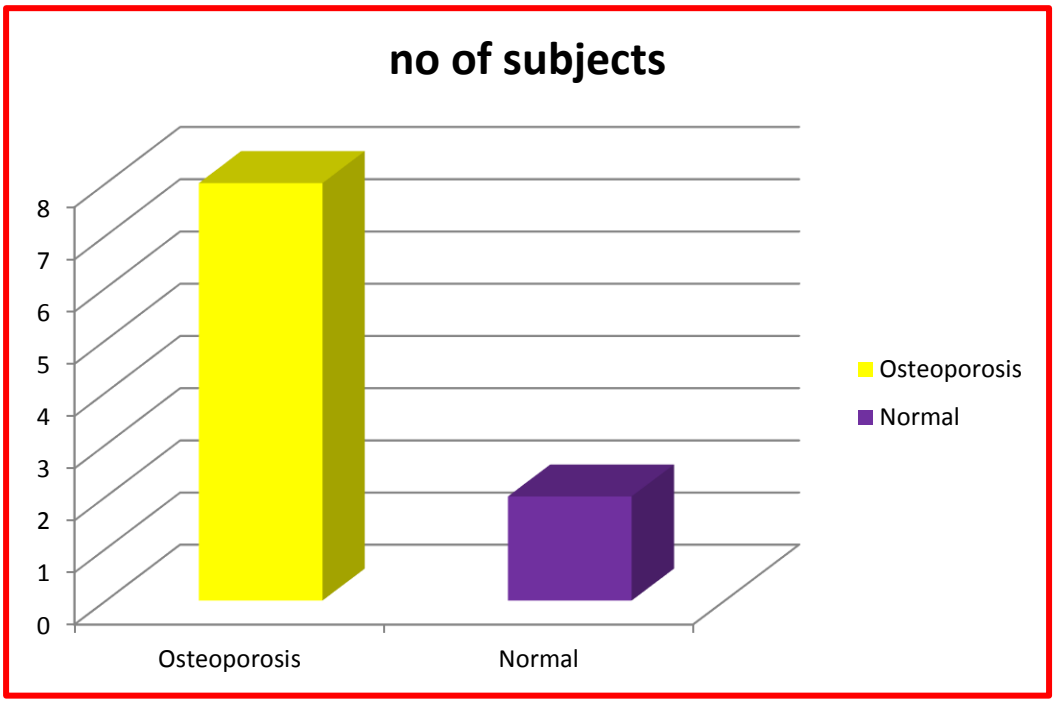
TABLE 5: Bone Mineral Density by Testosterone

Testosterone values*	Frequency (n) in Group A	Frequency (n) in Group B
Normal	3	2
Osteoporosis	7	8

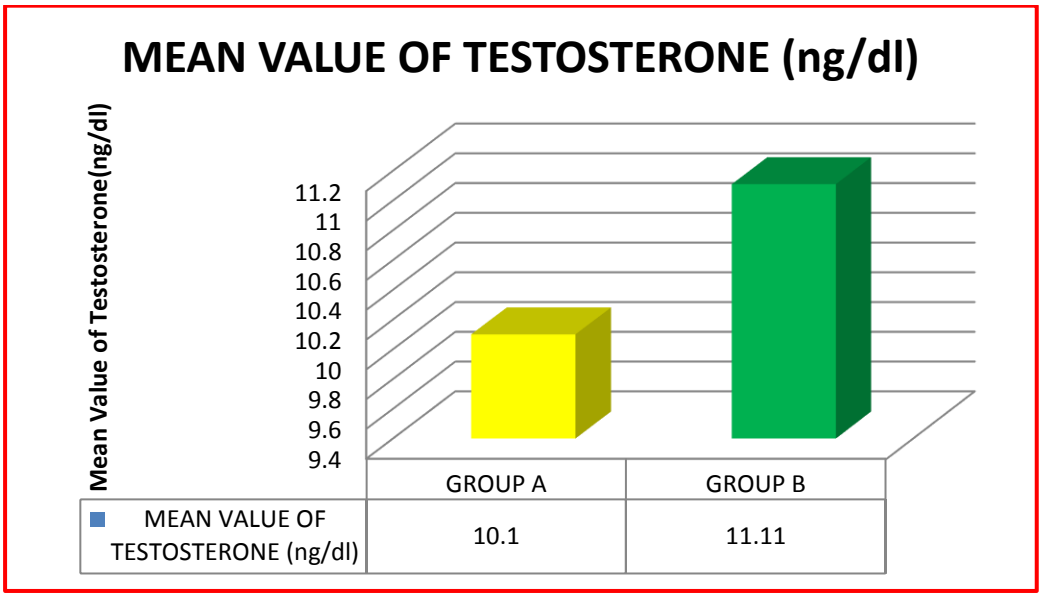
GRAPH9: Number of participants according to Bone Mineral Density by Testosterone in Group A



GRAPH10: Number of participants according to Bone Mineral Density by Testosterone in Group B



GRAPH 11: MEAN TESTOSTERONE VALUES OF THE PARTICIPANTS



The mean testosterone value of group A patients were 10.1 ng/dl and in group B patients 11.11ng/dl.

