ORIGINAL ARTICLE

Early detection of osteoporosis from incisure depth of human mandible in an orthopantomogram

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Abstract

Objectives: To see the correlation between changes in incisure depth of mandible on an orthopantomogram with bone mineral density and whether or not it can be employed for screening and early detection of osteoporosis.

Method: The analytical cross-sectional study was conducted at the Institute of Basic Medical Sciences, Dow University of Health Sciences, Karachi, from December 2011 to July 2012. It comprised 174 female subjects between 25 and 85 years of age who were divided into premenopausal (Group I) and postmenopausal (Group II) groups. Group I and Group II were further subdivided into normal (pre A, post A), osteopenic (pre B, post B) and osteoporotic (pre C, post C) groups on the basis of Dual Energy X-ray Absorptiometry scan. Changes in mandibular incisure depth seen on orthopantomogram in subgroups of Group I were compared with each other and with subgroups of Group II. SPSS 16 was used for statistical analysis. One-way Analysis Of Variance was applied to evaluate intra-group significance. For inter-group significance, independent samples t-test was applied.

Results: The depth of mandibular incisure was found to be significantly increased in osteoporotic patients ($p<0.05$).

Conclusion: The simple screening tool can be employed for early detection of osteoporosis in a cost-effective manner.

Keywords: Osteopenia, Osteoporosis, Premenopausal, Postmenopausal, Orthopantomogram, Dual energy x-ray absorptiometry, Mandible. (JPMA 64: 766; 2014)

Introduction

Osteoporosis is a disease of bone with distinctive decrease in bone mineral density and bone strength.[1] The micro-architectural changes that take place in osteoporosis are because of imbalance in bone resorption by the osteoclasts and bone deposition by the osteoblasts.[2] Osteoporosis leads to fragile bones.[3] Loss of normal micro-architecture of bone causes micro fractures to take place.[4] The patients may complain of non-specific bone pain and deformity.[5] Patients may present with musculoskeletal pain, numbness and decrease in body height.[6] The fragility fractures in turn causes increased morbidity.[3] It is important to diagnose it early before the patient presents to the emergency with a fractured hip or spine.

There are a number of risk factors for osteoporosis.[2] An ultrasonological study across Pakistan estimated that men and women are at equal risk of developing osteopenia, a condition of low bone mass that can proceed to osteoporosis.[7] Aging is the process that takes place in both males and females, but the effect of decreased oestrogen on bone mass is more pronounced compared to testosterone.[8] Therefore 30% to 50% of the females and 15% to 30% of the males suffer osteoporotic fragility fractures.[9] It is known that the diet taken by majority of Pakistani people is low in calcium content.[10] It is generally seen that 72% people across Pakistan are not in a habit of exercising or getting involved in physical jobs. Moreover, 83% women in our society show signs and symptoms of vitamin D deficiency, as many of them are not exposed to the required levels of sunlight.[11]

Osteoporotic fractures, especially those involving femoral neck and spine, are associated with poor quality of life in geriatric population.[12] Besides, the financial and physical burden because of prolonged hospitalisation in such cases is estimated to be too high.[13] It is a well-established fact that the total expenditure on osteoporotic fracture cases in the United States alone is $10-20 billion per year.[14]

Different techniques for the assessment of bone mineral density are used. Worth mentioning are single or dual energy X-ray absorptiometry (SXA- DXA), single or dual photon absorptiometry (SPA-DPA), quantitative computerised tomography (QCT), and quantitative ultrasound (QUS) which are expensive and may not be available at places.[15] Still the standard diagnosis can be done by DXA scan only.[16]

The current study was planned to see the correlation

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between changes in incisure depth of mandible on an orthopantomogram (OPG) with bone mineral density and whether or not it can be employed for screening and early detection of osteoporosis.

