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The Importance of Dental Surgeon in Observing Bone Changes Characteristics of Osteoporosis in Panoramic Radiographies- Literature Review

Leonardo Alvarenga[1], Raquel Tolentino[2]*, Hugo Geraldo Perdigão E Vieira[3]

[1]Graduation Student in the 7th semester of Dentistry Program – Faculty of Dentistry of Ipatinga – FADIPA, Ipatinga, MG, Brazil. Orcid: 0000-0002-8016-1925

[2]Specialist in Endodontics, Master's Student in Radiology, Professor of Endodontics and Radiology of Dentistry Program at Faculty of Dentistry of Ipatinga - FADIPA. Orcid: 0000-0001-8131-3188

[3]Coordinator of Dentistry Program – Faculty of Dentistry of Ipatinga- FADIPA, Ipatinga, MG, Brazil. Orcid: 0000-0002-3601-8291

clinica_tol@hotmail.com

***Corresponding Author:** Raquel Tolentino, Specialist in Endodontics, Master's Student in Radiology, Professor of Endodontics and Radiology of Dentistry Program at Faculty of Dentistry of Ipatinga - FADIPA, Brazil.*

Abstract

Objectives: *To clarify the importance of the dental surgeon in detecting the risk of osteoporosis through the detailed evaluation of panoramic radiographs.*

Methods: *Articles were researched related to the importance of early diagnosis of osteoporosis, which favors treatment and prevents bone fractures that can even lead to death. Once the dental surgeon, when assessing a patient's image exam, is not limited to just observing the patient's teeth, but expands their vision for bone evaluation, being able to detect images of cortical density loss of mandible base which is an indication of risk of osteoporosis, referring the patient to a specialized treatment.*

Discussion: *The articles based for study strengthen the importance of evaluating panoramic radiographs not for diagnosing osteoporosis, as the diagnosis is made through bone densitometry, but for the early detection of images that mean loss of mineral density, which may be observed on these radiographic exams.*

Conclusions: *It is concluded on this study that dental surgeons should be oriented about their role on the early diagnosis of osteoporosis, assessing the paciente as a whole, as the osteoporosis is a silent disease and when it is diagnosed in the beginning it has a favorable prognose avoiding several complications when it is discovered in advanced stage.*

Keywords: *osteoporosis, primary dental care, qualitative study, risk assessment.*

Introduction

Osteoporosis in recent decades has attracted special attention from the healthcare field worldwide, due to the higher incidence in the population. With the increase in life expectancy and the gradual aging of the population, the trend is for cases to rise in the indexes. In addition, we have an aggravating factor, which is the fact that the disease has a character of silent progression, which makes the patient often have a late diagnosis, often after having suffered some type of fracture.[1,2]

The diagnosis is made by the rheumatologist through the interpretation of the results of the radiological examination called dual energy X-ray absorptiometry (DEXA). The test uses BMD deviation values for young adults (T-score) as a reference and patients are classified according to the criteria defined by the Health Organization, which assesses bone mineral

density (BMD) in three regions of the body: spine, femur head and forearm. This test has a high cost and is considered the gold standard for the diagnosis of osteoporosis.2

Therefore, the objective of the present study is to emphasize the importance of the dental surgeon in the face of evaluations of panoramic radiographs, with a multidisciplinary view, so that he can evaluate the routine imaging exams in clinical practice in an integrated manner, observing possible bone changes present in them, compatible with the signs of osteoporosis, which is the theme proposed in this review.

Materials and Methods

This study was carried out through journals and virtual articles via PubMed and Scientific Electronic Library Online (SciELO). For PubMed search, we used the descriptors indexed in the Medical Subject Heading Terms (MeSH) developed by the US National Library of Medicine, which is used as a vocabulary control method for the two abstracts present in the Medline database and for those present only in PubMed. Articles related to the importance of early diagnosis of osteoporosis were researched, which favors treatment and prevents bone fractures that can even lead to death. Once the dental surgeon, when assessing a patient's image exam, is not limited to just observing the patient's teeth, but also expands their vision for bone evaluation, being able to detect images of cortical density loss of mandible base which is an indication of risk of osteoporosis, referring the patient to a specialized treatment.

