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Panoramic radiomorphometry and vertebral fractures in Spanish postmenopausal women

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ABSTRACT

Objective: To evaluate the relationship between panoramic radiomorphometric indexes, and the presence of osteoporotic fractures in a Spanish postmenopausal women. *Methods:* A sample of 120 women (60 with fragility spine fractures and 60 healthy), aged 55–70 years, with fragility spine fractures, were included in this cross-sectional study that was conducted from 2008 to 2011. All the women were referred to undergo a radiological spine examination, spinal densitometry and a panoramic radiograph for assessing osteoporosis using 3 radiomorphometric indexes: Panoramic Mandibular Index (PMI), Mental Index (MI) and Mandibular Cortical Index (MCI). According to mandibular cortical shape, in MCI, three groups were defined: C3 (osteoporosis), C2 (osteopenia), C1 (health).

Results: Significant differences were found between all the MCI groups due to their composition between fractures and non-fractures. C1 group (healthy) has less fractures women than C2 (Bonferroni p < 0.001), C1 has less fractures than C3 (Bonferroni p < 0.001) and finally, C2 has less fractures than C3 (Bonferroni p < 0.006). PMI and MI values were significantly lower in cases than in controls (*U* Mann–Whitney p < 0.001).

Conclusions: Panoramic radiomorphometrics mandibular indexes such as MCI, PMI, and MI, may be useful for identifying the population at higher risk for fracture. The relationship between panoramic index and osteoporosis remains unclear and further studies using fragility fracture as a real marker of osteoporosis are warranted to clarify the exact role and effect of one condition on the other and the corresponding clinical implications.

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1. Introduction

Bone resorption occurs at the same time in the mandible than in the rest of the body; therefore, mandibular and spinal bone loss could be considered as manifestations of the same condition. Mandibular bone mass has been correlated with whole skeletal bone mass [1,2]. Osteoporosis may affect craniofacial and oral structures at the same rate than the rest of the body and it has been found to be connected with periodontal bone loss and tooth loss [3–5]. Evidence exists that osteoporosis influences the mandibular status, although the contribution of osteoporosis

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in the loss of mandibular cortical width (MCW), periodontal bone tissues, number of teeth and heights of the residual ridges has not been clearly assessed [6]. Dental radiographs, especially panoramic images, have been used to predict low bone mineral density [7,8]. Because panoramic radiography is a relatively inexpensive procedure conducted frequently in elderly populations, it has been suggested that it can be used as a screening tool for osteoporosis. Several panoramic radiographic measurements, known as panoramic radiomorphometric indexes, have been developed to assess mandibular cortical shape and width, either qualitatively [7] or quantitatively [8–10].

A growing interest in the possible relationship between systemic and mandible osteroporosis has been observed in recent time. It has been suggested that in the absence of national screening program for osteoporosis, dental practitioners might identify those patients who appear to be at high risk by evaluation of dental radiographs. The large number of dental radiographic examinations carried out each year raises the possibility that useful information concerning bone mineral status of patients remains untapped. For







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this reason, radiographic markers of osteoporosis in the mandible should be identified.

Panoramic radiography is commonly available in dentistry. In addition to traditional assessments of teeth and jaw conditions such radiographs also allow analysis of other bone structures, including the mandible. A recent study has found that sensitivity and specificity of mandibular cortex measurements related to standard spine and hip BMD is of 77% and 40%, respectively (Klemetti index).

Systemic bone loss increases the risk of developing osteoporotic fractures. Clinical guidelines, including those from the National Osteoporosis Foundation and the International Osteoporosis Foundation, have recorded that rather than low BMD, vertebral fractures are the main risk factor for future fracture. However, most recent studies trying to find the relationship between mandibular bone mass and osteoporosis have used BMD as a predictor of fracture. Diagnosis of vertebral fracture carries pronostic information, independently from the results of dual-energy X-ray absorptiometry (DEXA) measurements [11]. Several clinical trials have demonstrated that a substantial improvement in the assessment of the risk for future fractures can be accomplished by the assessment of prevalent fractures in combination with BMD measurements [12]. Therefore, the present study was designed to evaluate the use of mandibular anatomic indexes on panoramic radiographs as predictors of bone fragility fractures.

