ISSN 2515-8260 Volume 09, Issue 07, 2022

"A Dual and Correlate bone Mineral Density and Periodontitis Among Post-Menopausal Women"

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Abstract

Both periodontitis and osteoporosis represent major health problems, with increased incidence and severity with advancing age, all over the world. Osteoporosis, though notbeing the initial cause of periodontitis, has been shown to be risk indicator that may contribute to the progression of periodontal disease. Some interventions that improve systemic BMD also improve measures of periodontal disease. Improvement of the two conditions by the same therapies suggests an underlying connection.

The three classes of therapy that have been implicated in this regard are

1) Hormone replacement therapy (HRT)
2) Diet supplementation with calcium and vitamin D
3) Bisphosphonates

A bone mineral density (BMD) test is used to measure an individual's bone mass. BMD is measured using a DEXA scan. Most common cause is involutional bone loss in postmenopausal age group. Osteoporosis may be a primary disorder or secondary to other diseases or conditions. Primary osteoporosis includes idiopathic and involutional form. Idiopathic forms of osteoporosis are rare and affect men and women equally. Involutional osteoporosis includes two patterns type I (postmenopausal) and type II (age related) osteoporosis.

The present study was designed to assess and correlate bone mineral density and periodontitis among post-menopausal women.

Keywords: Periodontitis, Osteoporosis, Progression, Periodontal, Interventions, Implicated, Hormone replacement therapy (HRT), supplementation, Bisphosphonates, Involutional Bone, Postmenopausal

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Introduction

Type I osteoporosis occurs in postmenopausal women. Bone loss in premenopausal women is slow and approximately equal to that of men (0.3 to 0.5% per year). With the onset of menopause in females, an accelerated rate of cortical bone loss of two to three per cent per year for about eight to ten years. Type I osteoporosis related to estrogen deficiency associated with menopause, leads to a cascade of accelerated bone loss by decreased secretion of parathyroid hormone, increased secretion of calcitonin and decreased calcium absorption which further aggravates bone loss. In addition, patients with type I osteoporosis and high bone turnover have increased production of IL — 1 from stimulated monocytes as compared with age matched controls, which also contributes to increased bone resorption. Type II (age-related) osteoporosis appears to affect virtually the entire population of aging men and women (Genco, R.J., & Borgnakke, W.S., 2013). There is evidence that osteoporosis affects the craniofacial and oral structures, although the contribution of osteoporosis in the loss of periodontal attachments, teeth, and height of the residual ridge has not been clearly elucidated (Dervis, 2005).

Bone loss is a central, common feature of both periodontal disease and osteoporosis (Pejcic et al., 2005). Osteoporosis has the highest degree of osteopenia, characterized by bone loss leading to structural bone transformation. Mechanisms by which osteoporosis bone loss may be associated with periodontal attachment loss, loss of alveolar bone height and tooth loss have been proposed by Bartold et al. (2000) as follows:

a) Low bone density in the oral bone associated with low systemic bone: This low bone density or loss of bone density may lead to more rapid resorption of alveolar bone following insult by periodontal bacteria (Jeffcoat, 2005).
b) Modification of local tissue response to periodontal infections due to systemic factors affecting the bone remodeling: Persons with systemic bone loss are known to have increased systemic production of cytokines (interleukins (IL) 1 and 6 that may have effect on the bone throughout the body including bone of oral cavity. Periodontal infections have been shown to increase local cytokine production that in turn increases local osteoclast activity resulting in increased bone resorption.
c) There are also certain genetic factors that predispose a person to systemic bone loss resulting in periodontal destruction
d) Other factors such as cigarette smoking and sub optimal calcium intake may put

individuals at higher risk for development of both osteopenia and periodontal disease. (Shum et al., 2010).

Aims and Objectives

The aim of this study is to assess and correlate bone mineral density andperiodontitis among post-menopausal women aged between 45-65 years.

The objectives are:

a) To assess the bone mineral density in post-menopausal women using DEXAscan.
b) To assess the level of periodontal diseases in post-menopausal women.
c) To correlate the bone mineral density and periodontal diseases in post-menopausal women.

Review of Literature

Osteoporosis is defined by the World Health Organization (WHO) as a bone mineral density (BMD) that is 2.5 standard deviations (SDs) below the young normal. Osteopenia is defined as a BMD between 1 and 2.5 SD. According to the WHO assessment, the patient is assigned a score that represents a comparison to the average young (25- to 45-year-old) healthy adult of the same gender (T-score) or to the average healthy age- and sex-matched patient (Z-score). A 1-unit change in T-score corresponds to a 1-SD difference in BMD from that in a young, healthy individual of the same gender. Thus, osteoporosis corresponds to a T-score of -2.5 or lower, whereas osteopenia corresponds to a T-score between -1 and -2.5.[18]

Periodontitis, a major cause of tooth loss, is clinically determined by radiographic bone loss and/or clinical attachment loss (CAL). The prevalence of periodontitis in the U.S. population, if defined as at least 1 site with CAL of >2 mm, is approximately 80% in all adults affected by bone loss, and approximately 90% in those aged 55 to 64 years. Although bacterial plaque is the primary cause of periodontitis, host susceptibility or responsiveness is believed to play a major role in the initiation and progression of tissue destruction. Both osteoporosis and periodontitis are bone-resorptive, host-dependent, multifactorial diseases, and the bone loss in both diseases is exaggerated, either systemically or locally, by the activity of cytokines (e.g., IL-1 and IL-6). In this section, studies of the relationship between systemic bone loss (i.e., BMD) and oral bone loss (e.g., alveolar bone loss [ABL] and subsequent tooth loss) are explored.[19]

