



Validation of occlusal radiography as a method to identify postmenopausal women with osteoporosis

Validação de radiografia oclusal como um método para identificar mulheres com osteoporose

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Abstract

Objective: Recognize the alterations in the vestibular cortical structure of the mandible through a strict occlusal lower X-ray in postmenopausal women with lower mineral bone density (BMD). **Materials and methods:** The sample consisted of 60 postmenopausal women, 28 with osteopenia and 32 with osteoporosis. Three specialists in oral and maxillofacial radiology evaluated the occlusal X-rays. The association between BMD and vestibular cortical structure were assessed by X2 test. **Results:** Statistic significance was found ($p = 0.006$). Sensitivity and specificity were assessed for the osteoporosis group. ROC analysis showed 82% sensitivity and 52% specificity. **Conclusion:** The strict occlusal lower X-ray can show changes in the vestibular cortical plate. This indicates BMD reduction and possible risk of osteoporosis.

Keywords: Osteoporosis. Bone mineral density. Jaw. Occlusal radiography.

Resumo

Introdução: Reconhecer as alterações na estrutura cortical vestibular da mandíbula, por meio de uma radiografia oclusal inferior, em mulheres na pós-menopausa com baixa densidade mineral óssea (DMO). **Materiais e métodos:** A amostra consistiu de 60 mulheres na pós-menopausa, 28 com osteopenia e 32 com osteoporose.

Três especialistas em radiologia oral e maxilofacial avaliaram as radiografias oclusais. A associação entre a DMO e a estrutura cortical vestibular foi determinada pelo teste de X2. Resultados: Houve diferença estatística ($p = 0,006$). A sensibilidade e a especificidade foram avaliadas para o grupo de osteoporose. A análise de ROC mostrou sensibilidade de 82% e especificidade de 52%. Conclusão: A radiografia oclusal estrita de mandíbula pode mostrar alterações na placa cortical vestibular. Isso indica redução da DMO e possíveis riscos de osteoporose.

Palavras-chave: Osteoporose. Densidade mineral óssea. Mandíbula. Radiografia oclusal.

Introduction

The World Health Organization (WHO) defines osteoporosis as a systemic disease featured by bone mineral density (BMD) decrease, microarchitecture deterioration, increasing its fragility and the consequent fracture risk (1-4). Osteoporosis is caused by systemic bone loss related to sex and age, predominantly in women after menopause. BMD loss was higher in older women than in men with the same age, and approximately 25% of the postmenopausal population loses between 5% and 8% of bone mineral per year (3-6). Dual-Energy X-Ray Absorptiometry (DEXA) bone densitometry is the worldwide study used to measure in vivo BMD considered as the gold standard (7, 8).

The in vitro bone morphometric analysis showed that the dentate jaws bone structure in older individuals is featured by porous laminar cortical bone presence, as in other parts of the skeleton. With age, changes in the cortex tend to be more marked in women, caused by sharp variations in the amount of jaw cancellous bone (9). The intracortical bone resorption appearance of jaw is similar to tubular bones postmenopausal osteoporotic features (4). Studies have shown that changes in mandibular bone mass correlate with changes in skeletal bone mass (5, 10-12).

The BMD loss in cortex seems to depend on age. In regions distal to mental foramen, the mandibular buccal cortex presents little relationship with BMD values than lingual cortex, which was evaluated by quantitative computed tomography (8). Panoramic X-rays show the mandibular basal cortical clearly, so has proved be an image suitable for evaluation (4, 9, 10). Klemmetti performed an index to assess osteoporosis in the mandibular cortical basal using panoramic X-rays. Its validity is based on intracortical

resorption patterns that proved useful for osteopenia/osteoporosis evaluation compared with BMD in the lumbar spine measured by Dual-Energy X-Ray Absorptiometry (DEXA) bone densitometry (5, 10-12). The sensitivity achieved was 77% and 40% specificity (4, 5, 10, 13). The mandibular cortical thickness may be useful for predicting low BMD (10, 14). Research has shown that postmenopausal women with a basal cortical thinned, less than or equal to 3mm, are at osteoporosis risk (13).

Dental radiographs are relatively inexpensive and often used in the adult population of the world, so it could be a huge tool for screening patients at osteoporosis risk (1, 4, 15). There are other analysis tools such as questionnaires, but these have shown their low sensitivity and specificity (9).