The descriptors used were: osteoporosis, primary dental care, qualitative study, risk assessment and panoramic radiography. The search in the Brazilian database, SciELO (Scientific Electronic Library Online - Brazil), had no vocabulary control, requiring that the search was made using the terms already used through a simple search in all indexes. The keywords used were: imaging tests, osteoporosis, diagnosis and risk factors.

Literature Review

A substantial number of patients undergo radiographic examinations for primary dental care each year, but little is known about the implementation of risk assessment for osteoporosis in this setting. Many researches have proven how radiological dental examination can be used to assess risk for osteoporosis. Much interest was concentrated in the cortical bone layer at the lower edge of the mandible in panoramic radiographs, being a statistically very effective measure for the risk of osteoporosis in addition to the assessment of the trabecular pattern observed in panoramic radiography.[3,4]

In a recent study[5], an assisted diagnosis system (CAD) was used, which consists of an interdisciplinary technology that combines elements of artificial intelligence (AI) and computer vision with radiological image processing.[6] In the study, the picture archiving and communication system (PACS) was integrated as a part of it.[7] This increased the sensitivity of the reader with less reading time, thus improving efficiency in daily clinical practice.[7] Panoramic radiography is generally performed by dentists. This radiographic examination allows the evaluation of the dentition and adjacent structures. The CAD used in the study based on panoramic radiography was developed to screen for systemic diseases, such as osteoporosis and atheroma of the carotid artery.[8-10]

Despite the current study having several limitations, a previous study revealed a high accuracy of the mandibular inferior cortex clearly eroded in the detection of osteoporosis.[11]

In addition, after the study by Lee et.al[5], several other studies also demonstrated a significant table of diagnosis of osteoporosis on panoramic radiographs using AI, demonstrating an association between the mandibular cortical shape on panoramic radiographs and skeletal bone densitometry (BMD) in dual energy X-ray absorptometry (DEXA) in postmenopausal women.

The risk of osteoporosis is also higher among postmenopausal female patients, as age and estrogen deficiency are recognized as factors associated with reduced bone mass.[12,13]

Dual energy X-ray absorptiometry (DEXA) is the gold standard method for measuring bone mass.[14] The test uses BMD deviation values in young adults (T-score) as a reference and patients are classified according to

the criteria defined by the Health Organization.[15] BMD values are measured in the proximal femur, lumbar spine and hips. Despite being reliable, the high cost of DEXA represents a disadvantage of this method.[15]

Panoramic radiography has been indicated as a predictive tool for osteoporosis in several studies.[16-19] A change in the cortical morphology of the maxillary bones is essential to make it possible to track patients using this method. This type of examination is often used in clinical practice and is widely accessible due to its low cost. Most recently developed tools, such as panoramic digital radiography (PDR) and cone beam computed tomography (CBCT), can also be used. The first improved the image quality; however, distortions, overlaps and enlargements still limit the analysis of anatomical features. On the other hand, the latter is more detailed, as it provides a three-dimensional perspective and is widely used to assess the bone structure of patients in dentistry and to associate subspecialties. [13-15,18, 20]

Qualitative and quantitative indices have been created to standardize the evaluation of BMD in dentistry.[14,15,21]. The most used qualifications is the mandibular cortical index (MCI), also known as the Klemetti index. The MCI assesses the morphology of the mandibular cortical bone based on the presence of a gap or porosity.[22] It has been recognized that PDR and CBCT provide accurate images with improved resolution, which can be used safely to measure the thickness of anatomical structures.[13, 15]

However, it is not yet clear whether the ICM classification obtained by PDR and CBCT panoramic reconstruction (PR) is a reliable and useful measure to predict low BMD. Therefore, it is important to evaluate the usefulness of both dental exams compared to DEXA, which is the gold standard for the detection of low BMD.

In order to assess the relevance of oral and maxillofacial effects in the evaluation of patients with low BMD, the objective of the study by Kato et.al[23] was to evaluate the usefulness of the ICM obtained by the PDR and by the PR of the CBCT with three thicknesses of slices different from the cortical bone of the mandible (5, 15 or 25 mm), as auxiliary tools to detect low BMD in postmenopausal women. The hypothesis was that the PR of the CBCT would be more accurate than the PDR when analyzing the morphology of the mandibular cortical bone.