Spearman's Rank correlation coefficient was calculated between DEXA , OPG and serum testosterone. + 0.500 is considered as positive value and P value of less than 0.05 is considered as statically significant.

TABLE 6: Co-relation between DEXA and OPG in both groups

GROUPS	SPEARMAN'S CORRELATION COEFFICIENT	PROBABLITY
GROUP A	0.904**	p = 0.000
GROUP B	1.000**	p = 0.000

**. Correlation is significant at the 0.01 level (2-tailed).

Bone mineral density was considerably correlated with cortical width of the mandible. The analysis of variables revealed a significant association between the cortical width of the mandible and BMD ($p < 0.000$; 99% significant) [table 6]. Subjects with osteoporosis, osteopenia and normal had significantly positive correlation [Group A - **0.904****& Group B **1.000****] with mean cortical width at mental region of OPG suggested that detecting reduced cortical width on panoramic radiographs may be more helpful for identifying postmenopausal women with an increased risk of osteoporotic fracture.

TABLE 7: Co-relation between DEXA and serum testosterone in both groups

GROUPS	SPEARMAN'S CORRELATION COEFFICIENT	PROBABLITY
GROUP A	1.000**	p = 0.000
GROUP B	1.000**	p = 0.000

**. Correlation is significant at the 0.01 level (2-tailed).

Bone mineral density detected by DEXA and serum testosterone has strong positive correlation[Group A &B **1.000****] revealing that simple blood investigation can detect low bone mineral density in postmenopausal women and which was statically significant [p = 0.000] but the negativity is osteoporosis and osteopenia cannot be detected.

TABLE 8: Co-relation between OPG and Testosterone in both groups

GROUPS	SPEARMAN'S CORRELATION COEFFICIENT	PROBABLITY
GROUP A	1.000	p = 0.000
GROUP B	1.000**	p = 0.000

**. Correlation is significant at the 0.01 level (2-tailed).

Bone mineral density detected by OPG and serum testosterone also has strong positive correlation [Group A &B **1.000****] revealing identifying patients with low bone mineral density and simple blood investigation can detect density of bone in postmenopausal

women and it was which was statically significant [p = 0.000] but the negativity is osteoporosis and osteopenia cannot be detected.

Osteoporosis is often referred as "silent disease" because bone loss occurs without symptoms. Postmenopausal women have many opportunities to visit dental hospital for oral care or treatment[35]. A large number of dental panoramic radiographs are taken annually for the diagnosis and treatment of dental diseases or non dental disease in general dental practice[36]. It is possible for dentists to screen those patients, through radiographs mainly by clinical dental examination and OPG & refer them for a DXA test. Bone densitometry, also called dual-energy x-ray absorptiometry, DEXA or DXA, uses a very small dose of ionizing radiation to produce images of the bone (usually lumbar spine and hips) to measure bone loss. It is commonly used to diagnose osteoporosis, to assess an individual's risk for developing osteoporotic fractures. DXA is simple and noninvasive procedure. It's also the most commonly used and the most standard method for diagnosing osteoporosis. Systemic bone loss results from a decline in estrogen levels in menopause[37]. In women, the function of estrogens is well established, but the function of androgens is not. Testosterone enhances bone formation.[38] Evidence suggests that testosterone alone is more effective than estrogen–testosterone or estrogen therapy for the management of somatic and psychological symptoms in menopausal patients, and it appears safe at pharmacologic doses[39]. In the present study, mental index was calculated from OPG of postmenopausal women were compared with the BMD conditions obtained by DEXA scan T‑scores of lumbar spine and with serum testosterone levels.

