
The importance of panoramic radiography in the analysis of bone quality

A importância da radiografia panorâmica na análise da qualidade óssea

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Abstract

The bone quality allows identifying some diseases, more appropriate treatments, besides serving to determine the patient's age. The objective is to identify studies that analyzed bone quality using panoramic dental radiographs to determine diagnoses and promote. A bibliographic search of the five years was carried out, published in dentistry journals, which used and discussed the applicability of panoramic radiographs in the evaluation of bone quality. The initial search resulted in 183, totaling 12 eligible articles. Panoramic dental radiographs are important exams for the evaluation of bone quality, changing as an accessible alternative and with less exposure to radiation, promoting an interaction between professionals and the creation of new clinical criteria.

Descriptors: Bone quality, Bone density, Panoramic radiography.

Resumo

A qualidade óssea permite identificar previamente algumas doenças, propõe tratamentos mais adequados, além de servir para determinar a idade do paciente. O objetivo é identificar estudos que analisaram a qualidade óssea por meio de radiografias panorâmicas odontológicas para determinar diagnósticos e promover tratamentos. Foi realizada uma pesquisa bibliográfica dos últimos cinco anos, publicados em periódicos de odontologia, que utilizaram e discutiram a aplicabilidade de radiografias panorâmicas na avaliação da qualidade óssea. A busca inicial resultou em 183 estudos, totalizando 12 artigos elegíveis. As radiografias panorâmicas odontológicas são exames importantes para a avaliação da qualidade óssea, se apresentando como alternativa acessível e com menor exposição à radiação, promovendo a interação dos profissionais e a criação de novos protocolos clínicos.

Descritores: Qualidade óssea, Densidade óssea, Radiografia Panorâmica

Introduction

The use of dental panoramic radiography (DPR) is widespread, as it is a complementary exam used as a basis for general screening¹⁻³ which allows a comprehensive view of the maxillofacial region, allowing the identification of anatomical structures and possible changes. Its applicability extends from the moment of diagnosis⁴, to identify pre-existing injuries^{5,6}, possible volumetric changes of hard structures^{7,8}, dental dispositions and possible absences⁹, discontinuous areas and even fracture identification and control^{10,11}; going through several stages of treatment to be proposed^{12,13}, combining several radiographic shots to determine their evolution (14), even after its end^{15,16}. Also as an alternative in determining the age of human beings during life and even after death¹⁷.

One of the limitations of the DPRs is the fact that the images generated are two-dimensional³, this allows it to be gradually replaced by cone-beam computed tomography (CBCT)⁸, that produces three-dimensional images¹⁸. However, it is important to consider the reason for the examination, as CBCTs imply a higher incidence of radiation¹⁹. Usually the ALARA principle (as low as possible radiation)^{20,21} is applied as a reference, remembering that incidence of radiation is cumulative and should be limited to the minimum possible to the patient, as they can cause cellular changes if they remain in the body for a long time, especially in the youngest who are more sensitive to these effects, as

they present developing organs, with the possibility of accumulating this radiation for longer¹⁸.

The evaluation of bone quality is extremely important, because through the bone pattern it is possible to identify pathologies, not only of a dental nature, but also systemic ones, the impact of any medications administered and define parameters to be followed to promote quality of life.

One of the ways to assess bone quality is through DPR, creating indexes regarding the base of the mandible^{22,23}, used in adults and can be used for children⁶ as an aid in the diagnosis of osteoporosis⁵. According to these indices, the bone pattern is classified as: C1-Normal, C2-Moderate erosion and C3-Severe erosion.

Osteoporosis is a chronic disease of multifactorial origin, characterized by low bone quality. The use of DPR has been presented as an alternative to identify changes in bone volumes that may suggest the presence of these disease².

This literature review aims to identify studies that analyzed bone quality on all aspects, highlighting the application of DPR to determine diagnostic procedures and promote more appropriate treatments for each case.