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Baxter et al in (1987) reviewed of the various factors that can cause osteoporosis and its impact on the periodontium was described by bone loss can be due to mechanical, systemic or nutritional factors and pose a great challenge to the dentist. Osteoporosis, a systemic condition resulting in loss of bone density occurs in one third of all postmenopausal women by the age of 60. Osteoporosis affects both the cortical and trabecular bone, which is attributed to dietary calcium deficiency and estrogen depletion respectively.

Jeffcoat et al in (1993) reviewed various risk factors associated with systemic osteoporosis and oral bone loss and their interrelationship. Generalized bone loss from systemic osteoporosis may render the jaws susceptible to accelerated alveolar bone resorption. The initiating risk factors for systemic osteoporosis, periodontitis differ. For systemic osteoporosis age and estrogen deprivation has been shown as the major initiating factors, which also have some risk factors in common with periodontitis.

Von voren et al in (1994) the possible relationship between osteoporosis and the degree of periodontal bone loss in elderly women was analyzed The study consisted of 26 dentulous Caucasian women divided into two groups, an osteoporotic group and a control files without this message by purchasing group. The osteoporotic group consisted of 12 dentulous patients with osteoporotic fractures and the control group consisted of 14 patients. Bone mineral content of the mandible and forearm was determined by dual photon scanning.

Krall et al in (1996) conducted study to evaluate the increased systemic bone loss can be a risk factor for tooth loss by contributing to the resorption of tooth supporting alveolar consisted of 189 postmenopausal women who participated in three intervention trials conducted within a 7-year period. Bone mineral density was measured by DEXA technique at whole body, femoral neck and spine. Teeth were counted at baseline and number and timing of teeth lost over the observation period were assessed by questionnaire. Women, who lost teeth during 7 year follow up, experienced less favorable changes in bone mineral density at all risks compared with women who lostno teeth.

Buer et al in (1997) was conducted study to elucidate the relationship between osteoporosis and tooth loss using correlations between tooth loss and spinal bone density. The relationship between clinical periodontal status and spinal bone density was also

evaluated. The study consisted of forty-four white women aged 50 to 75 years.

Hildebolt et al in (1997) conducted a study to determine whether postmenopausal bone loss and factors associated with osteoporosis affect tooth retention. The study consisted of 135 postmenopausal women in the age range of 41-70 years. Full mouth attachment loss measurements were made using a pressure sensitive probe. The clinical and dietary features such as body mass index, smoking history, and dietary calcium intake, age at menopause, years of lactation, number of pregnancies andnumber of missing teeth were recorded. Bone mineral density was measured at the vertebral and proximal femur regions using dual energy x-ray absorptiometry.

Bando et al in (1998) found possible relationship between masticatory function and skeletal bone mineral density (BMD) has been evaluated. The study consisted of twenty-six postmenopausal women between 57 and 74 years of age divided into two groups, the periodontally healthy group (group H) consisted of 14 women and the edentulous group (Group E) consisted of 12 women. BMD of the lumbar spine was measured by dual energy x-ray absorptiometry. In addition occlusal force was measured by using an occlusal diagnostic system. Risk factors associated with osteoporosis were assessed by interview and questionnaire sent to all participants.

Earnshaw et al in (1998) found poor dental status may be a suitable criterion for bone densitometry referral in early postmenopausal women. The study consisted of 1365 Caucasian women aged 45 to 59 years. Bone mineral density at lumbar spine and proximal femur was measured by dual energy x-ray absorptiometry. A full physical examination was performed including a tooth count.

Moria et al in (1998) conducted study to investigate the relationship between osteoporosis and alveolar bone loss. The study consisted of 20 four week old femalerats divided into four groups. Group A consisted of ovariectomized rats given with a standard solid diet, Group B consisted of ovariectomized rats given with calcium deficient diet, group C consisted of sham-ovariectomized rats given with a solid diet and group D consisted of sham-ovariectomized rats given with a calcium deficient diet. After 4 weeks the rats were euthanatized and maxillae, mandibles, femurs and tibias were removed carefully and fixed in 10% formalin. The bone mineral density of each boneand the alveolar bone loss was

measured by radiographic and visual inspection methods. The bone mineral densities of maxillae, mandible, femur and tibia in-group C were significantly higher than those in group B and group D, but not higher than those in-group A.

Weyant et al in (1999) conducted a clinical study, the association between systemic bone mineral density and clinical signs of periodontal tissue destruction in a large population of elderly dentate women has been evaluated. The study consisted of 292 dentate women who were randomly selected for a cross sectional periodontal sub study. Bone mineral density was measured using single photon absorptiometry (radius, calcaneous) and dual energy x-ray absorptiometry (hip, spine). Oral health examinations recorded were the number of missing teeth.