Studies in Finland, Japan and the United Kingdom showed that the panoramic X-ray could be a test for women at high risk of osteoporosis. Almost 70% of dental practitioners from a research performed in Japan, became familiar with this index use, which indicates that the panoramic X-ray can be used to identify women with low BMD trend in clinical practice (4).

The features listed by Klemmetti for basal ridge are sometimes barely perceptible in the panoramic X-ray, because of its size and lack of definition (4). These details can be improved using intraoral radiographs that have greater clarity, resolution and less blur than extraoral radiographs (16). Occlusal radiographs are a type of intraoral X-ray that may clearly show mandibular buccal cortex us when were applied on strictly projection to lower jaw.

This research tries to highlight how strict lower occlusal radiography, a simple technique with low cost, is useful to visualize mandibular bone architecture changes in postmenopausal women with low BMD.

Materials and methods

This research was approved by the Cayetano Heredia Peruvian University Ethics Committee. A non-probability sampling was performed and postmenopausal women from Cayetano Heredia Peruvian University, Medical Clinic, Densitometry Service, were selected. Osteopenia diagnosis (T-score: -1 to -2.5) and osteoporosis (T score < -2.5) were included according to the Clinical Densitometry International Society criteria.

Total body bone densitometry tests were performed by DEXA (Lunar DPX NT, GE) covering lumbar spine, radius, hip and femoral neck regions. Pre-selected women were notified of the study and those who agreed to participate were recruited on the Oral and Maxillofacial Radiology Service. The sample consisted of 60 postmenopausal women, 28 were diagnosed with osteopenia and 32 with osteoporosis.

A strict lower occlusal radiograph was taken (FPX-occlusal, Fabinject, Brasil) using radiographic film # 4 (Ultra-speed D, Kodak, USA) and focal distance was 25cm. Radiographs were obtained with a periapical X-ray equipment (Timex, Gnatus, Ribeirão Preto, SP, Brazil) at 70kV, 8mA and 1.50s. A radiographic film automatic processing was performed in seven minutes (AT-2000, Air Techniques, USA).

Radiographs were evaluated by three Oral and Maxillofacial Radiology specialists, previously calibrated. Three training sessions were organized prior to the final observations for calibration of the observers, each one of one hour of duration. The kappa for intra-observer agreement was 0.87 and for inter-observers agreement was 0.81. Images were analyzed by direct observation in a viewer box (negatoscope). The same parameters determined by Klemmetti et al. were assessed into two categories: no change (SC) and changes (CC) (Figure 1).