Literature review

A bibliographic search of the PubMed (pubmed.ncbi.nlm.nih.gov) was carried out until March 30, 2020, in addition to manual searches. The search strategy used for the database was: bone AND quality OR bone AND



Figure 1. Panoramic dental radiography

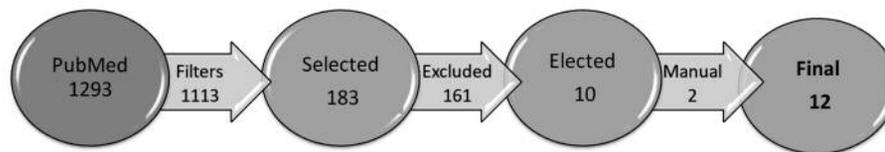


Figure 2. Flowchart

density OR digital AND panoramic AND radiographic, after, the filters were applied: Full Text, in the last 5 years, Humans, English, Dental Journals, as criteria for inclusion of clinical and/or observational studies that discuss the use of panoramic radiographs in the evaluation of bone pattern and its applications. The results obtained were used to read titles and/or abstracts by two operators, who considered the selected articles, in addition to promoting manual searches. Of the selected studies, the use of panoramic radiographs, the type of analysis and the diagnostic tools were used as a criterion for the final selection. Differences and similarities were considered for data analysis.

The initial search resulted in 1293 articles. After applying the filters as inclusion criteria, 183 studies were used to read titles and abstracts by the operators, who selected 10 studies, added to two articles of manual searches performed, totaling 12 eligible articles as shown in the flowchart en figure 2.

Discussion

Trough DPR are possible to assess the bone pattern, as to its quality and quantity. But must observe at what times its applicability is relevant, always determining a reason for its use and respecting the criteria of the exams already consolidated for that purpose, being able to combine with additional exams to refine an evaluation and establish the most accurate diagnosis.

Osteogenesis imperfecta and pamidronate

In a study involving 67 children with osteogenesis imperfecta (OI) type I, III and IV being treated with pamidronate (PAM)5, 197 DPRs were analyzed, visually observing the estimate of the mandibular cortical with (SVE), quantitatively the mandibular cortical width (MCW) and the quality with the mandibular cortical index (MCI). Fisher's test and factor analysis of variance were used to compare MCW and Fractal dimension (FD) in children with different types of OI for different PAM cycles. The results showed that in all patients the cortical indexes were thinner and more porous at the beginning of treatment, but with significant differences between MCW and FD for the OI groups and in different cycles of PAM use. However, trabecular indices in FD did not show statistical differences. Therefore, the authors concluded that children with OI present mandibular cortical changes during treatments with PAM and that the standard of analysis used was efficient to assess bone mineral density (BMD) and can be used to monitor the progress of treatment in these patients.

Hematological neoplasm

Another study evaluated the bone pattern of childhood survivors of hematopoietic stem-cell transplants (HSCT) from hematological neoplasms²⁴, whereas these patients tend to develop osteopenia and osteoporosis throughout their lives, compared 21 DPRs, performed

6.59-83.95 months after transplantation, of surviving patients aged 3.69-18.88 and 31 DPRs of healthy patients (control group) aged 3.69-25.1 years, using the quantitative assessment parameter performed by measuring the cortical bone width bilaterally at the mental foramen level and qualitative the mandibular cortical index bilaterally. The results showed that the surviving patients had a cortical quantity of mandibular bone 17% smaller and qualitatively more porous than those of healthy patients. Considering that according to the World Health Organization (WHO), the dual energy x-ray absorptiometry (DXA) exam of long bones or vertebrae is the exam of choice for diagnosis of low bone density, despite its high cost. Morphometric assessment using DPR was proposed as an alternative to DXA in the diagnosis of osteoporosis. It also highlights that HSCT surviving patients correspond to a high risk population with low bone density and need more attention, that dental professionals can contribute to the improvement of these patients and that the Taguchi bone pattern assessment index²³ is more adequate than the Klementti index²².

Scleroderma

Highlighting the feasibility of using DPR in treatment of patients diagnosed with scleroderma, a study carried out on 100 patients²⁵ demonstrates its viability, as this chronic inflammatory autoimmune disease has a high risk of developing osteoporosis and also affects oral tissues, including the bones. In this study 49 patients with scleroderma (study group) and 51 healthy patients (control group) had their radiomorphometric indexes measured (MCI, MI, GI, AI and PMI) through DPR that were used to identify porosities in the mandibular cortical bone. The results showed statistically significant differences for MCI, MI and PMI between the groups studied, where patients with scleroderma had higher bone porosity rates than healthy patients. They therefore concluded that patients with scleroderma have a high risk of developing osteoporosis and confirm the validity of using DPR to assess the radiomorphometric indices for these patients.