Payne et al in (1999) conducted study on alveolar bone height and density changes in osteoporotic / osteopenic women were compared with normal lumbar spine bone mineral density (BMD) in a prospective study. The study consisted of thirty-eight postmenopausal women of whom 21 women had normal BMD while 17 women had osteoporosis or osteopenia of the lumbar spine at the baseline. Four vertical bitewing radiographs of posterior sextants were taken at baseline and 2 year visits. Radiographs were examined using CADIA for changes in bone density at the crestal and subcrestal regions of interproximal bone. Changes in the alveolar bone height were also measured.

Soben Peter (1999) The probing depth recorded at three sites on the buccal and lingual surfaces of the teeth allows for the fact that the disease is not missed. The present study showed statistically similar mean probing depths in the controls and cases. The correlation between the BMD values and the probing depth showed statistical insignificance.

Lopez et al in (2000) conducted study by to detected early diagnosis by means of orthopantograms and oral x-rays. They found out there were 406 articles, and with the limits established, this number was reduced to 21. Almost all of the articles indicate that when examining oral x-rays, it is possible to detect signs indicative of osteoporosis and on this finding they came to conclusion that combination of mandibular indices, along with surveys on the risk of fracture, can be useful as indicators of early diagnosis of osteoporosis. Visual and morphometric indices appear to be especially important in the orthopantograms. Photodensitometry indices and the trabecular patterns are used in periapical x-rays.

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Pilgram et al in (2002) conducted study to evaluate the association between bone mineral density of the spine and hip and attachment loss38. The study consisted of 135 patients. The clinical parameters recorded were probing depth at 6 sites on each tooth, and recession measurements at baseline and at annual intervals for 3 years. Bone mineral density was measured with dual energy x-ray absorptiometry at the lumbar spine and proximal femur at baseline and at annual intervals for years. Correlations between cross-section measurements of clinical attachment level and bone mineral density were very weak, and did not approach statistical significance. A few somewhat stronger correlates were found between longitudinal changes in bone mineral density and attachment. There is no clear association between clinical attachment level and bone mineral density of the lumbar spine and proximal femur, whether examined on a cross-sectional or longitudinal basis. Patterns in the data suggest there may be a week association in the longitudinal changes.

Marque et al in (2003) conducted study by to associate between Periodontal disease and osteoporosis and mechanisms. Periodontitis and osteoporosis, diseases that affect millions of people in world, present bone loss as common hallmark. Prevalence of both osteoporosis and tooth loss increase with advancing age in both women and men. Systemic bone loss has been proposed as a risk factor for periodontal disease with increasing evidences that osteoporosis, and the underlying loss of bone mass characteristic of this disease, is associated with periodontal disease and tooth loss. Current evidences including several prospective studies support an association of osteoporosis with the onset and progression of periodontal disease in humans. Studies have provided evidence that hormones, heredity, and other host factors influence periodontal disease's incidence and severity.

Yoshira et al in (2004) to conducted evaluate the relationship between systemic bone mineral density and periodontal disease among older people. The study consisted of 184 subjects who did not have diabetes mellitus, who had more than 20 teeth, whowere non-smokers and who did not take medication for osteoporosis. The clinical examination included recording of probing attachment level at baseline and after 3 years. The bone mineral density of the heel was measured using an ultrasound bone densitometry, based on which two groups were made osteopenic and non osteopenic group. There was a significant relationship between periodontal disease and general bone mineral density.

Tezal et al in (2005) conducted a study on 70 post-menopausal women aged 51 to 78 years in 2000, to assess the relationship between bone mineral density and periodontitis. The mean alveolar bone loss was significantly correlated with BMD of the trochanter (r=-0.27), ward's triangle (r=-0.26), and total regions of femur (r=-0.25). MeanCAL appeared to be related to BMD consistently at all regions of the skeleton, although the association did not reach statistical significance. They concluded that skeletal BMDis related to interproximal alveolar bone loss and, to lesser extent, to clinical attachment loss, implicating postmenopausal osteopenia as a risk indicator for periodontal disease.

Suresh et al in(2010) [3] conducted a study on 20 women age between 45 — 55 years to assess the relationship between bone mineral density and periodontitis in premenopausal and postmenopausal women. All patients were assessed for plaque index, probing depth and clinical attachment loss. Radiographs were taken and assessed for interproximal alveolar bone loss. The patients were scanned to assess the bone mineral density of lumbar spine (L2) and femur using dual energy x-ray absorptiometry (DEXA). In results the bone mineral densities of lumbar spine and femur were significantly lower in the study group than the control group. Osteopenia of lumbar spine and femur was observed in 60% whereas osteoporosis of lumbar spine was observed in 30% of cases in study group. They concluded that increased proportion of osteopenia and osteoporosis cases of lumbar spine and femur in postmenopausal women with periodontitis suggests that there is association between bone mineral density and periodontitis.

Cagri et al in (2011) conducted a study on 600 patients in mean ages were 31 and 87 years respectively to determine bone height measurement of maxillary and mandibular bones in panoramic radiographs of edentulous patients. They found that in maxilla all vertical measurements distance were significantly greater in the edentulous men than in edentulous women ($p<0.05$). In the mandible all vertical measurements distance were significantly greater in the edentulous men than in the edentulous women ($p<0.05$). The results of this study may guide clinicians to make primer decision of implant insertion area for implant supported prosthesis in edentulous patients.

