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ORIGINAL RESEARCH

Evaluation of Effect of Bisphosphonates on Dental Implant Therapy in Postmenopausal Women Using Cone Beam Computed Tomography

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ABSTRACT

Aim: Osteoporosis is one of the diseases which show significant bone mass reduction especially in post menopausal women. The present study was conducted to determine the effect of Bisphosphonates (BP) on alveolar bone and dental implant therapy in women after menopause.

Materials and methods: The present study was conducted on 30 postmenopausal women who received at least one dental implant in the last 5 years. Group I comprised of 15 patients who were on BP therapy for 1.5 years, and group II consisted of 15 patients who were on parathyroid hormone (PTH). Bone mineral density (BMD) and bone thickness were assessed in both groups.

Results: Group I had 3.85% and group II had 3.15% of dental implants failures. BMD of cortical bone was 1552± 145 mg/mL and 1012 ± 94 mg/mL in groups I and II respectively. BMD of cancellous bone was 80 ± 15 mg/mL and 104 ± 72 mg/mL in group I and group II respectively. The difference was significant ($p < 0.05$). Cortical bone thickness was 2.5 ± 0.6 mm in group I and 2.2 ± 0.8 mm in group II. The difference was non-significant ($p > 0.05$). There was a reduction in BMD (mg/mL) of cortical and cancellous bone. There was an increase in cortical bone thickness with the use of BPs over the years. The difference was significant ($p < 0.05$).

Conclusion: There was a decrease in bone mineral density of both cortical and cancellous bone in both groups. There was increase cortical bone thickness on prolonging use of BPs.

Clinical significance: Patients on BPs therapy should be carefully evaluated both clinically and radiographically before dental implant treatment as these agents affect the quantity and quality of cortical bone especially in the posterior mandibular region in patients with osteoporosis.

Keywords: Bone mineral density, Dental implant, Osteoporosis, Postmenopause.

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INTRODUCTION

Dental implants have popularized over the past few years due to various reasons. The higher success rate over 95% in 5 to 10 years have made this treatment of choice in most of the partially or completely edentulous cases. However, there are few absolute contraindications of dental implant therapy. Hyperthyroidism, diabetes mellitus (DM), osteoporosis, etc. are among few examples.[1]

It has been observed that with advancing age there is osteoporosis due to low calcium level and women are liable to show a reduction in bone density. Women after menopause show increase in cancellous bone and low cortical bone. BP therapy is useful in cases of osteoporosis. BP is an inhibitor of bone resorption, and it indirectly increases bone mass. Studies have shown that women are prone to develop osteoporosis, especially after menopause.[2]

Parathyroid hormone (PTH) therapy is widely used in postmenopausal osteoporosis in women and osteoporosis in men. It acts by increasing bone turnover by increasing renal production of 1, 25-dihydroxy vitamin D and by GIT calcium absorption. However, patients on BP therapy are more likely to develop osteonecrosis which is known as BP induced osteonecrosis. This is the biggest drawback of this therapy. Patient exhibit altered bone microarchitecture shown by dual-beam X-ray absorptiometry (DXA), increased risk of fracture and increased bone fragility.[3]

Patient receiving a dental implant should be screened carefully as there are a few parameters which can lead to implant failure therapy. Though BP is anti-bone resorptive agents, BP induced osteonecrosis cannot be overcome. Hence, to ensure successful dental implant therapy in patients especially women after menopause, there is a requirement of estimation of bone mineral density (BMD).[4] Considering this, the present study was conducted to determine the effect of BP on alveolar bone and implant therapy in women after menopause.

MATERIALS AND METHODS

The present 7 yearsstudy was conducted on 30 postmenopausal women above 60 years of age. All were diagnosed cases of osteoporosis and had at least 1 dental implant in the last 5 years. Patients with unilateral or bilateral edentulous mandible were included in the study. Exclusion criteria for BPs included patients on medicationssuch as steroids, history of type II DM, periodontal diseases and other bone resorptive disorder. Patient consent was obtained prior to the commencement of the study. Ethical clearance was obtained from the ethical committee.

General information such as name, age, gender, etc. was recorded. Patients were divided into two groups. Group I comprised of 15 patients who were on BP therapy (Tab Alendronate 10 mg once daily) since 1.5 years and group II consisted on 15 patients who were on parathyroid hormone derivative (PTH) (injection teriparatide 20 mcg once daily).