SAMPLE AND AGE DISTRIBUTION

In the present study, 20 postmenopausal women with no previous diagnosis of osteoporosis took part in this study. Graph 1 explains the number of participants in group A and B. Table 1and graph 2 describes the mean age of patients. The mean age in group A is 57.1 $\pm$ 4.12 ranging from 52 to 62yrs and group B is 66.7 $\pm$ 3.40 ranging from 63 to 72 yrs were included in the study. **McKinlay SM 1992 et all** suggested that the median age of menopause among white women from industrialized countries ranges between 50 and 52 years and at onset of the perimenopause is 47.5 years[40].

The age of the patient was correlated with cortical width of mandible , dexa spine and serum testosterone according to group. **Verheij JGC et al in 2009** correlated the age of the patient with cortical width of mandible and found that patient in age group above 63 years had more reduced cortical width than in 50 – 60 age group patients and its statistically significant. This coincides with the previous study by **Delvin and Horner in 2002**[41] stated that as the age of patient increasing cortical thickness of mandible reduces.

Ravleen ragi et al in 2014 also correlated the relationship between femur bone mineral density, body mass index and dental panoramic mandibular cortical width at the region of mental foramen in diagnosis of elderly postmenopausal women with osteoporosis and concluded age is a non – modifiable risk factor for osteoporosis as the age increases the mandibular cortical width decreases. In our study similar results were found which reveals more osteoporosis patients in 63 to 72 yrs age group than 52 to 62yrs age group patients.

ESTIMATION BY OPG

Screening can be achieved mainly through dental radiographs and especially panoramic radiographs, where several radiographic indices, such as Mandibular Cortical Width (MCW), Mandibular Cortical Index (MCI), Gonial Index (GI), Antigonial Index (AI), Panoramic

Mandibular Index (PMI) and alveolar crest resorption degree (M/M ratio) can be assessed. For most of them, the cortical margin of the lower jaw is used, as it is more obvious and easy to detect compared to the trabecular bone. Furthermore, the area below the mental foramina is mostly studied, due to

(1) the usual lack of muscle attachment there and

(2) the fact that the distance between the mental foramen and the inferior margin of the mandibular cortical bone remains relatively stable during the lifespan, irrespective of the alveolar bone resorption following tooth extraction or inflammation.

Furthermore, the authors suggested that only those patients with the thinnest mandibular cortices, e.g Cortical Width ≤3 mm, would benefit from DXA examination and therefore only those patients should be referred, as they are at higher risk of suffering from osteoporosis. Hence Qualitative panoramic radiomorphometric indices have been proposed as diagnostic tools for identifying osteoporosis.

FIG 8: ORTHOPANTOMOGRAPH

Taguchi et al. (2003) showed that Cortical Width can also be used to detect postmenopausal osteoporosis in younger women, aged less than 65 years[42] whereas another study done by

Ledgerton et al in 1999 and **Dutra et al in 2005** claims that the MI, PMI and AI indices may be useful for screening osteoporosis in men as well, although no significant correlation was found between Cortical Erosion and BMD[15].

In the present study mean mental index (MI) was calculated in group A patients and group B patients . In a study conducted by **sangeetha et al in 2013**, there was a significant relationship in the width of the mandibular cortex for normal, osteopenic and osteoporosis patients. In their study the cortical width was reduced less than 4 mm for patients with osteoporosis and the cortical width was normal and greater than 4 mm in patients without osteoporosis[29]. The mean cortical width of patients with osteoporosis was 2.7, 3.9 mm for osteopenic patients, 4.18 mm for patient without osteoporosis. Similar criteria was taken into consideration in our study to distinguish between normal , osteopenia and osteoporosis patients . Table 2 and Graph 3 & 4 explains frequency of normal, osteopenia and osteoporosis patients in group A and group B.

Group A contains 4 osteoporosis and 6 osteopenic patients. No patients were found normal in group A. Group B includes 2 normal patients, 5 osteoporosis and 3 osteopenic patients. Table 3 and Graph 5 & 6 states the mean cortical width for Group A and Group B patients. The number of osteoporotic patients was greater in group B (63 -72yrs) than in group A (52 - 62yrs) due to decrease in testosterone level.

