Correlation between mandibular bone density and skeletal bone density in a Catalonian postmenopausal population

Albert Estrugo-Devesa, DDS, PhD, MD,[a,b,c] Juan Segura-Egea, DDS, PhD, MD,[d]
Laia García-Vicente, DDS, PhD,[a,b,c] Mayra Schemel-Suárez, DDS,[a,b,c] Ándres Blanco-Carrrión, DDS, PhD, MD,[e]
Enric Jané-Salas, DDS, PhD, MD,[a,b,c] and José López-López, DDS, PhD, MD[a,b,c]

Objectives. The aim of this study was to determine if the mandible (MD) experiences reductions in bone mineral density (BMD) similar to the lumbar spine (LS) and femoral neck (FN) in a postmenopausal population.
Study Design. A total of 137 postmenopausal women underwent 3 types of densitometric examinations: LS, FN, and MD as measured in 3 regions (MD-R1, MD-R2, and MD-R3), as well as the entire mandible (MD-Net) using a dual photon bone X-ray densitometer. Densitometry of the LS and FN were performed according to the protocol of the International Society for Clinical Densitometry. Mandibular densitometry was performed using a modification of a previous technique, placing the patient in the left lateral decubitus position, with the head supported by a 13-cm-thick cushion above the temporomandibular joint.
Results. Significant correlations were found between densitometry results for the LS and the MD, with *P* values of .021 at MD-R1 (ramus); .001 at MD-R2 (body); .050 at MD-R3 (symphysis), and .001 at MD-Net (total mandibular density). No correlation was found between mandibular and FN densitometry (*P* > .05).
Conclusions. According to the results, for this population, it can be affirmed that the MD responds to osteoporosis in ways similar to the LS. (Oral Surg Oral Med Oral Pathol Oral Radiol 2017;■■:■■–■■)

Osteoporosis is a systemic disease characterized by a generalized reduction in bone mass and the deterioration of bone architecture.[1] Currently, it is defined as a skeletal disorder characterized by compromised bone strength that predisposes the bones to a higher risk of fracture.[2] Osteoporosis is the most prevalent metabolic bone disease in the developed world and affects 1 in 4 women and 1 in 8 men over age 50 years. Its clinical and social importance lies in the increased incidence of bone fractures among those affected.[3] It is the most important health problem among middle-aged women, coinciding with menopause,[3] and is the main cause of fractures among older women.[4] In the United States, in 2010, among adults age 50 years and older, 10.2 million (10.3%) had osteoporosis at the FN or lumbar spine (LS) and 43.4 million (43.9%) had low bone mass at either skeletal site.[5] The prevalence of osteoporosis in the European Union was estimated at 27.6 million in 2010.[6] In Spain, over 3 million people suffer from osteoporosis, and with increasing life expectancy, its prevalence will rise along with age. Osteoporosis affects 35% of Spanish women over age 50

years and 60% of women over age 80 years.[7] Among men over age 50 years, prevalence is estimated to be 8%. But in spite of the high prevalence of osteoporosis, less than 30% of sufferers are diagnosed, and fewer than 10% of them receive treatment.[8]

The most widespread osteoporosis-related fractures are vertebral, hip, and distal-third forearm fractures.[7] Various factors, including bone geometry, the risk of falling, traumatic impact, and the weight of soft tissues, affect the risk of fracture.[9]

Bone densitometry is used to detect osteoporosis in the early stages.[10] According to the report published by the World Health Organization (WHO) in 1994, osteoporosis diagnosis should only be performed by determining bone mineral density (BMD) using X-ray dual-photon absorptiometry (DXA).[11,12] Following the WHO criteria, the diagnosis of osteoporosis is determined by bone densitometry values of 2.5 or more standard deviations (SDs) below the average value for a young healthy population (T-score <−2.5); osteopenia is diagnosed when the value is between 1 and 2.5 SD below average (T-score between −1 and −2.5).[11,12] The LS and proximal femur should be analyzed systematically in all patients at risk. The lowest BMD found in the LS, femoral collar, or hip is used to establish the diagnosis.

In addition to low BMD values, other risk factors independent of BMD also increase the probability of future

[a]Faculty of Medicine and Health Department of Odontostomatology Sciences, University of Barcelona, Barcelona, Spain.
[b]Dental Hospital Barcelona University, Barcelona, Spain.
[c]Oral Health and Masticatory System Group (Bellvitge Biomedical Research Institute) IDIBELL, L'Hospitalet de Llobregat, Barcelona 08907, Spain.
[d]University of Sevilla, Faculty of Dentistry, Department of Stomatology, Seville, Spain.
[e]University of Santiago de Compostela, Faculty of Medicine and Dentistry, Department of Surgery and Medical-Surgical Specialties, Santiago de Compostela, Spain.