All were subjected to CBCT of the posterior edentulous mandibular region with Planmica CBCT machine operating at 120 kVp, 1–10 mA and exposure time of 18 seconds. Slice thickness of 0.3 mm was used. A phantom containing calibration cellsof two equivalent concentrations of calcium hydroxyapatite was simultaneously scanned to quantifythe BMDs. The values obtained from the edentulous mandible were thencompared with those of the calibration phantom to measurethe BMDs (Fig. 1) per unit area (mg/mL) for both regions. Cancellous and cortical bone thickness was measured (Fig. 2) using the software. The procedure was repeated every year for 7 years. Cancellous and cortical bone thickness was compared between both groups using Mann Whitney test. A p-value less than 0.05 was considered significant.

RESULTS

Mean age of patients in group I was 62.4 years, and in group II was 63.1 years. There was one dental implant failure out of 26 in group I. Group II had one dental implant failure out of 32 implants (Table 1). BMD cortical bone in group I was 1552 ± 145 mg/mL, and in group II was 1012 ± 94 mg/mL. BMD of cancellous bone in group I was 80 ± 15 mg/mL and in group II was 104 ± 72 mg/mL (Table 2). The difference was significant ($p < 0.05$). Cortical bone thickness found to be 2.5 ± 0.6 mm in group I and 2.2 ± 0.8 mm in group II (Table 3). The difference was nonsignificant ($p > 0.05$). It was found that there was a reduction in BMD (mg/mL) from 1st year to 4th year, a slight increase in a 5th year and subsequently reduction till 7 years (Graph 1). However, the difference was non- significant ($^{p} > 0.05$). It was seen that the BMD of cancellous bone showed a slight decrease in values over

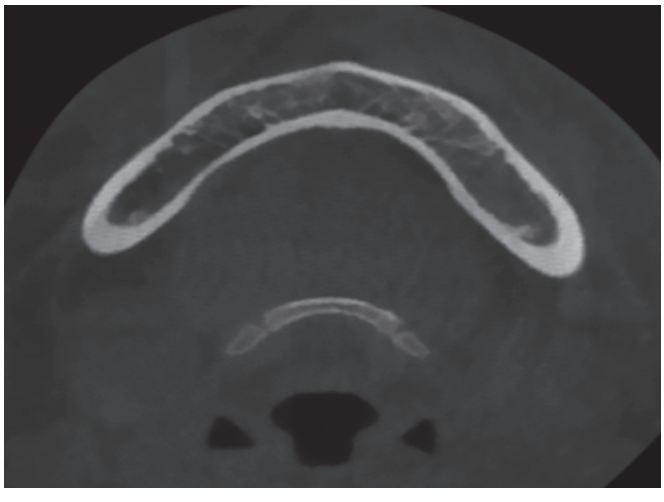


Fig. 1: Assessment of bone mineral density

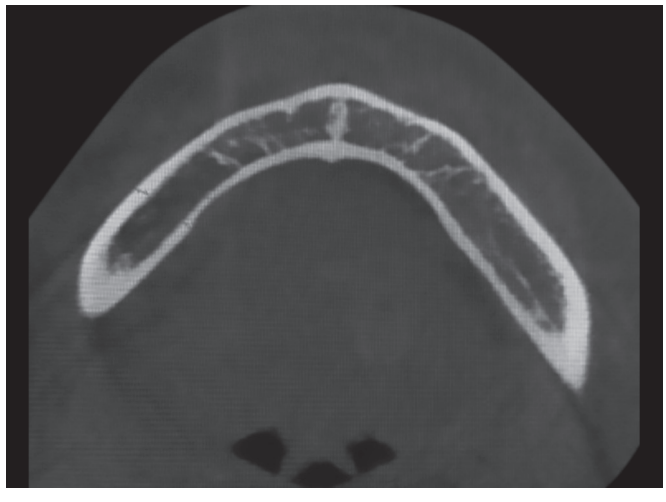


Fig. 2: Assessment of cortical bone thickness

Table 1: Demographic data of patients

Parameters	*Group I*	*Group II*
Mean age (years)	62.4	63.1
Number of dental implants	26	32
Failure cases	1 (3.84%)	1 (3.12%)

Table 2: Bone mineral density (BMD) in both groups

Bone mineral density	*Group I*	*Group II*	*p value*
BMD of cortical bone (mg/mL)	1552 ± 145	1012 ± 94	0.01
BMD of cancellous bone (mg/mL)	80±15	104±72	0.02

Table 3: Cortical bone thickness in both groups

Groups	*Group I*	*Group II*	*P value*
Cortical bone thickness (mm)	2.5 ± 0.6	2.2 ± 0.8	0.14

years (Graph 2), but the difference was non- significant ($p > 0.05$). There was an increase in cortical bone thickness with the use of BPs over years (Graph 3). The difference was significant ($p < 0.05$).