2. Materials and methods

2.1. Study population

A sample of 120 women (60 with fragility spine fractures and 60 healthy), aged 55–70 years, living in the same health care region of Seville (Spain) were included in this cross-sectional study that was conducted from 2008 to 2011. All the women were referred to undergo a radiological spine examination, spinal DEXA and a panoramic radiograph for assessing osteoporosis using 3 radiomorphometric indexes: Panoramic Mandibular Index (PMI), Mental Index (MI) and Mandibular Cortical Index (MCI). According to mandibular cortical shape, MCI was categorized in 3 groups: C3 osteoporosis, C2 osteopenia and C1 health [7].

Three hundred and thirty-one women were not accepted due to the exclusion criteria and ninety-one refused to participate in the study. The remaining 120 postmenopausal women constituted the study sample. Cases (fractured women) were recruited from radiology units and controls from a gynecological screening program. Participants eligible for this study were postmenopausal women, with no history of a systemic condition (history of metabolic disease as diabetes mellitus, primary or secondary hyperparathyroidism, osteomalacia, rheumatoid arthritis, multiple myeloma, or secondary osteoporosis), medication intake that might influence the BMD (antireabsortive or corticosteroid treatment or chemotherapy), history of chronic renal problems, connective tissue diseases or periodontal disease. Cancer with bone metastasis was also excluded. No patients had sustained a trauma. The study group consisted of 60 dentulous patients with osteoporotic fractures but no other metabolic disease and a BMD with a *T*-score ≤ -2.5 . The control group consisted of 60 normal dentulous women with no vertebral compression fractures, as evaluated by radiographs and BMD with a *T*-score ≥ -1 . All subjects gave written informed consent before enrollment into the study, which was conducted according to the tenets of the Declaration of Helsinki and approved by Virgen del Rocio Hospital Ethics Committee.

The sample size was established based on the fact that the studied condition (mandibular osteoporosis related to vertebral fractures) may affect different percentages of women [3.7 cases for fractured group and 2.88 cases for the non fractured group with 1.5

SD for both groups] [13]. Thus, using statistics software to calculate sample size with a 5% maximal acceptable error, 95% confidence level, potential of 80% and possible losses of 10%, we determined that 60 women were required in each group. Therefore, a total of 120 women were initially included.

2.2. Data collection

The survey was conducted between 2008 and 2011. The questionnaire was interview administered and collected sociodemographic information including age, age of menopause, years since menopause, body mass index, smoking, physical activity, education, teeth brushing and medical history. Education was categorized according the presence of twelve or more years of schooling.

2.3. Dental panoramic radiographic measurements

The radiographs were taken using the same orthopantomograph (Sirona, 18 89 356 D3285, serial 05414, 80 kV/11 mA, with a tube Siemens SR 80/10, 2809 163 V 7012, Serial No.: 577 083 0'5 IEC). Patients were positioned in the dental panoramic machine in such a way that the vertical line produced by the machine was aligned with the patient's sagittal plane, with the horizontal line (Frankfort plane) parallel to the floor. Blinded to case–control status, the following radiomorphometric indexes were measured bilaterally on each panoramic radiograph.

Mandibular Cortical Index (MCI) (Figs. 1–3): MCI is a qualitative index based on the shape of the mandibular inferior cortex, distally



Fig. 1. A C1 (MCI) grade radiograph: Inferior cortex is well defined, even and sharp.



Fig. 2. A C2 (MCI) grade radiograph: Inferior cortex has little eroded areas, the endosteal margin presents little lacunar resorptions, and semilunar defects.

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