Statement of Clinical Relevance

Bone mineral density results obtained in the mandible correlates with those obtained in the lumbar spine, indicating that in postmenopausal women, the mandibular bone behaves in a similar way to the lumbar spine.

fracture.[9] These factors are age, a low body mass index, previous vertebral fracture, and family antecedents of hip fracture and/or peripheral fracture in individuals over age 50 years. Other risk factors, such as menopause, age, and life-style factors (smoking, alcohol or caffeine consumption, low calcium intake, and physical exercise) have shown a high degree of variability and poor uniformity across different research papers.[12-14]

Orthopantomography and periapical radiographs are routinely used in current dental practice. Several studies have analyzed orthopantomography findings related to low BMD.[15,16] These include the mandibular cortical and Klemetti visual indices, which assess the degree of resorption of the mandibular cortex at the level of the lower premolars. These indices can be used to detect osteoporosis in the early stages and may suggest the need for further examination and treatment.[15,17-19] In an attempt to test whether the jaw behaves like other bones in the skeleton and to validate the findings related to decreases in bone density obtained from radiographs, various studies have performed densitometry in the jaw.[20-23] These studies would appear to present significant results, suggesting that when bone mineral density decreases, the jaw behaves in the same way as do other bones.

The aim of this study was to determine whether the jaw shows the same densitometric behavior in terms of BMD reduction as do other bone regions (FN and LS) among a population of postmenopausal women in Catalonia.

PATIENTS AND METHODS
Population
The study population was drawn from a group of 694 women who had completed a health questionnaire on risk factors for bone fracture issued by the Rheumatology Service at Bellvitge University Hospital (L'Hospitalet de Llobregat, Barcelona, Spain) in 1999. The online FRAX (Fracture Risk Assessment Tool) questionnaire was used to assess the risk of fracture.[14] A BMD study using DXA was conducted between 1996 and 1999 on these women. The results showed that 17.3% had osteoporosis, 49.1% had osteopenia, and 33.6% had normal BMD, according to the WHO classification criteria of 1994. Contact was re-established with 427 of the participants, of whom 137 were willing to take part in the present study. Data were collected between May 2009 and September 2012.

The study design was approved by the Ethics Committee of the Dental Clinic at the University of Barcelona Faculty of Dentistry (protocol 08/08). All participants were informed of the study's objectives and procedures, and all gave their informed consent to take part in the study.

The inclusion criteria were being postmenopausal women, being willing to participate in the study, having given informed consent, and having completed the earlier questionnaire.

The exclusion criteria were women being unwilling to participate in the study, presenting metabolic bone diseases other than osteoporosis, and lacking mobility as a result of a disease that would prevent their participation in the study.

Densitometry system
Densitometry was carried out at the Densitometry Unit at Bellvitge University Hospital. A dual photon bone X-ray densitometer was used: Hologic QDR 4500 (1999-2000; Hologic Inc., Bedford, MA). All patients underwent 3 types of densitometric examination: LS, FN, and MD.

Densitometry of the lumbar spine and proximal femur. Patients were placed in positions recommended by the International Society for Clinical Densitometry.[3,24] Densitometric examination of the LS in the vertebrae (L2, L3, and L4) and of the right FN was performed. The T-score involves an individual's BMD compared with the mean value of a young healthy reference population, with the difference expressed as an SD.[25] In this study the T-score was calculated against patients included in an epidemiologic study of LS BMD in the Spanish population and the Third National Health and Nutrition Examination Survey (NHANES III) study of the femoral collar.[3,26,27] Classification of patients as normal, with osteopenia, or with osteoporosis followed diagnostic categories established by the WHO.[11] Diagnosis was based on the lowest BMD registered in the LS or FN, from which the T-score was calculated.

Mandibular densitometry. To perform mandibular densitometry, patients were positioned according to a modified version of the indications proposed by Horner et al. in 1996.[20] Each patient was placed in the left lateral decubitus position, with the head supported by a 13-cm-high cushion in the left parietal area above the temporomandibular joint, keeping the head level with the body's axis and the neck bent back. The purpose of this position was to superimpose the contralateral aspects of the jaw without superimposing the cervical spine (Figure 1).
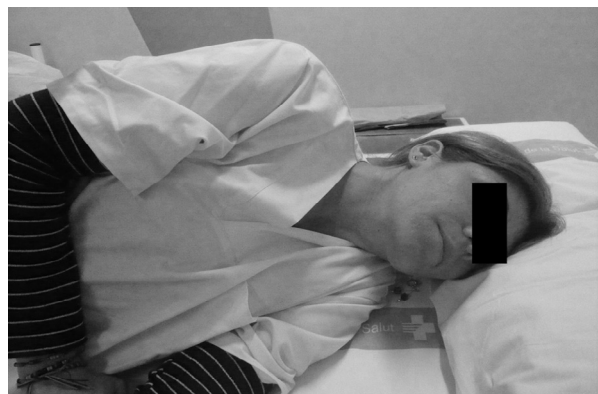

Fig. 1. Patient position for mandibular densitometry.