Kraft et al reviewed in (2012) Association between periodontitis and osteoporosis and possible therapeutical approaches in Periodontology discussed. Many research groups have considered a possible relationship between systemic loss of bone density andlocal bone loss

which occurs in periodontal disease. The goal of this review is to find evidence-based answers to frequently asked questions concerning osteoporosis and periodontitis. Furthermore, possible new treatment approaches, deriving from osteoporosis therapy, for periodontal disease will be discussed.

Veersha et al in (2013) conducted study on osteoporosis: A silent oral health deterrent that osteoporosis may accentuate that already existing periodontal diseases which are more prevalent in many developing and developed countries leading to early loss of teeth and have a great impact on the quality of life. The present prevalence of osteoporosis is about 10% and with the growing proportion of elderly population worldwide, this could become a major public health problem. However of its etiology, risk factors and management is of significant importance to health professionals.

Aspalli et al in (2014) conducted study to find out is there a possible link between osteoporosis and periodontitis on 200 subjects in which test group which was diagnosedwith osteporosis (n=100) and control group which included healthy group (n=100).Probing depth and CAL were significantly negative correlated with the T-score in test group when compared with control group. There was inverse relationship in between the T-score and clinical parameters, PD and CAL. Furthermore, some difference was noted in test group in PI, GI and PD, CAL and T-score when compared with controls. They concluded that there is definite relationship between osteoporosis and periodontitis based on PD and CAL.

Alves et al in (2015) conducted a cross sectional study on portugese population in to Evaluate the possible effects of menopause on the severity of periodontal disease and tooth loss, by considering several general, oral and periodontal parameters in which 102 women with chronic periodontitis, and at least six teeth, were divided into two groups: a study group (SG) consisting of 68 menopausal women and a control group (CG) consisting of 34 premenopausal women. The participants had extensive anamnesis, made by a single senior periodontologist, which collected demographic data, medical and gynaecological history and habits. Additionally, oral and periodontal parameters including: number of teeth, plaque index, presence of calculi, probing depth, bleeding on probing, gingival recession and attachment loss were recorded. The following statistical tests were used: Chi-square, Fisher's t-test for independent samples, non-parametric Wilcoxon-Mann-Whitney, and linear multiple regression. Results were found that the number of teeth was significantly lower in

postmenopausal women (SG 10.8 ± 5.9, CG 6.8 ± 4.6), however, after adjusting for age, smoking and plaque index, the difference was no longer statistically significant (*P*=0.169). The attachment loss was slightly higher in the study group, although the difference is not significant (SG 4.31 ± 1.08, CG 4.05 ± 1.28). They concluded that Menopause does not appear to significantly influence the severity of periodontal disease and tooth loss. Other factors may exert a greater influence on the progression of periodontal disease rather than menopause itself.

Material and Methods

The present study was undertaken at the Krishna Institute of Medical Sciences, Karad after due approval from the Ethical Committee of KIMSDU. (Ref no. KIMSDU/IEC/04/2014, dated 23/09/2014)

Procedure

The study consisted of 106 postmenopausal women in the age range of 45 to 65 years, out of which 12 patients were excluded as they did not fulfill the inclusion criteria's. Ninety four patients who were fulfilling the inclusion criteria's were considered and subjected to DEXA Scan to check for the level of osteoporosis. Depending on the BMD values the patients were divided into three groups as healthy, osteopenia and osteoporosis patients. Patients were dichotomized based on the T score obtained by bone mineral density test using dual energy x-ray absorptiometry technique. Detailed periodontal examination was carried out by a single calibrated examiner to diagnose the level of periodontitis. The level of osteoporosis and periodontitis were correlated to find out whether periodontitis is a risk factor for osteoporosis and vice versa.

Selection of patients:

Patients were randomly selected from outpatient section of KIMS hospital.

Inclusion criteria

a) Age group: post-menopausal women of 45-65 years
b) Patients who have at least 15 natural teeth.
c) Patients who were willing to be part of the study.

Exclusion criteria

a) Patients who required antibiotic prophylaxis
b) Patients suffering from Parathyroid disease, Metabolic disease or any Malignancy
c) Patients with history of early onset of menopause

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d) Patients on long term Steroid medication, Hormone Replacement Therapy (HRT) and calcium supplements.

Armamentarium

The following material was used for the study (Fig -1)

a) Mouth mirror
b) University of North Carolina(UNC)-15 probe(Hu-friedy)
c) Tweezers
d) Kidney tray
e) Disposable mask
f) Disposable gloves
g) Sterile gauze and cotton rolls
h) Instrument pouch
i) Data recording sheets, pens and pencils.
j) Disclosing agent- Basic Fuschin

Data Entry:

A specially designed case proforma was prepared and all the relevant data was entered in the pre-evaluated proforma.

Bone Mineral Density Evaluation:

BMD of the subjects was measured using dual energy x-ray absorptiometry (DEXA) with Prodigy system (GE, Prodigy health care system, Madison WI, encore version 12.30). The BMD of lumbar vertebrae was measured in anteroposterior view of lumbar vertebrae one to four (L1 to L4) (Fig-7)

All DEXA scans were performed by a single calibrated examiner, who was blinded tothe periodontal status of the patients.