FIG 9; **PATIENTS WITH NORMAL CORTICAL THICKNESS**

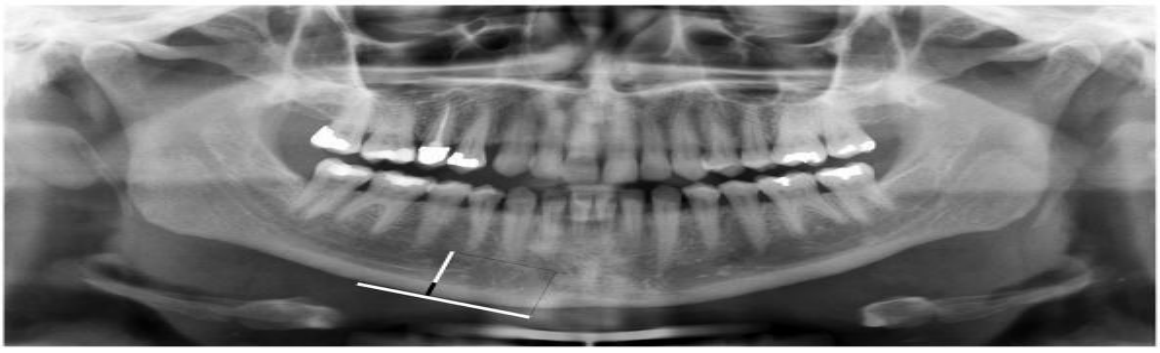


FIG 10 : OSTEOPOROSIS PATIENTS

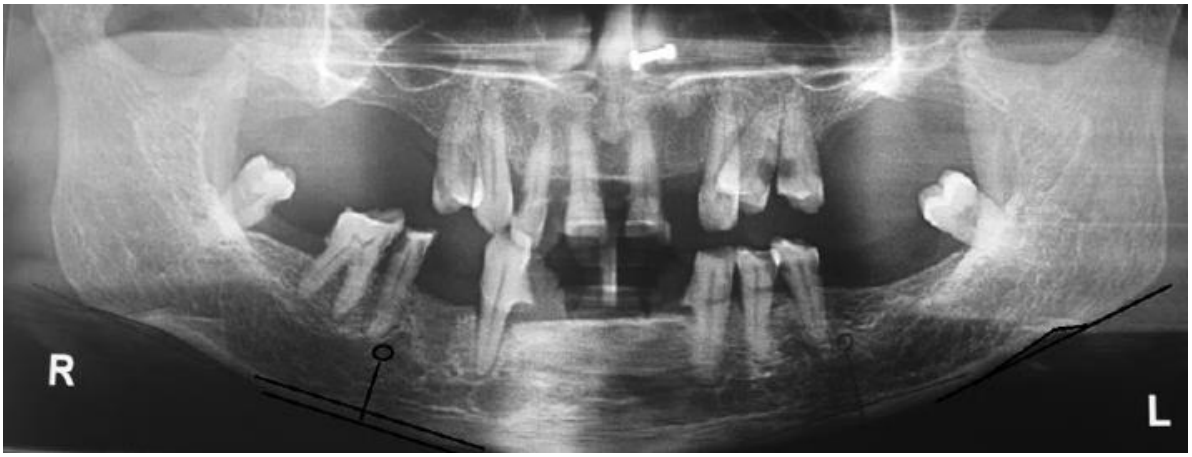
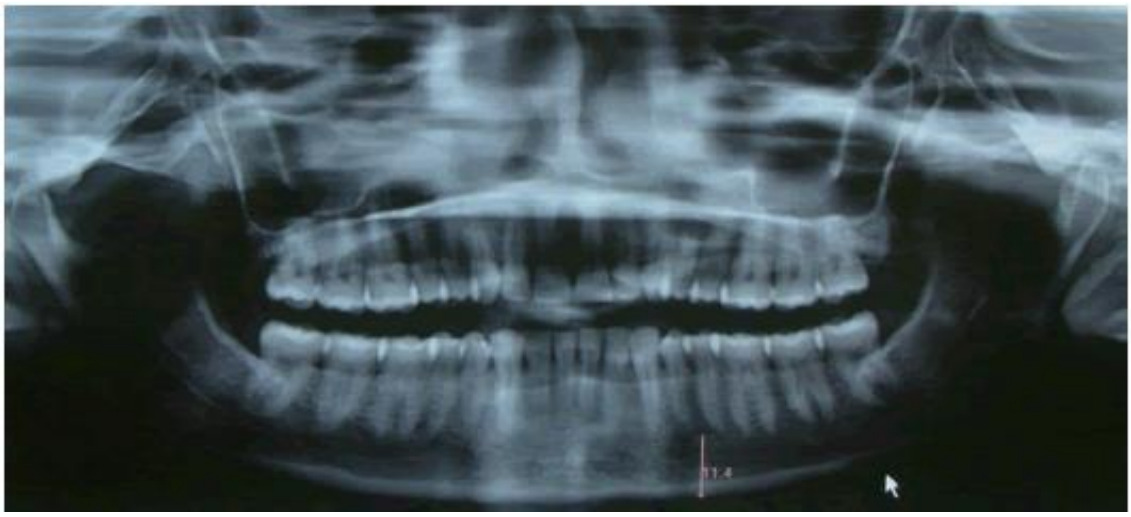