Patients and Methods

The analytical cross-sectional study was conducted at the Institute of Basic Medical Sciences, Dow University of Health Sciences, Karachi, from December 2011 to July 2012. Taking the prevalence of osteoporosis as 12% and that of osteopenia as 43.4% in Pakistan,[9] the sample size of 174 subjects was calculated using OPEN EPI sample size calculator with 5% margin of error and 95% confidence interval (CI). Females subjects between ages 25 and 85 were randomly selected from amongst the females visiting Dow Radiology, their attendants, volunteers, patients from dental and orthopaedic out-patient department (OPD), Ojha campus, and patients from the dental OPD of the nearby Patel Hospital. Consecutive sampling technique was employed. Females with endocrine disorders, menorrhagia, oligomenorrhoea and polymenorrhoea were excluded. Pregnant and lactating females, patients on oral contraceptive pills (OCPs) and hormone replacement therapy (HRT) were also excluded. People addicted to betel nut and pan chewing were not considered for the study.

Having signed a consent form and information sheet, a proforma regarding subject's history was filled by the researcher. On the basis of history the subjects were divided into premenopausal (Group I) and postmenopausal (Group II) groups. On the basis of DXA scan the females were subdivided into normal (pre A, post A), osteopenic (pre B, post B) and osteoporotic (pre C, post C) groups. OPG X-Ray was then conducted at Patel Hospital. The expense on DXA scan differs in government and private sectors, ranging between Rs1000 and Rs2940 respectively. OPG X-ray being cost-effective and employed commonly can be used to demonstrate changes in mandibular morphology in osteoporotic patients. This can lead to early diagnosis of osteoporosis in a cost-effective manner.

Incisure depth was studied by using software K-Pacs-Lite at zoom factor ×0.84. All measurements were taken bilaterally and the mean of two was taken. Measurements were taken by drawing a line touching the upper limits of condylar and coronoid processes. The longest perpendicular from this line was drawn which was taken to be the incisure depth (ID).[17] Intra-observer and inter-observer analysis gave a difference of just 0.5mm.

Comparisons were made between subgroups of Group I and those of Group II to evaluate changes that occur because of osteoporosis. Similarly, comparisons between Group I and Group II were made to exclude age changes. The changes seen in incisure depth of mandible were a measure of both osteoporosis and age. SPSS 16 was used for statistical analysis. For Intragroup comparisons Kruskul Wallis Test was applied in the groups where normality assumption was not fulfilled. One-way analysis of variance (ANOVA) was applied to evaluate the significance between subgroups of Group I (premenopausal) and Group II (postmenopausal). For multiple comparisons in the subgroups of both groups Tukeys-B Test was applied. Independent samples t- test was applied for inter-group comparison. The results were expressed as mean ± standard deviation (SD) and $p<0.05$ was considered statistically significant.

Results

There were 85(49%) patients in Group I and 89(51%) in Group B. Comparison of means in Group I came out to be significant with ($p<0.05$). Multiple comparisons between subgroups of Group I showed a significant increase in the incisure depth between Pre A vs Pre B groups ($p<0.04$) at CI of 95% (Figure). This change is also apparent when Radiograph-1 and Radiograph-2 are compared, where Pre-normal group shows normal Incisure depth (ID) and Pre osteopenic group shows increased Incisure depth (ID) respectively.

Comparison of means in Group II came out to be highly significant ($p<0.001$). Multiple comparisons between subgroups of Group II showed highly significant increase in incisure depth between Post A vs Post- Post C, and Post B vs Post C ($p<0.001$ each) at CI of 95%.Intergroup