The DEXA value or 'T' score is a comparison of patients BMD to that of a healthy 30- year-old adult with peak bone mass. The World health organization defines osteoporosis and osteopenia by measures of standard deviation (SD) as compared to that of normal healthy young adult]. According to WHO guideline it is graded as follows:

Table 1: Index Value

CONDITION	DESCRIPTION
Normal	BMD≤ 1SD below the mean for a young healthy adult.
Osteopenia	BMD > but < 2.5 SD below the mean for young healthy adult.
Osteoporosis	BMD ≥ 2.5 SD below mean for young healthy adult.

DEXA is established standard for measuring bone mineral density (BMD).DEXA scans are often used to diagnose or assess someone's risk of osteoporosis, a condition that weakens bones and make them more likely to break.

As well as being quick and painless, a DEXA scan is more effective than normal x-raysin identifying low bone mineral density.DEXA is two dimensional projection system that uses an x-ray beams which pass through bone are picked up by the detector (Fig-6). Computer is used to analyze the resulting images and calculate bone mineral density based on the amount of radiation absorb by the same. DEXA measurements are good predictors of fracture risk because the vertebrae is least affected by artifacts and earlier detection of change in bone mineral content is possible. There are two different types of DEXA scanning devices:

Central DEXA devices are large machines that can measure bone density in the center of skeleton, such as hip and spine and gives more accurate results so we have used thesame.

Peripheral DEXA devices are smaller, portable machines that are used to measurebone density on the periphery of skeleton, such as wrist, heel or finger. These are mainly to get an idea about whether further tests are needed, as they are not as accurate as the larger DEXA machines.

The readings obtained were:

a) The bone mineral density of the focused area which is expressed in units of grams / cm square.

b) T-score represents the difference from the peak bone mass for the population expressed in standard deviation (SD).

c) A low score indicates that the bone is less dense than it should be, some material of the bone has been lost, and it is more prone to fracture.

Periodontal Examination:

The periodontal status was recorded using the following parameters,

a) Probing pocket depth (PPD)

b) Clinical attachment level (CAL)

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c) Oral hygiene index(OHI)

d) Plaque index(PI)

a) Probing pocket depth (PPD) was measured from gingival margin to the base of gingival sulcus and was recorded at sixsites around all teeth (buccal, mesiobuccal, distobuccal, lingual, mesiolingual and distolingual). The UNC (University of North Carolina) — 15periodontal probe was inserted parallel to the vertical axis of the tooth and walked circumferentially around each surface of the tooth with constant probing force of 0.75 N (Fig-4).

b) Clinical attachment level (CAL)

Attachment loss was measured from cemento-eneamel junction to the base of sulcus at six sites around all teeth (buccal, mesiobuccal, distobuccal, lingual, mesiolingual and distolingual). The UNC — 15 periodontal probe was inserted parallel to the vertical axisof the tooth with constant probing force of 0.75 N and measured. The subjects were classified as having chronic periodontitis based on (AAP1999) consensus classification of periodontal diseases. Chronic periodontitis patients were characterized into three categories depending on level of average clinical attachment loss (CAL), slight: 1-2mm CAL, moderate: 3-4mm CAL and severe: ≥5mm CAL (Fig-5).

c) Oral hygiene index (OHI) (John C. Greene, 1964)

Oral hygiene index was depicted as a sensitive, simple method for assessing group or individual oral hygiene quantitatively. The oral hygiene comprises of two components, the Debris index (DI) and Calculus index (CI). Each of these index is based on numerical determination representing the amount of debris or calculus found on buccal and lingual surfaces of each of three segments of maxillary and mandibular dental arch.

i Debris index

0 – No debris or stain present

1 — Soft debris covering not more than one third of the tooth surface, or the presence of extrinsic stain without other debris regardless of surface area covered.

2 – Soft debris covering more than one third, but not more than two thirds of the exposed tooth surface.

3 – Soft debris covering more than two thirds of the exposed tooth surface.

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ii Calculus index

0 - No calculus present

1- Supragingival calculus covering not more than one third of the exposed tooth surface.

2- Supragingival calculus covering more than one third but not more than two third of exposed tooth surface or the presence of individual flecks of subgingival calculus around cervical portion of tooth or both.

3- Supragingival calculus covering more than two third of the exposed tooth surfaces or a continuous heavy band of subgingival calculus around cervical portion of tooth or both.

iii OHI's Calculation

The Buccal/ labial and lingual scores are tabulated and totalled for each segment and arch. The debris and calculus score are tabulated separately and the indices for each are calculated independently.

For an individual, the formula for DI and CI are:

DI- Buccal total score + lingual total score/ number of segments scored CI — Buccal total score+ Lingual total score/ number of segments scoredTo calculate OHI, the DI and CI are summed:

d) OHI = DI + CI

DI and CI value range from 0 to 3, and OHI which can interpreted as:

Interpretation=Good – 0.0 to 0.6

Fair - 0.7 to 1.8

Poor – 1.9 to 3.0

The OHI-S value ranges from 0 to 6, which can be interpreted as:

Good – 0.0 to 1.2

Fair - 1.3 to 3.0

Poor – 3.1 to 6.0

e) Plaque index (PI) (Turskey –Gilmore –Glickman Modification QuieglyHein Plaque Index, 1970)

A score of 0 to 5 is assigned to each facial and lingual non restored surface of all the teeth except third molars, as follows using Alphaplac (Alphaplac, DPI, Wallace Street, Mumbai) as a disclosing agent.