According to the author, [23] there may be inaccuracy in the diagnosis of low BMD when altered, observed in the mandibular cortical bone by means of dental exams (DPR or CBCT). However, the tests are inexpensive, offering guidelines that can help the clinician to make early diagnoses and can facilitate timely referrals for treatment, thus improving the prognosis of the disease.[24] As a diagnostic test, the tests evaluated in this study showed inferior performance to DEXA (score from 0.50 to 0.60) .[24] However, as a screening test, they can be useful for the early identification of asymptomatic individuals undergoing dental treatment who have low BMD. As expected, the hypothesis was confirmed, as the CBCT PR images obtained better results than the PDR. The CBCT PR with 25 mm slice thickness also showed a better result.

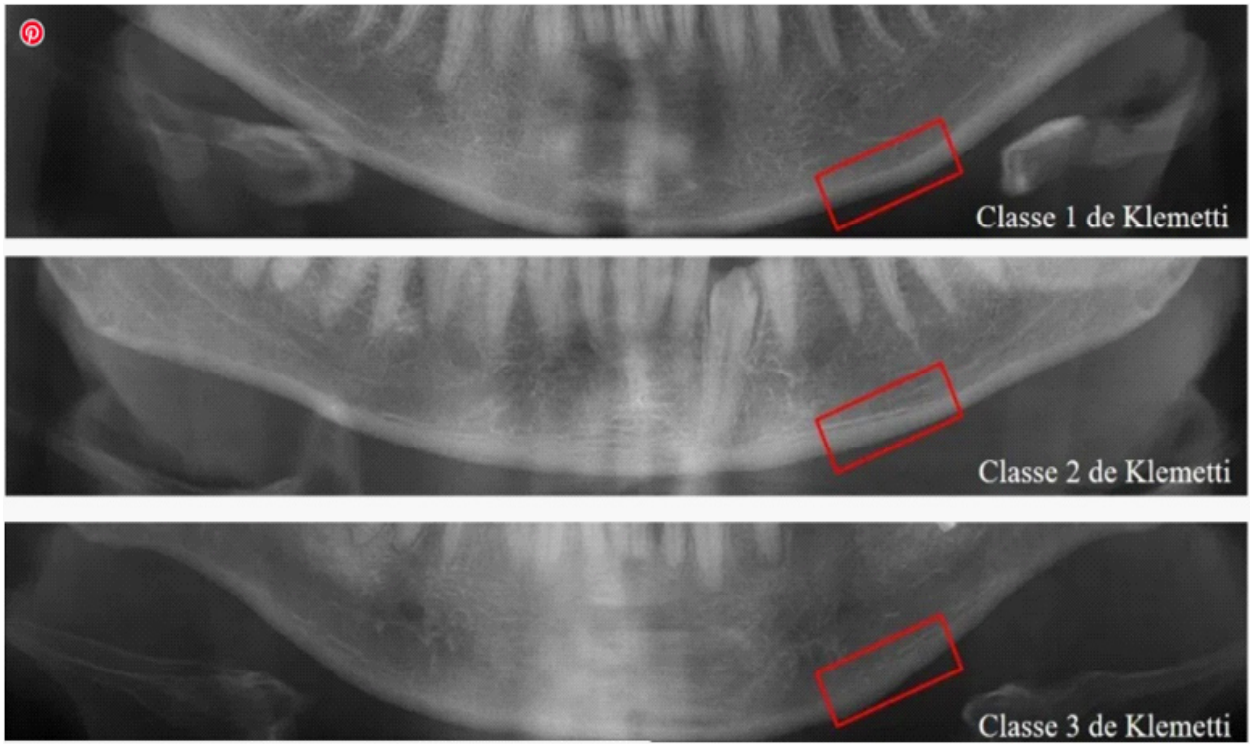
Discussion

Osteoporosis is the most underlying cause of painful fractures, which can cause weakness and even lead to death. Often the patient does not have the proper diagnosis and only comes to discover the disease when he falls, due to a possible bone fracture. It is an inflammatory bone disease that causes a generalized reduction in bone mass whose aspect of the bone is normal, however there is an imbalance in the bone formation process causing changes in the volume and architecture of the trabecular bone, making it more fragile. The first stage of bone degeneration, called osteopenia, begins with the imbalance between absorption and regeneration cells where osteoclasts start to act more quickly, degrading bone with greater speed than osteoblasts are able to replenish.[25] The main triggers of the problem are lack of calcium and vitamin D, physical inactivity and genetic predisposition, in addition to the hormonal changes that accompany women in menopause, as they decisively interfere in the loss and gain of bone mass. This is because there is a sharp drop in estrogen, an important hormone in the fixation of calcium in bone.[26,27] Osteoporosis has oral manifestations of interest to the dentist, as the quality of the gnathic bones is compromised. Osteoporosis, which is a systemic bone disease, considered by the World Health Organization (WHO) to be a worldwide