Osteoporosis

A study was conducted to diagnose osteoporosis in 194 postmenopausal Korean women with the aim of assessing whether digital panoramic radiographs could be used as a diagnostic tool to determine the bone pattern². The panoramic radiographic indexes MI, MCI and SVE were used to determine a BMD that were correlated with the BMD results acquired through BMD of lumbar spine and the proximal femur measured by DXA. The results showed that Pearson's dispersion and correlation graph that the mental index is correlated positively with BMDs, concluding that the morphological and thickness changes of the cortical bone of the mandible are associated with BMD of DXA, in addition to the mandibular cortical thickness being influenced by aging. Therefore, panoramic radiographic indexes (PRI) are valid for the diagnosis of osteoporosis.

In another study involving 113 postmenopausal women from Lithuania⁷, where the diagnosis with low or normal BMD was obtained from DPRs and bone densitometry, where lumbar vertebrae L2 to L4 and base of the mandible were observed, confirming that PRIs are valid for the diagnosis of osteoporosis.

With the proposal to offer low-cost methods, using minimal radiation, to assess bone quality, a study²⁶ proposed to compare the use of qualitative ultrasound (QUS) in the proximal phalanx III of the fingers, with the mandibular morphometric analysis of DPR in 97 postmenopausal women. The results showed that bone standards of bone quality can be compared and that DPR used in dental treatments can serve as a reference in the investigation of patients with suspected osteoporosis.

To identify variables in DPRs that can be used as a diagnostic support for osteoporosis, the authors of a study²⁷ used 454 DPRs, considering the FD and the gray level co-occurrence matrix (GLCM) in several regions in two groups, with and without osteoporosis. The results showed, due to the significant difference in the characteristics of the support at the endosteal margin, that there is potential for the development of a model for detecting osteoporosis in DPR.

Another studied the utility of the MCI²⁸, evaluated 54 women in the post-menopausal period where DPR digital and panoramic reconstruction (PR) of CBCT were compared with DXA exams. The results showed that the PRs were more accurate in relation to the DPR. However both are valid as a reference for the evaluation of BMD.

Bisphosphonate therapy

Analyzing the clinical, radiographic and hematological aspects of patients undergoing bisphosphonate therapy, a study was carried out²⁹ involving 135 patients divided into two groups, with and without osteonecrosis of the jaw, who were evaluated with DPRs divided into six segments and also periapical for each segment. The results showed bone changes in both groups of patients treated by bisphosphonates, demonstrating the importance of using DPRs in treatment accompaniments that cause bone changes.

Treatments with dental implants

Treatments involving dental implants require BMD evaluation, as shown by a study that evaluated the bone characteristics that influence the insertion torque (IT) of the implants¹, in 25 patients who received 31 implants, where demographics, DPRs were used for the initial evaluation of BMD, complementing as with CBCT to define the position of the implants in the planning phase. The DXA analysis was performed in addition to exams with microcomputed tomography (micro-CT). The results suggest high sensitivity and specificity for IT and that is possible to accurately predict the IT based on the radiographic data obtained from the patient, since the osseointegration of dental implants depends on bone.

This principle was also observed in a study¹² involving 20 patients who used DPR, in order to determine BMD at specific points in the mandible, Gray-scale markers. The data obtained from CT, concluding that BMD can be evaluated with DPR for implant installation, however with certain restrictions.

Analyzing the images of preoperative DPRs from 32 implant procedures performed, a study¹³ to assess the type of bone and classification of its density, comparing its results with preoperative CT that determined bone classification using the Lekholm and Zarb scale³⁰ and a visual analogue scale (VAS) that subjectively measure bone density. New data were collected from the post-surgical period and the authors confirmed the prediction of the precision of the pre-surgical data, when this evaluation is made by an experienced professional, highlighting the importance of evaluating bone quality through images previously in the predictability of procedures involving dental implant surgery.

Conclusion

The DPRs are important tests for the evaluation of bone quality in initial screening, monitoring and post-treatment control of patients in different situations, both dental and systemic. Although there are specific exams already consolidated in some cases, DPRs presents itself as an accessible alternative and generates less exposure to radiation, in addition to providing data, which in some situations, promote the interaction of health professionals and even in the creation of new clinical protocols.

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