Scores	Criteria
0	No plaque
1	Separate flecks of plaque at the cervical margin of the tooth
2	A thin continuous band of plaque (up to one mm) at thecervical margin of the tooth
3	A band of plaque wider than one mm but covering less thanone-third of the crown of the tooth
4	Plaque covering at least one-third but less than two-thirds ofthe crown of the tooth
5	Plaque covering two-thirds or more of the crown of the tooth

An index value for the entire mouth is determined by dividing the total score bythe number of surfaces examined.

PI Calculation –

Index score = total score / number of surface examinedInterpretation —

A score of 0 or 1 is considered is low

A score of 2 or more is considered high.

f) Body Mass Index (BMI)

The body mass index (BMI) or Quetelet index is a value derived from the mass (weight) and height of an individual. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m², resulting from mass in kilograms and height in metres**.** The BMI is an attempt to quantify the amount of tissue mass (muscle, fat, and bone) in an individual, and then categorize that person as *underweight*, *normal weight*, *overweight*, or *obese* based on that value. Commonly accepted BMI ranges are underweight: under 18.5kg/m2, normal weight: 18.5to 25, overweight: 25 to 30, obese: over 30. (Fig-2 & 3)

The body mass index of post-menopausal women were calculated using weightand height (meter)².

$$\text{BMI} = \frac{\text{Weight of post-menopausal women}}{\text{Height (meter)}^2}$$

Apart from periodontal parameters, the following general parameters were recorded-

(i) Socioeconomic status

Socioeconomic status (SES) is one of the most important social determinants of health and disease, thus, widely studied constructs in the social sciences. Usually composite scales are used to measure SES, which has a combination of social and economic variables. Several

ways of measuring SES have been suggested for categorizing different rural and urban populations in last decades.

The most widely used scale for urban populations is Kuppuswamy's socioeconomic scale, which was devised by Kuppuswamy in 1976. Kuppuswamy scale is a composite score of education and occupation of the head of the family along with monthly income of the family, which yields a score of 3-29. This scale classifies the study populations into high, middle, and low SES. Usually education and occupation of head of family are not changeable with time. However, the income ranges in the scale lose their relevance following the depreciation in the value of the rupee. Steady inflation, lower interest rates, and country's current account deficits are the main factors contributing to fall in the value of currency. Therefore, it is needed to update the scale regularly for socioeconomic classification of study populations.

(ii) Education level

The data on education are based on Statistics Finland's Register of Completed Education and Degrees

Six categories are used for the level of education in vital statistics: basic level, lowest level, tertiary, lower degree level tertiary, higher — degree level tertiary, and doctorate or equivalent level. Educational level is measured by the duration of education. Lowest level tertiary education lasts 2 to 3 years after secondary education.

Lower degree level tertiary education comprises polytechnic degrees and lower university degrees. Higher degree level tertiary education comprises education with duration of 5 to 6 years after upper secondary education.

Results

After screening for eligibility using inclusion and exclusion criteria 94 post- menopausal women were selected for the study. Out of 94 post-menopausal women 60 (68.33%) maximum number belongs to age group 45-50 years which has highest percentage of patients and age group 51-55 years were 29 (30.85%). The least percentage of patients belongs to age group of 55-60 years 5 (5.32%).

Table 2: Distribution of patients according to Periodontitis

Periodontitis	Number of Patients	Percentage (%)
Slight	8	8.51
Moderate	62	65.96
Severe	24	25.53

Patients were screened for periodontal status and were divided into three categories as slight, moderate and severe according to Consensus of Periodontal Classification (AAP 1999). Out of 94 subjects 8(8.51%) were suffering from slight periodontitis, 62(65.96%) were suffering from moderate periodontitis and 24(25.53%) were suffering from severe periodontitis.

Table 3: Distribution of patients according to Bone Mineral Density

Bone Mineral Density	Number of Patients	Percentage (%)
Normal	4	4.26
Osteopenia	44	46.81
Osteoporosis	46	48.94

BMD was evaluated in all the subjects using DEXA machine and the subjects were categorised as normal, osteopenic and osteoporotic according WHO Classification depending upon the DEXA values Normal BMD ≤ 1 SD below the mean for a young healthy adult, Osteopenia BMD > 1 but < 2.5 SD below the mean for young healthy adult and Osteoporosis BMD ≥ 2.5 SD below the mean for a young healthy adult. Out of 94 subjects 4(4.26%) were having normal BMD levels, 44 (46.81%) were osteopenic and 46(48.94%) were osteoporotic.

Table 4: Distribution of patients according to Oral Hygiene Index

Oral Hygiene Index	Number of Patients	Percentage (%)
Good	23	24.47
Fair	57	60.64
Poor	14	14.89

Oral hygiene of the study subjects was evaluated using OHI (Greene Vermillion) and categorised on having good, fair and poor oral hygiene. Out of 94 subjects 23(24.42%) were having good oral hygiene, 57(60.64%) were having fair oral hygiene and 14(14.89%) were having good oral hygiene.