FIG 11: OSTEOPENIA PATIENTS



ESTIMATION OF DEXA SPINE

Dual energy x ray absorptiometry (DXA) scans to measure bone mineral density at the spine and hip. It has an important role in the evaluation of individuals at risk of osteoporosis, and in helping clinicians to explain the precautionary methods to prevent the fracture[43].Until the

mid 1980s bone density measurements were used mainly for research, and it was only with the introduction of dual-energy x ray absorptiometry (DXA) scanners in 1987 that they entered routine clinical practice[39]. The study conducted by **santosh patil et al 2017** in 269 subjects referred by clinicians for DEXA scan compared the sensitivity between lumbar spine and hip and found that determination of BMD at lumbar spine was more sensitive for diagnosis of osteoporosis in their study. In the present study lumbar spine was taken as sensitive site to detect osteoporosis.

White SC in 2005 conducted a study to predict the bone density in post menopausal women and suggested that in the dental practice, a cortical bone width 3– 4 mm seems not to be an appropriate threshold for referral for DXA examination in postmenopausal women. **Nakamoto T** in year **2003** showed that a 1-mm decrease in cortical bone width increases the likelihood of low BMD to 40% using DXA. **Devlin H, Horner in 2002** suggested that the MI has shown a long-term positive correlation with skeletal bone loss in dexa[44] , but it has presented inconsistent sensitivity. Regarding the cortical bone width (MI), 90% of the patients with width < 3 mm may present low BMD, and 30% of them have osteoporosis.

Similarly in our study patient who have cortical thickness of 3 to 4 mm are osteopenic and patients under 3 mm of cortical thickness are osteoporotic according to dexa spine. So in group A 40 % are osteoporotic and group B 50 % of post menopausal women are osteoporotic and results were statically significant. **Taguchi et al in 2006** conducted a study in 158 healthy postmenopausal women regarding the degree of agreement between the dental panoramic radiograph and the skeletal DXA in the identification of low BMD. He concluded that though OPG and dexa present a moderate to good sensitivity, they have never been used as interchangeable tools.