public health problem, with morbidity and mortality rates increasing every day. For manifesting some characteristics in the tissues of the stomatognathic complex, it has also become a topic of great interest for dentistry.[28]

A cross-sectional study was carried out with women over 40 years old at menopause, with the purpose of evaluating the shape and width of the mandibular bone cortex in panoramic radiographs of these patients, concluded that the radiomorphometric indices are capable of early identification of post-menopausal women with low bone mineral density, being used to refer the patient to a more appropriate examination and specialized treatment.[29]

In the work developed by Klemetti et.al,[22] it was possible to observe that in a qualitative evaluation (which refers to the quality of the bone) the evaluations of the dental radiographs showed that the mandibular cortical bone is thinner and more porous. The sparse trabecular structure in individuals with osteoporosis when compared to individuals without the disease (figures 1, 2 and 3) .[30]



Figures 1, 2 & 3. *Panoramic Radiographs showing the Klemetti Index.*

Source: Images from personal archive Profa. Dr. Maria Beatriz C. C. Alonso Figure

In the images, we observe the exemplification of the classification of the Klemetti index or ICM, in: C1, when the border of the cortex is clear and sharp on both sides; C2, when the endosteal surface presents semilunar defects (lacunar resorption) or the surface presents cortical residues and C3, whose cortical layer is extremely porous.[30] The role of panoramic radiographs in the diagnosis of osteoporosis has been described in the literature. Some articles have suggested DEXA as the gold standard method for assessing bone quality and the occurrence of osteoporosis. However, findings from studies in the literature on these two methods indicate that the use of panoramic radiography to predict bone mineral density in the mandible also allows determining the general loss of skeletal bone mineral density in patients.[31]

In addition, specific measures, such as the thickness of the lower mandible cortex on panoramic radiographs (figures 4 and 5), [31] have also been suggested as a way to predict low BMD in patients. These radiomorphometric data, together with other criteria, such as clinical symptoms and / or family history of osteoporosis, may prove to be a promising tool in the assessment of the risk of skeletal osteoporosis.[30]