Table 5: Distribution of patients according to Plaque Index

Plaque Index	No. of Patients	%
Low	76	80.85
High	18	19.15

Score was calculated (Turskey –Gilmore –Glickman Modification Quiegly Hein Plaque Index,1970) using alphaplac disclosing agent in which out of 94 patients 76(80.85%) patients were having low plaque index while 18(19.15%) were having high plaque index.

Table 6: Distribution of patients according to Post-Menopausal History

Post-Menopausal History	No. of Patients	%
0-4 years	41	43.62
5-9 years	42	44.68
>10 years	11	11.70

Out of 94 subjects 42(44.68%) females were having post-menopausal history of 5-9 years, 41(43.62%) were having history of 0-4 years. Only 11(11.70%) females were having post-menopausal history of >10 years.

Table 7: Distribution of patients according to BMI

BMI	**Number ofPatients**	**Percentage (%)**
Normal	3	3.19
Overweight	69	73.40
Obese	22	23.40

The body mass index (BMI) or Quetelet index is a value derived from the mass (weight) and height of an individual. The body mass index of post-menopausal women was calculated using weight and height (meter)². Out of 94 patients 69(73.40%) patients were overweight, followed by 22(23.40%) were obese while only 3(3.19%) patients were having normal BMI.

Table 8: Distribution of patients according to Education

Education	**Number of Patients**	**Percentage (%)**
Illiterate	3	3.19
4-10 std	57	60.64
11-12 std	15	15.96
Graduate or other Professional coarse	17	18.09
Post Graduate	2	2.13

Out of 94 patients 57 (60.64%) patients were having education in the class of 4^{th} to 10^{th}, followed by 17 (18.09%) were having education up to graduation or other professional course. 15 (15.96%) have education up to 11^{th}-12^{th} while only 2 (2.13%) patients have done post-graduation and 3 (3.19%) were illiterate.

Table 9: Distribution of patients according to Socio Economic Class

Socio EconomicClass	**Number of Patients**	**Percentage (%)**
> Rs. 26000	4	4.26
Rs. 16000- Rs. 25000	10	10.64
Rs. 11000- Rs. 15000	8	8.51
Rs. 5000- Rs. 10000	63	67.02
< Rs. 5000	9	9.57

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Out of 94 patients 63 (67.02%) patients were having monthly income in the socio economic class of Rs. 5000- Rs. 10000, 10(64.02%) were having monthly income in the socio economic class of Rs. 16000- Rs. 25000. 9(9.57%) had monthly income < Rs. 5000 and only 4(4.26%) had monthly income > Rs. 26000.

Correlation Relationship

Coefficient of correlation (r) was calculated using the periodontitis and bone mineral density values. There was no correlation between periodontitis and bone mineral density ($r= -0.009$, $p< 0.339$)

Chi square test of Independence

Table 10: Association between Periodontitis and Bone Mineral Density

Periodontitis	Bone Mineral Density			
	Normal	**Osteopenia**	**Osteoporosis**	**Total**
Slight	1	4	3	8
Moderate	3	23	36	62
Severe	0	17	7	24
Total	4	44	46	94
Chi-square statistic = 9.76, p-value = 0.045				

The chi square test was used to check the association between periodontitis and bone mineral density. Since the p-value (0.045) is less than the significance level (0.05), we conclude that there is a relationship (association) between periodontitis and bone mineral density.

Discussion

Bone remodeling is a lifelong process, which allows the replacement of old tissues, repair of injuries and adaptation to physical constraints. Metabolic bone diseases such as osteoporosis, that lead to demineralization are the result of unbalanced remodeling cycles, so that less new bone is formed than resorbed at each cycle of active remodeling. Osteoporosis is characterized by low skeletal bone mass and fragility, which cause hip, radius and vertebral fractures. Because bone loss in osteoporosis is a generalized condition it also affects the cranial skeleton, and there is evidence that the loss of alveolar bone as a manifestation of osteoporosis. Reports indicated that age- related loss of bone is more pronounced in postmenopausal women due to estrogen deficiency (Birkenfeld L, Yemini M, Kase N G, Birkenfeld A., 1999).

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Some researchers have suggested a relationship between periodontal disease or tooth loss and Osteoporosis. One of the main features of periodontal disease is severe alveolar bone loss. Genco and Loe reviewed the role of systemic conditions and disorders in periodontal disease and indicated that osteoporosis could be implicated as a contributing factor to the progression of periodontal disease.

The present cross sectional study was conducted to determine the effect of osteoporosis on the periodontal status in a group of 94 postmenopausal women who were divided into three groups as; normal, osteopenic and osteoporotic group. The subjects were dichotomized based on the bone mineral density test, aided by medical history. Bone mineral density test was carried out at the lumbar spine level for all the subjects, as it is considered as a gold standard for diagnosing osteoporosis (Elders et al, Tezal et al, Weyant et al, Hildebolt et al).

According to Richelson et al 1984, ovarian deficiency and associated alterations, but not aging as the predominant causes of bone loss during the first two decades after menopause. Hence, the subjects included in the present study were in the age range of 45-65 years. As the significant effect of systemic bone loss on localized periodontal disease may not become apparent until a certain amount of bone is lost at older ages (Tezal et al), so this particular age range was selected for the present study.