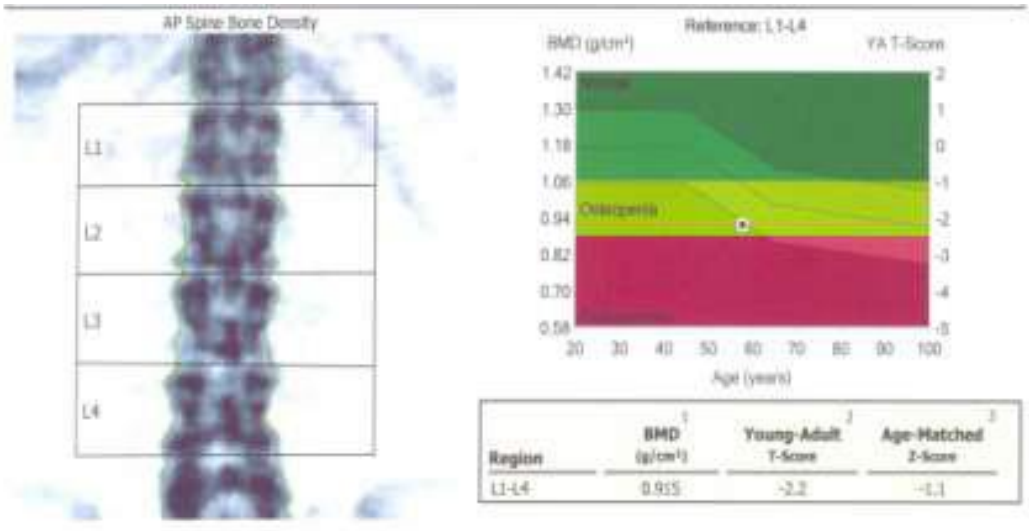


FIG-12: DEXA ANALYSIS SHOWING T SCORE WITH BMD

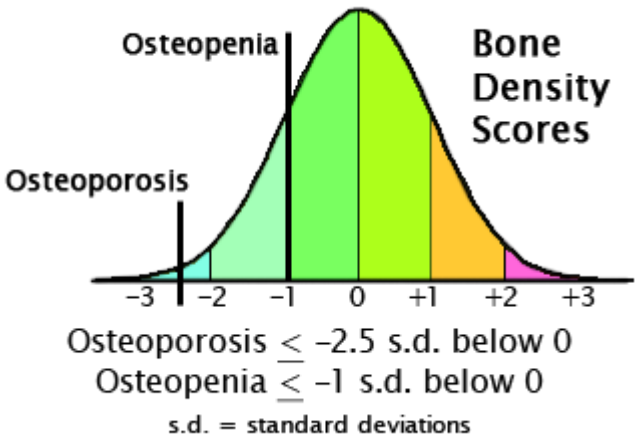


FIG-13: T SCORE VALUE

ESTIMATION OF SERUM TESTOSTERONE

Postmenopausal bone loss has been well documented because the reason behind inflated numbers of osteoporotic fractures in women in later life. Testosterone can

influence bone health by binding to androgen receptors directly or to estrogen receptors (ERs) indirectly via aromatization to estrogen. Cellular studies showed that androgen stimulated the proliferation of preosteoblasts and differentiation of osteoblasts. The converted estrogen suppressed osteoclast formation and resorption activity by blocking the receptor activator of nuclear factor k-B ligand pathway. According to the University of Rochester Medical Center, normal measurements range from 15 to 70 ng/dL

A Human experimental study conducted by **Mohamad Et Al In 2016** showed that estrogen was needed in suppressing bone resorption, but both androgen and estrogen were indispensable for bone formation and he concluded , maintaining optimal level of androgen is essential in preventing osteoporosis and its complications in elderly men and postmenopausal women.

Previous reports by **Adami S et al in 1998** showed that high androgen levels are associated with increased BMD in premenopause[45]. **Miller kk et al** in the year **2002** conducted a study in postmenopausal women with osteoporosis and fractures, both estrogens and androgens are lower, and estradiol and androgen therapy raised their BMD[46]. **Chevon M. Rariy et al** in the year 2011 conducted a observational study in 232 postmenopausal women aged above 65 yrs calculated the total and free testosterone compared with DEXA spine and hip of every individuals. In their study lowest mean total testosterone [8.6 ng/dl] and free testosterone [1.2 pg/ml] levels were seen in women with osteoporosis of the hip and the highest levels [16.3 ng/dl and 2.1 pg/ml] were seen in those with normal BMD which was statistically significant[47]. Similarly in our study serum testosterone was assessed for both the patients in group A and group B. Table 5 and graph 9, 10 explains number of normal and osteoporosis patients in group A and group B according to the serum value of testosterone which coincides with previous study. In Group A 3 patients were normal and in Group B only 2 patients were normal but osteopenia patients cannot be ruled out by testosterone estimation. In women of

the advanced age, testosterone is the major source of circulating estradiol. Testosterone may also regulate local production of cytokines and growth factors in bone, including IL-6, IL-1β, TGF-β, and IGFs[48]. The anabolic effects of T on muscle mass and strength could also indirectly affect bone mass. Additional studies are needed to elucidate the independence of the roles of physical activity and sex steroids on bone.

CO-RELATION BETWEEN DEXA AND OPG IN BOTH GROUPS

Esin Hastar, et al in his study showed that there were statistically significant differences according to gender and dental status in the radiomorphometric index values between patients with and without osteoporosis. Similarly, in our study we have described a statistically significant relationship between osteoporotic status and radiomorphometric indices (MI) as linked to dental status and bone mineral density[49].

CO-RELATION BETWEEN DEXA AND SERUM TESTOSTERONE IN BOTH GROUPS

Huong T. T. Nguyen et al in his observational study concluded that DEXA and serum testosterone results are statistically significant. Similarly our study supports the notion that estradiol levels have a stronger association with BMD, especially testosterone is more important as a predictor of BMD in postmenopausal women[50].

CO-RELATION BETWEEN OPG AND SERUM TESTOSTERONE IN BOTH GROUPS

There is significant relationship between OPG and serum testosterone showed the strong association between both the investigation. Further study should be conducted in larger population to confirm the results.

LIMITATION OF STUDY

The sample size was small and the aim of this study was to screen the finding of osteoporotic changes on panoramic radiographs. This study paves way for a future case-controlled study with a larger sample size in order to find a definitive correlation between osteoporosis detection on panoramic radiographs.

FROM THE STUDY THE FOLLOWING INFERENCES WERE MADE,

1. Age was correlated with the cortical width of the mandible in this study.
2. Postmenopausal women with osteoporosis may be identified by dental practitioners based on analyses of their panoramic radiographs.
3. The panoramic radiograph and the DXA demonstrated a moderate to good agreement, mainly when the results of the mandibular panoramic radiograph were compared with the DXA in the lumbar spine.
4. Maintaining optimal level of testosterone is essential in preventing osteoporosis and its complications in postmenopausal women.