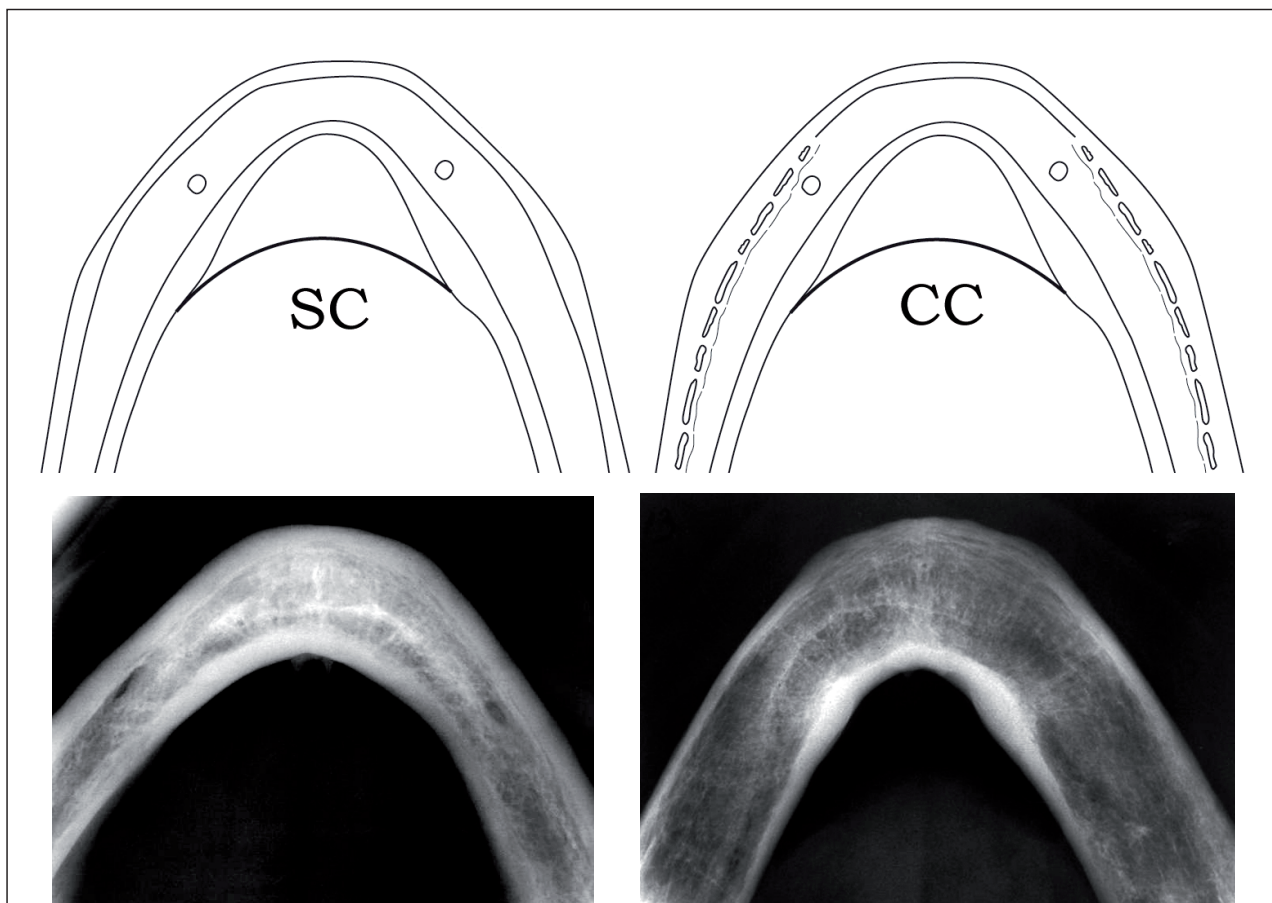


Figure 1 - Lower occlusal radiograph diagrams with their respective examples showing no changes (SC) and changes (CC) in the buccal cortical structure

Data were analyzed using SPSS software v15 (SPSS Inc, Chicago, IL) where a X2 test for statistical association analysis and ROC (receiver operating characteristic) were acquired for sensitivity and specificity method determination.

Results

Sixty postmenopausal patients were selected from Cayetano Heredia Peruvian University, Medical Clinic. According to their BMD patients were divided in two groups: 27 with osteopenia and 33 with osteoporosis (Table 1).

For the SC patients group, 6 (30%) had osteoporosis and 14 (70%) had osteopenia (Table 1).

Table 1 - Relationship between BMD and buccal cortical structure

BMD	Buccal cortical structure		Total (N)
	SC (n)	CC (n)	
Osteoporosis	6 30.0%	27 67.5%	33 55.0%
Osteopenia	14 70.0%	13 32.5%	27 45.0%
Total (n)	20 100.0%	40 100.0%	60 100.0%
χ^2		0.006	

Note: BMD = bone mineral density; SC = no changes; CC = with changes; X2 = chi square.

Then for the CC patients group, 27 (67.5%) had osteoporosis and 13 (32.5%) had osteopenia (Table 1).

X2 test was used to determine the association between BMD status and buccal cortical structure changes. Statistical significance level was set to $p < 0.05$. Statistically significant association was found for BMD and changes in the buccal structure ($p = 0.006$) (Table 1).

Finally, the area beneath the ROC curve was used to determine sensitivity and specificity. An area under the curve was found equal to 0.668 with 82% sensitivity and 52% specificity (Figure 2).