Several potential mechanisms have been proposed by which osteoporosis or systemic bone loss may be associated with periodontal attachment loss, loss of alveolar bone height and tooth loss.

(i) Low bone density in the oral bone associated with low systemic bone: This low bone density or loss of bone density may lead to rapid resorption of alveolar bone following insult by periodontal bacteria.

(ii) Modification of local tissue response to periodontal infections due to systemic factors affecting the bone remodeling: Persons with systemic bone loss areknown to have increased systemic production of cytokines that may effect on the bone throughout the body including bone of oral cavity. Periodontal infections have been shown to increase local cytokine production that in turn increaseslocal osteoclasts activity resulting bone resorption

(iii) Genetic factors that predispose a person to systemic bone loss: Genetic factors may also influence or predispose an individual to periodontal destruction.

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(iv) Environmental factors such as cigarette smoking and sub optimal calcium intake, among others, may put individuals at risk for development of both osteopenia and periodontal disease (National Osteoporosis Foundation, 2002)

In present study there is association between periodontitis and bone mineral density, the p-value (0.045). We conclude that there is a relationship (association) between periodontitis and bone mineral density and are in accordance with study conducted by Aspalli et al in which they found that there is definite relationship between osteoporosis and periodontitis. Similar study conducted by Suresh et al found that increased proportion of osteopenia and osteoporosis cases of lumbar spine and femur in postmenopausal women with periodontitis.

Study conducted by Tezal et al concluded that skeletal BMD is related to interproximal alveolar bone loss, implicating postmenopausal osteopenia as a risk indicator for periodontal disease. A double blind case control study conducted by Juluri et al inferred a possibility of probable relationship between osteoporosis and periodontal disease. Study conducted by Lohana et al suggests that increasing severity of periodontitis increased risk of osteoporosis and vice versa, and there is definite association between periodontitis and osteoporosis. Pejcic et al conducted study in which they concluded that osteoporosis has a significant role in development of periodontitis, as loss of oral bone due to osteoporosis can change the process of disease.

Study conducted by Vishwanath et al found that calcaneal BMD was related to alveolar bone loss and to a lesser extent, to clinical attachment loss, implicating postmenopausal women bone loss as risk indicator for periodontal disease.

Study conducted by Aggarwal et al found there is a significant correlation between mandibular cortical index and bone mineral density of the lumbar vertebrae as determined by dual energy x-ray absorptiometry (DEXA).

The relationship of tooth loss and BMD has been studied. Several reports find a correlation between tooth loss and diminished systemic BMD (Dawson et al, Taguchi et al and Jeffcoat et al, Tezal et al, Cagri et al, Suresh et al, Lin et al, Aggarwal et al.,)

A direct relation between osteoporosis and destruction of periodontal tissues,established by measuring the loss of the inter-proximal alveolar bone in post- menopausal women, was presented by Wactawski et al.

Postmenopausal women with osteoporosis had a 2.5 times greater risk of having periodontal disease than women without osteoporosis, confirming the previous findings regarding alveolar crest height. Osteoporotic women presented with higher CAL values than those with normal BMD, while CAL measurements of osteopenic women did not differ from those with normal bone density levels. This would suggest that early diagnosis of low BMD prior to occurrence periodontal disease may be beneficial to prevent periodontal disease. Another study also found that osteoporotic sites had significantly higher inter-proximal CAL values than non-osteoporotic sites in postmenopausal women. The statistical results of all these studies suggest osteoporosis as a risk indicator for periodontal disease in postmenopausal women.

Drozdzowska et al, Famili et al and Krall et al did not show an association between osteoporosis and periodontal disease. This may indicate that the number of teeth may not be relevant in the assessment of a relationship. If the local effects of occlusion and the attached muscle, as well as smoking, had been factored out, the results might have demonstrated a more convincing difference. The difference in the results of these previous studies may be due to difference in the study population and design of the study.

A total of 94 post-menopausal women in the age range of 45-65 years were evaluated for bone mineral density using DEXA scan. The level of periodontal disease was measured and correlated with BMD values.

Following conclusion can be drawn from the study

(i) There is an association between severity of periodontal disease and osteoporosis in post-menopausal women.

(ii) The level of education and socioeconomic status did not have any association with level of osteoporosis.

The occurrence of osteopenia and osteoporosis of lumbar vertebrae in post- menopausal women with periodontitis suggests that there is an association between bone mineral density and periodontitis and that the severity and extent of alveolar bone loss in post-menopausal women may be a risk indicator for systemic bone loss.

There is also evidence that patients with postmenopausal osteoporosis have decreased bone mass in the jawbones. Therefore, estrogen deficiency may enhance the progression of marginal periodontitis, either by causing increased expression of osteotropic cytokines, or by decreasing the amount of alveolar jawbone.

Limitations

The study consisted of smaller sample size and further longitudinal studies with larger sample size are required for better understanding of the relationship between these two diseases.

Future Perspective

Periodontist and Orthopaedicians should understand the effects of osteoporosis on both systemic and oral health. These two health care providers working together could increase the awareness among people, offer early diagnosis of the disease, elucidate solutions and fabricate treatment modality.

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