Our results suggest that simple visual estimation of the mandibular cortical thickness at mental index on panoramic radiographs and simple blood investigation for serum testosterone estimation may be useful for identifying postmenopausal women with low BMD. Panoramic radiograph is a simple, quick, easy, inexpensive, non-invasive and widely used yet a sensitive diagnostic tool that has been proposed as a diagnostic marker for the systemic changes of osteoporosis and serum testosterone evaluation in menopausal women seems to be an important factor in the perception of low bone mineral density. Hence this study was undertaken to assess efficacy of panoramic radiographic index and serum testosterone as a diagnostic marker for osteoporosis.

As a technique for performing bone densitometry, hip and spine DXA examinations have a number of important clinical advantages including compatibility with the WHO T-score definition of osteoporosis, their proven effectiveness at predicting fracture risk, proven effectiveness for targeting of antifracture treatment, effectiveness at monitoring patients' response to treatment, and compatibility with the new WHO fracture risk algorithm. Other advantages include the stable calibration of hip and spine DXA scanners, the good precision of the measurements. Their future clinical use will be determined by the NICE guidelines and by the new approach of basing patient treatment on individual fracture risk but the disadvantage is equipment availability and expensive procedure. So Dual Energy X-Ray absorptiometry can be advised as a guidance tool for diagnostic and the therapeutic intervention in a needy cases.

Hence interpreting panoramic radiographs in regular dental practice are helpful in identifying patients with low bone mineral density, OPG should be mandatory adviced by oral physicians However, further studies should be carried out in larger population to substantiate the results.

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ANNEXURE I

INSTITUTIONAL ETHICAL COMMITTEE

Best Dental Science College and Hospital

Ultra Nagar, Madurai - 625 104.

RECOGNIZED BY DENTAL COUNCIL OF INDIA, NEW DELHI
AFFLIATED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI

IRB/IEC Reference No: 2016-STU-BrIX-KRI-26

Project title: Evaluation of serum testosterone level and bone mineral dentistry in post menopausal women.

Principal Investigator: Dr. R. Kirthika. PG student

Review: New/Revised/Expedited

Date of Review: 27/09/2016

Date of previous review, if revised application:

Decision of the IEC/IRB:

- Provisional approval to conduct the study is being given
- The results of this study, along with summary are to be submitted for obtaining final approval

Recommended time period: one year (28-09-17)

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104

ETHICS COMMITTEE SIGN DATE

INSTITUTIONAL REVIEW BOARD SIGN DATE

Signature of Member Secretary

NB:

- Inform IRB/IEC immediately in case of any issue(s)/adverse events
- Inform IRB/IEC in case of any change of study procedure, site and investigator
- This permission is only for the period mentioned above
- Annual report to be submitted to IEC/IRB
- Members of IEC/IRB have right to monitor the trail with prior intimation

ANNEXURE II

PARTICIPANT INFORMATION SHEET

TITLE OF RESEARCH : **EVALUATION OF SERUM TESTOSTERONE LEVEL AND BONE MINERAL DENSITY IN POST MENOPAUSAL WOMEN.**

NAME OF INVESTIGATOR: Dr. R.KIRTHIKA

Osteoporosis is a systemic bone disease that is characterized by a generalized reduction of the bone mass. This bone disease exhibits micro architectural degradation of bone scaffold that leads to increased bone fragility and more prone to fracture. Early diagnosis is essential to prevent its complications. DEXA scans are often used to diagnose or assess someone's risk of osteoporosis. As well as being quick and painless, a DEXA scan is more effective than normal X-rays in identifying low bone mineral density. Systemic bone loss is due to decline in estrogen level. Androgens enhance bone formation. Evidence suggest that testosterone alone is efficient than combination therapy. You are being asked to participate in this research study. You will be subjected to take DEXA skull and serum testosterone. However before you give your consent to take part in this study, you must read and understand the following explanation of proposed study. After you read it , please feel free to ask any questions you may have. This is to make sure you understand what your participation in this study may involve before you sign the informed consent. Your participation in this study is voluntary. The results of your samples will be kept confidential and used for research only.

INFORMED CONSENT

I confirm that I have read the participant information sheet on _____or it has been read to me, that I understand it, that I have had the opportunity to ask questions about it, and my questions have been answered to my satisfaction.