DISCUSSION

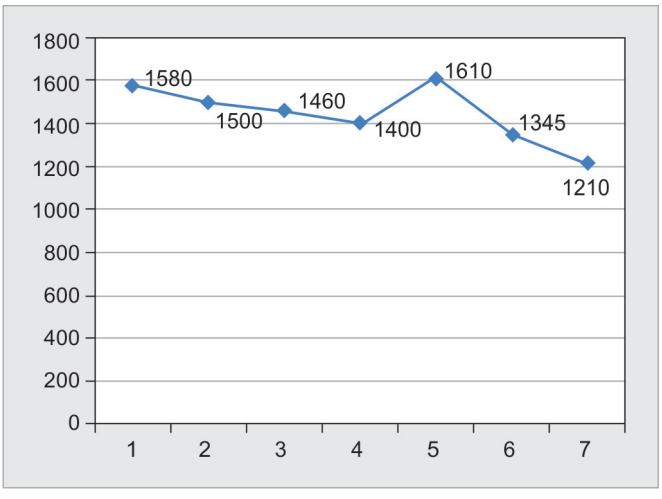
Osteoporosis is a silent condition prevalent in women. It starts itself without showing many clinical symptoms. The diagnosis of osteoporosis is based on the bone mineral density of proximal femur and spine measuredwhen it is 2.5 or more standard deviations belownormal peak bone mass by DXA. Women are more at risk of developing osteoporosis due to various reasons.[5] After menopause, there is a reduction in calcium in the bone due to bone resorption, making long bones vulnerable to fracture. Subsequently, menopausal women pose a challenge for the clinician during dental implant therapy. In women, the reason for osteoporosis is a deficiency of estrogen which leads to increased destruction of bone as compared to bone formation. The imbalance between the two processes leads to bone loss of up to 4–5% per year after 1 year of post menopause.[6]

Bisphosphonate (BP) is most commonly and extensively used a pharmacological agent in the management of osteoporosis of spine bone. Nitrogen-containing BPs alendronate (ALN) and risedronate(RIS) are widely used in postmenopausal women for the prevention of osteoporosis. BP causes thickening of cortical borders and lamina dura, narrowing of the inferior alveolar canal and diffuse sclerosis.[7] Though it indirectly prevents bone resorption, but bisphosphonate-induced osteonecrosis may occur. PTH derivatives stimulate bone formation by enhancing bone matrix formation by osteoblasts. This drug increases bone mass by preventing bone resorption and can be safely used in postmenopausal women and in men who are at great risk for fractures.

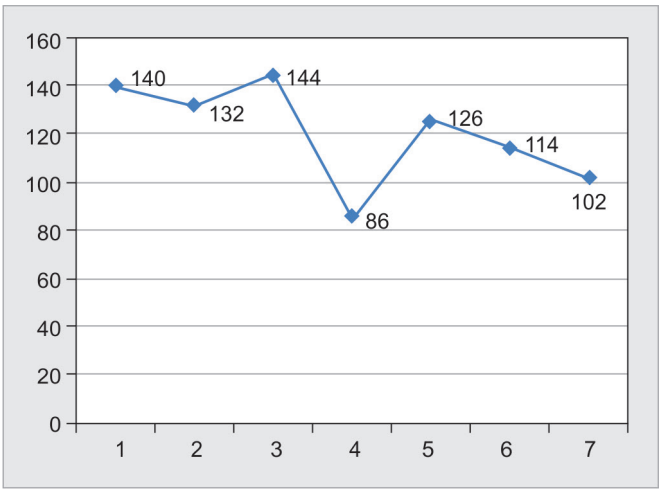
In the present study, 30 postmenopausal women were divided into two groups (group I on BPs, group II on PTH) (Table 1). It was observed that BMD of cortial bone in group I was significantly more as compared to group II. Similarly, the BMD of cancellous bone was higher in group II as compared to group I (Table 2). Mashiba et al.[8] in their study found that the there was significantly increased BMD of cortical bone ofdog rib. Similar results were found in the present study.