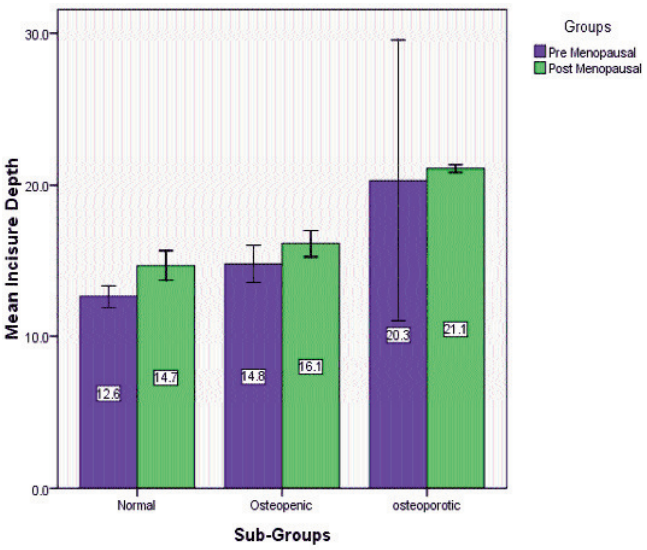
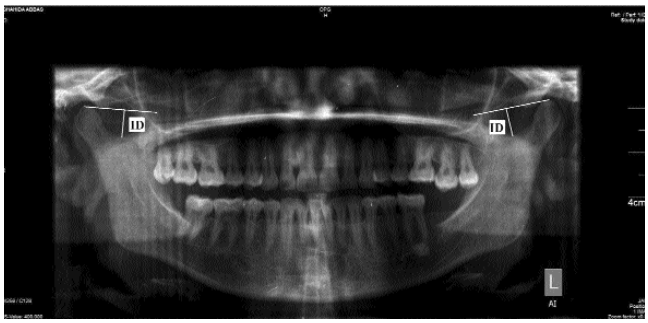
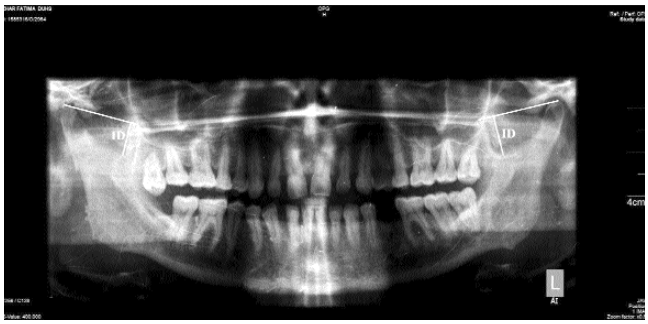


Figure: Mean Incisure Depth (mm).



Incisure Depth (ID).

Radiograph-1: OPG from Group I Pre normal showing normal Incisure Depth.



Incisure Depth (ID).

Radiograph-2: OPG from Group I Pre osteopenic showing increased Incisure Depth.

comparison between Group I and Group II showed a significant increase in incisure depth between Pre A vs Post A (p-=0.001) at CI of 95%.

Discussion

Age is an important risk factor for osteoporosis where natural drop in oestrogen levels are seen.[18] Vertebral fractures are more common in females over 60 years of age in Western countries.[19] Similarly, females aged over 65 years from some developed Asian countries show a high incidence of hip fractures.[20] In Pakistan, the incidence of hip fracture is on the increase amongst females of older age group.[21] As life expectancy is increasing, the prevalence of osteoporosis is also increasing. Osteoporosis is known to be a silent killer as the patient does not even know what changes are silently taking place in the bones.

In our part of the world where medical facilities and screening tests are not easily approachable by all, patients get aware of the disease when they come up in emergency with the fracture of the femur neck. As majority of the population of Pakistan belong to low socioeconomic class, DXA scan is not in reach of every person. There should be some readily available test which can be used as a cost-effective tool. OPG is a radiological technique which is very commonly done in dental clinics and is cost-effective compared to the DXA scan.

The grouping pattern used and the comparisons done in the current study are designed to show changes in mandible that take place with aging as well as osteoporosis. The results of this study show that in low bone mass elsewhere in the body, changes do occur in mandible also. The changes are so obvious that they could be seen by OPG X-ray examination.

Incisure depth (ID) was seen by researchers in 2005[17] and it was found to be increased in females without teeth. Keeping in view the fact that teeth fall complement to low bone mass because of the absorption of alveolar ridges[17] this study observed the changes in ID due to osteoporosis. It was found that ID increased significantly in pre normal vs pre osteopenic groups as Group I. An increase in ID at the stage of osteopenia signifies that this variable could be used for early detection of osteoporosis at younger age. Highly significant increase was observed in post normal vs post osteoporotic groups and post osteopenic vs post osteoporotic groups of Group II. This high significance demonstrates that this parameter could easily be used in diagnosing osteoporosis in post-menopausal patients. Significant increase in pre normal vs post normal groups of Group I vs Group II was observed. An increase in the ID amongst pre normal and post-normal groups indicates that age changes do affect the incisures.

Conclusion

The findings of incisure depth on OPG X-ray concluded that it can be conveniently used as a screening tool for osteoporosis.

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