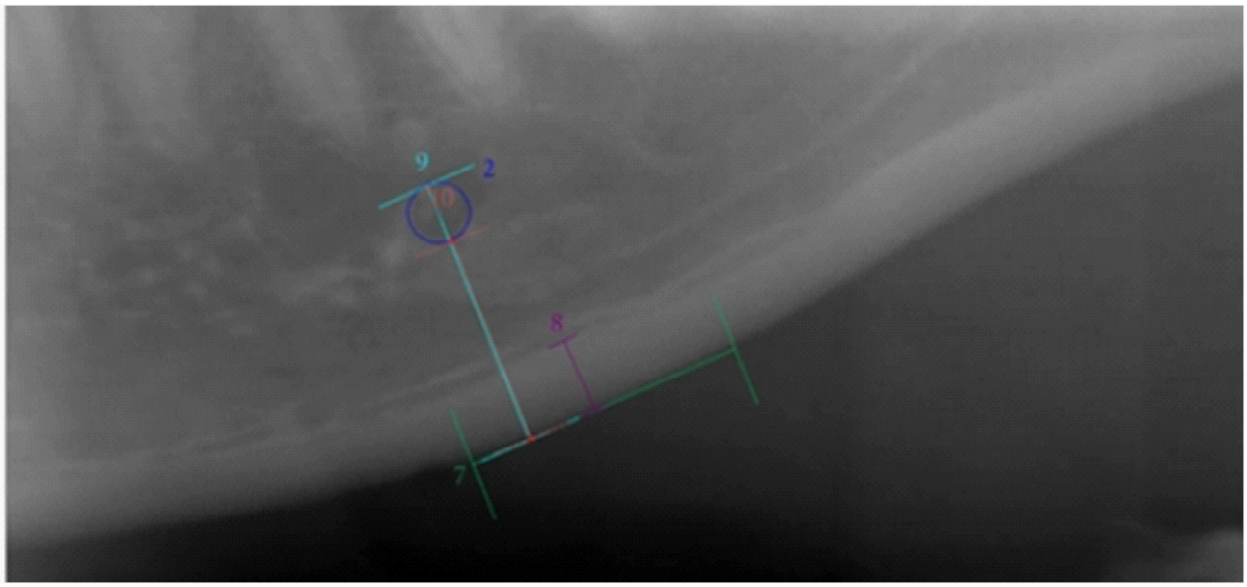


Figure 4. *Measurement of cortical thickness in the mental foramen (mental index - IM) using the Radioimp software.*

Source: Alonso et.al

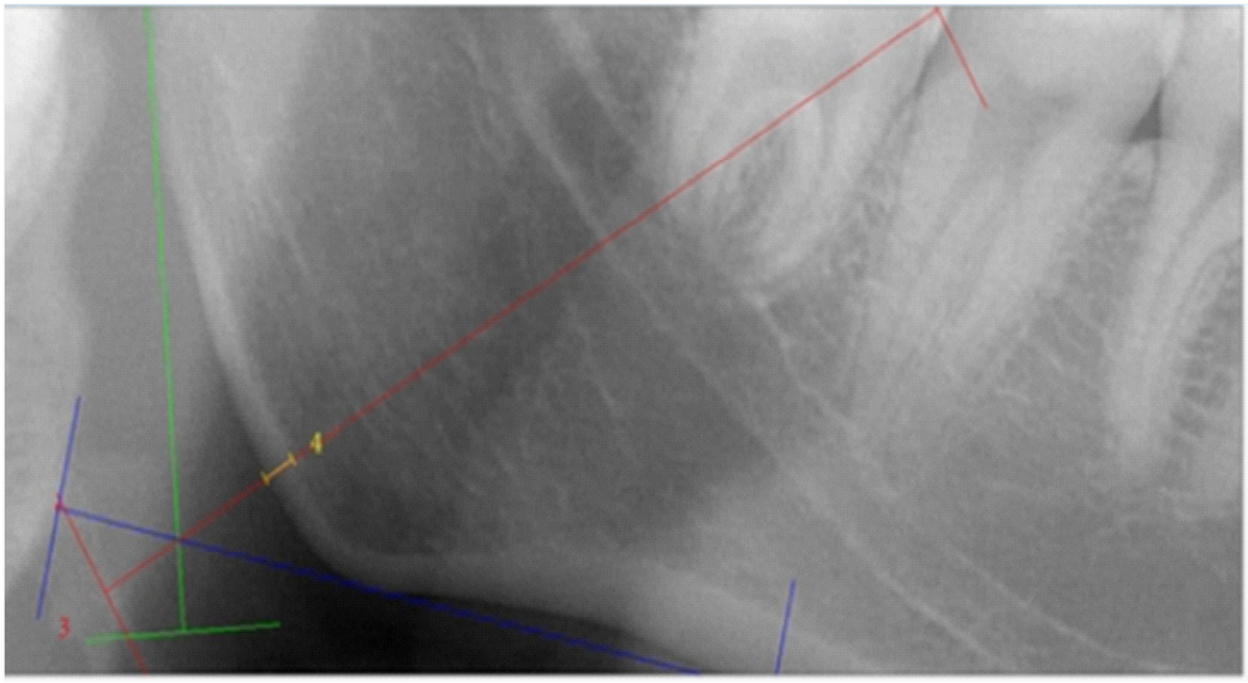


Figure 5. *Measurement of cortical thickness in the gonial region (gonial index - IG) using the Radioimp software.*

Source: Alonso et.al

Conclusion

The present study supports the importance of age-related changes in mandibular radiomorphometric indices in the identification of skeletal osteopenia and the role of osteoporosis in changes in the radiomorphometric index, which can occur significantly and differently in male and female patients. Currently, with the advent of cone beam computed tomography (CBCT) or cone beam CT, many other studies are being developed with the aim of evaluating these indications in computed tomography, which

qualifies and quantifies the bone by correlating this information with a series of risk factors for osteoporosis.

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