Carvas et al.[9] found that on zoledronic acid administration there was increased cortical bone thickness in the tibial bone of rabbits. Yip et al.[10] conducted a study on middle-aged women to evaluate the association between oral bisphosphonate use and dental implant failure and observed that patients on oral BPs had 66.7% decrease in the survival rate of dental implants.

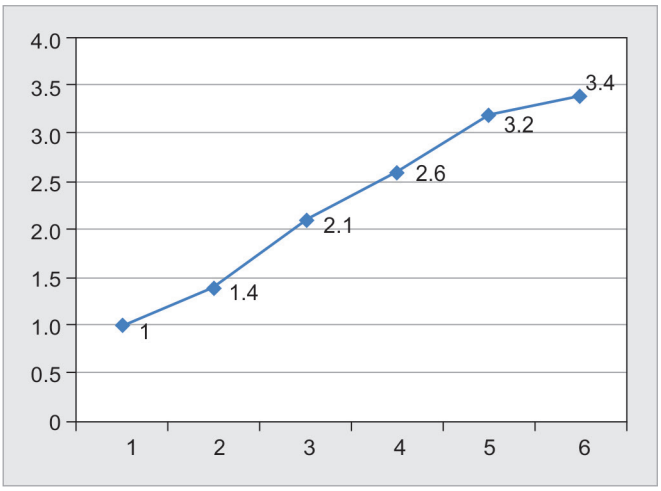
Literature has suggested that osteoporosis in postmenopausal women is because of elevated levels of bone resorption resulting from increased bone turnover. There is osteoclasticbone resorption in the first stage of the bone remodeling process, which can be loweredby suppressing osteoclast generation, osteoclast activity or both.[11,12]



Graph 1: Association of the duration of BP use with BMD of cortical bone



Graph 2: Association of the duration of BP use with BMD of cancellous bone



Graph 3: Association of BPs use and cortical bone thickness

It was observed that there was an increased cortical bone thickness in patients on PTH as compared to on BPs (Table 3). Zahid et al.[13] in their study determined whether there is any effect of BP on dental implant success rate. Authors found that out of 51 implants placed in 26 patients, there was a failure in only 3 cases. 94.11% of success rate was observed. Higher implant failure was seen in maxillary arch than in mandibular arch.

In the present study, it was observed that there was a reduction in BMD (mg/mL) of cortical bone over years. Similarly, BMD of cancellous bone showed a slight decrease in values over the years, but the difference was nonsignificant ($p > 0.05$) (Graphs 1 and 2). De-Freitas et al.[14] in their systemic review observed 8.5% dental implant failure rates in patients who were on BPs than those who were not (1.6%). In the present study, we observed that there were 3.84% and 3.15% of dental implants failure in group I and group II respectively. The difference between both groups was non- significant ($p > 0.05$). It was observed that the cortical bone thickness increased as age advanced (Graph 3).

Koh and Kim[15] evaluated postmenopausal osteoporosis in females using CBCT by evaluating mandibular indices. Sandra et al. in their study evaluated cortical bone thickness in patients with bisphosphonate-related osteoporosis of jaws using CBCT. Authors found that there was slightly higher cortical bone thickness in patients on BPs than the control group.

In the present study, we used CBCT in determining cortical bone thickness in postmenopausal women (Figs 1 and 2). CBCT has been proved efficient tool in dentistry in various conditions. The less exposure as compared to CT scan is one of the best advantages which make this technique universally accepted.[16] Moreover, it is cost effective and depending upon the area of interest, and images can be acquired. The limitation of this study was a small sample size and only postmenopausal women were selected. The only mandibular posterior region was selected. Men with diagnosed cases of osteoporosis were not included in this study. The changes in bone architecture could be due to other effects of PTH derivatives on patients who received it. Large scale studies are needed to be done.

CONCLUSION

It was found that BPs may increase cortical bone thickness. There was a decrease in bone mineral density of cortical as well as cancellous bone in both groups.

CLINICAL SIGNIFICANCE

Patients on BPs therapy should be carefully evaluated both clinically and radiographically before dental implant treatment as these agents affect the quantity and quality of cortical bone, especially in the posterior mandibular region in patients with osteoporosis.

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