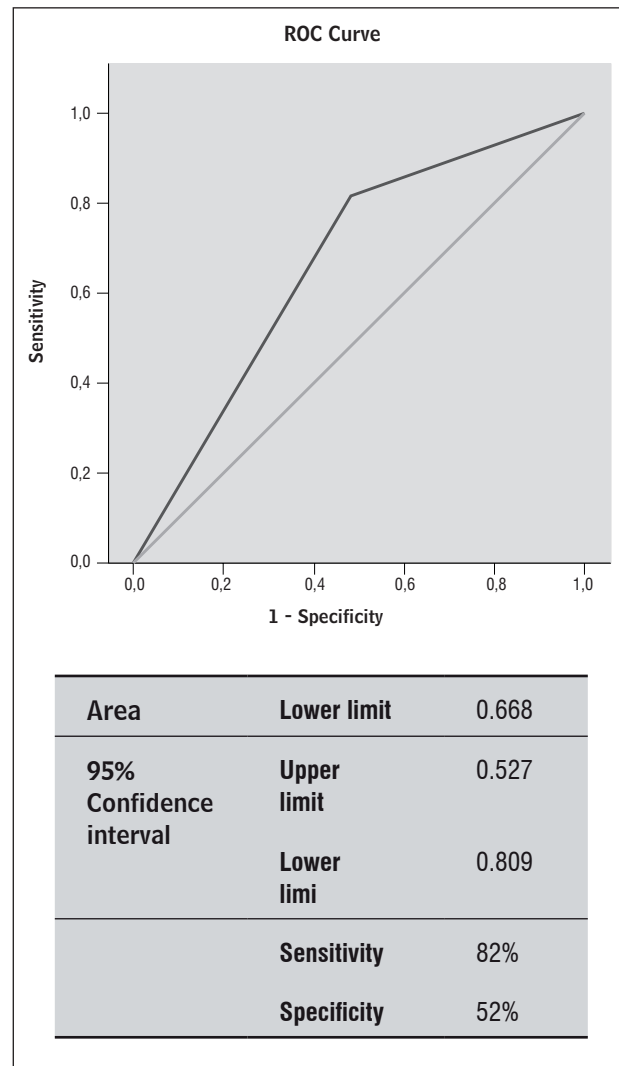


Table 1 - ROC curve to determine sensitivity and specificity, according to the observed changes in occlusal radiograph buccal cortical structure and lower BMD group (osteoporosis).

Discussion

Radiographs are an auxiliary test routine used in the dental office, through these tools oral health professionals can diagnose people could at risk for osteoporosis (10, 17-19). Panoramic X-ray is a diagnostic tool often used by dentists. Klemmetti et al. developed an index to assess the risk of osteoporosis by evaluating the mandibular basal ridge based on intra-cortical resorption patterns (5, 10-12). This method showed 77% of sensitivity and 40% of specificity compared with a BMD standard assessment performed at lumbar spine and femoral neck by DEXA (4, 5, 10, 13).

Our study used the conventional strict lower occlusal radiography to assess mandibular buccal cortex changes. This test is cheaper and with less radiation dose than a standard panoramic X-ray. Whole body bone densitometry test was performed by DEXA at the lumbar spine regions, radio, hip and femoral neck.

Micro-architecture impairment in the mandibular buccal cortex was characterized by lacunar defects presence and inner cortical outline discontinuity. This was most severe for the osteoporosis group with 67.5%, compared to the osteopenia group with 32.5%. These data were not compared with the literature because of lack of publications.

BMD relationship with changes observed in strict lower occlusal radiograph showed statistically significant differences ($p < 0.05$). The same bone changes ratio in patients with osteoporosis perceptible through dental X-rays has been reported in the literature (1, 2, 5, 15, 20-24). At this stage, not only low BMD were found but also microarchitecture changes in cortical bone with presence of lacunar defects, intrinsic cavities and significant thinning. All these perceptible through morphological evaluation methods such as X-rays.

Sensitivity and specificity were determined by ROC curve. The osteoporosis group had 82% sensitivity and 52% specificity. These results are superior than those reported in literature using for Klemmetti index for basal ridge (4, 5, 10, 13). A strict lower occlusal radiograph may show changes in the buccal cortex and a decrease in BMD and potential osteoporosis risk.

The sensitivity and specificity values obtained in this research are higher than those reported in the literature due to the imaging type used in the study. A panoramic radiograph has not the image detail of intraoral radiographs. Occlusal radiography has greater resolution than panoramic X-ray because of its ability to differentiate structures that are very close. The standard panoramic X-ray resolution skirts six pairs of lines per millimeter while intraoral radiographs have more than doubled. Another important factor is the sharpness of occlusal radiographs, which exceeds the one obtained on panoramic X-ray. This is thanks to the shortest distance between the object and the radiographic film, which decreases the shadow and let to define more precise edges (16).

Methods used to diagnose BMD state are expensive and are hardly accessible to the general population. Systems must be accessible for broader populations to embrace a public health problem such as osteoporosis. The low cost together with different technique applications can guide us to choose people who need a more accurate test to determine their BMD and potential osteoporosis risk. So, at this point, radiographic tests used in dentistry can play a fundamental role.

In our reality, the more people who come to the dental office are women, and a significant number of them exceed forty years old. Auxiliary tests such as panoramic X-ray or lower occlusal radiography can serve the oral health professional to discern which patients should receive special attention because of their possible low BMD and osteoporosis risk found in their radiographic patterns. Therefore, the dentist becomes a key actor in addressing public health problems such as osteoporosis.

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