I have no objection to being a part of this study. The operator has promised to keep the confidentiality of my personal record. I understand that my participation is voluntary and I am free to withdraw at any time.

(In case of illiterate participant the information is explained and thumb impression is obtained in the presence of an unrelated witness. Right hand thumb impression for female)

Name of the participant

Signature

Date

Name of the researcher

Date

ANNEXURE II

[illegible]

[illegible]:

[illegible]:

[illegible]:

[illegible]:

[illegible]:[illegible] / [illegible]

[illegible].

[illegible].

[illegible],
[illegible].

[illegible].

[illegible].

[illegible].

[illegible]:...[illegible]
:..

ANNEXURE III

PROFORMA FOR CASE HISTORY

DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY

BEST DENTAL SCIENCE,MADURAI

NAME : REG NO:

AGE: DATE:

ADDRESS:

CHIEF COMPLAINT:

H/O PRESENTING ILLNESS:

PAST MEDICAL HISTORY:

H / o anemia :

H / o pain in long bones hand or feet :

H / o fall injury or fracture:

H /o any calcium supplement:

MENOPAUSAL HISTORY:

LAST CYCLE:

MOLIMINAL SYMPTOMS:

ANNEXURE III

ASS. PAIN:

VAGINAL DRYNESS:

PAST DENTAL HISTORY:

FAMILY HISTORY:

GENERAL EXAMINATION:

EXTRA ORAL:

INTRA ORAL EXAMINATION :

A. SOFT TISSUE:

GINGIVA

TONGUE

LABIAL MUCOSA

BUCCAL MUCOSA

HARD PALATE

SOFT PALATE

FLOOR OF MOUTH

B.HARD TISSUE:

ANNEXURE III

BLOOD INVESTIGATION :

Routine investigation : RBC ,WBC, BT ,CT , PCV, ESR , RBS , DLC

SERUM TESTOSTERONE-

RADIOLOGICAL INVESTIGATION:

1.OPG

2.DEXA

PROVISIONAL DIAGNOSIS:

ANNEXURE IV

GROUP A

F18

	A	B	C	D	E	F
1	NAME	AGE	SEX	DEXASPINE	OPG	SERUM TESTOSTERONE
2	SAROJA	62	F	OSTEOPOROSIS yes	YES2mm	yes11ng/dl
3	VIJAYALAKASHMI	54	F	NORMAL no	no3.4mm	no>14ng/dl
4	THULASI	55	F	NORMAL no	no3.5mm	no>8ng/dl
5	SHANMUGA NAYAKI	61	F	OSTEOPOROSIS yes	yes1mm	yes7ng/dl
6	SELVI	62	F	OSTEOPENIA yes	no3.9mm	yes13ng/dl
7	FATHIMA	62	F	OSTEOPOROSIS yes	yes2.4mm	yes12ng/dl
8	LALITHA	55	F	OSTEOPENIA yes	no3.5mm	yes9ng/dl
9	BHAVANI	55	F	OSTEOPENIA yes	no3.5mm	yes14ng/dl
10	JEYANTHI	52	F	OSTEOPOROSIS yes	yes1.9mm	yes6ng/dl
11	SHANTHI	53	F	NORMAL no	no3.9mm	no>7ng/dl
12						

GROUP B

F25

	A	B	C	D	E	F
1	NAME	AGE	SEX	DEXASPINE	OPG	SERUMTESTOSTERONE
2	YEGAMMAI	65	F	OSTEOPENIA yes	no3.8mm	12.5ng/dl yes
3	GEETHAMALA	67	F	NORMAL no	no4.2mm	>14ng/dl no
4	SEETHALAKSHMI	64	F	OSTEOPENIAyes	no3.5mm	11 ng/dl yes
5	SANKARESWARI	70	F	OSTEOPENIAyes	no3mm	12.92ng/dl yes
6	BOOPATHI	63	F	NORMALno	no4mm	>7.0 ng/dl no
7	RAJAMMAL	64	F	OSTEOPOROSISyes	yes2.8mm	13.52ng/dl yes
8	BACKIALAKSHMI	63	F	OSTEOPOROSISyes	yes2.1mm	9.52ng/dl yes
9	PRABAVATHY	68	F	OSTEOPOROSISyes	yes2.3mm	9.72ng/dl yes
10	GANDHI	72	F	OSTEOPOROSISyes	yes2mm	8ng/dl yes
11	KASTHURISEKAR	71	F	OSTEOPOROSISyes	yes1.9mm	13ng/dl yes
12						