ANALYSIS OF THE USE OF MODERN METHODS IN THE STUDY OF DENTAL PATHOLOGIES

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Abstract: Today in dentistry, as in other medical disciplines, the issue of early and correct diagnosis of diseases of the dental and maxillofacial system is acute. Timely and successful treatment and rehabilitation of dental patients depends on this. The introduction and use of modern research and diagnostic methods, such as densitometry and CBCT, can undoubtedly help in this.

Keywords: Densitometry in dentistry, CBCT in dentistry.

INTRODUCTION

Although traditional intraoral sighting radiography is still relevant, it is not applicable to the study of all types of maxillofacial pathology. Moreover, nowadays, due to the rapid development of medical technology, more and more advanced and informative devices and technologies are emerging that make it possible to quickly diagnose and predict the results of treatment. These types include all types of densitometry and CBCT.

Materials and methods: the materials for this study were articles, abstracts, books, dissertations from the sites Google academia, PubMed, Scopus, Elsevier. The method is a review analysis of the data provided.

Results and discussion:

Modern medicine is actively studying cases of drug-induced osteonecrosis of the jaw in cancer patients who receive osteomodulatory drugs such as bisphosphonates and denosumab. This problem attracts the attention of specialists in various fields: dentists, maxillofacial surgeons and oncologists. Despite extensive information, practical methods for preventing medicinal osteonecrosis of the jaw are still poorly developed, which is confirmed by an increase in the number of cases and an aggravation of clinical manifestations of this disease. This article analyzes the main publications and documents related to this topic in Russia and abroad over the past 10 years. The scientific and clinical experience of the authors of the article was also taken into account, the main problems associated with ineffective prevention of medicinal osteonecrosis of the jaws in oncological patients were identified, and ways to solve them were proposed. The need to protect the interests of patients and medical professionals from the point of view of this complication is discussed. Developments in the field of laboratory diagnostics and risk assessment of medicinal osteonecrosis of the jaw in cancer patients, including the identification of markers of bone metabolism, are also being considered. Criteria for the safe use of bisphosphonates and denosumab for oncology have been determined.[8]

For practicing dentists, it is of interest to identify markers of systemic diseases in the oral cavity, in particular metabolic syndrome. This article presents the results of scientific work aimed at assessing the condition of the oral cavity in people with mental disorders on the background of metabolic syndrome, depending on the duration of the disease. 206 patients treated for paranoid schizophrenia were examined. Depending on the duration of the disease, all patients were ranked into three groups: 1 group with a disease duration of less than 5 years (88 people), 2 group – from 5 to 10 years (73 people) and 3 group – more than 10 years (45 people). According to the information entered into the medical records of inpatient patients, concomitant diseases were studied. The study included patients with diseases of the cardiovascular system and diabetes mellitus. The latest indicators of systolic and diastolic pressure, body mass index,

fasting blood glucose, low and high density lipids were recorded. A dental history was collected and the oral cavity was examined according to generally accepted criteria. Assessment of the severity of the inflammatory process in periodontal tissues against the background of systemic osteoporosis in mentally ill patients by ultrasound bone densitometry. As a result, it was revealed that the severity of the metabolic syndrome in people with mental disorders depended on the duration of the course of the underlying disease and was associated with continuous use of antipsychotics. [4]

Currently, dentists are increasingly faced with the problem of bone deficiency, which requires additional interventions to replenish the necessary bone volume for subsequent dental implantation. The deficiency of soft tissues observed in atrophy of the alveolar ridge creates certain difficulties for performing directed bone regeneration (NCR), the success of which to a certain extent depends on closing the wound without tension. The study examined the effectiveness of the method of pre-expansion of soft tissues before the NCR and the long-term results of subsequent installation of dental implants and orthopedic structures based on densitometry data performed after 6 months. [14]

The frequency and clinical course of chronic generalized periodontitis against the background of liver cirrhosis of various etiologies have been studied. 70 patients with chronic generalized periodontitis of various degrees in combination with cirrhosis of the liver were examined (23 patients (32.9%) had cirrhosis of the liver class A, 25 (35.7%) — class B, 22 (31.4%) — class C. The comparison group was 17 patients with periodontitis without somatic pathology. The control group consisted of 20 practically healthy volunteers. A significantly reduced level of oral hygiene was revealed in patients with cirrhosis of the liver of classes B and C. Periodontal pathogenic microorganisms were significantly more common in the contents of periodontal pockets with CP. As the CPU class increased, the frequency of bacterial expansion increased. The severity of periodontal lesion in patients with cirrhosis of the liver is associated with loss of bone mineral density by type of osteopenia (47.2%) or osteoporosis (31.4%), increasing according to the class of cirrhosis of the liver and the severity of periodontal disease. The degree of resorption of the alveolar process is associated with a systemic decrease in bone mineral density. The most severe manifestations of generalized osteopenic syndrome and alveolar process resorption Based on densitometry data are typical for patients with alcoholic liver damage and cirrhosis of the liver with cholestasis syndrome.[2]

Quantitative methods for diagnosing the condition of periodontal tissues and monitoring the effectiveness of treatment of chronic generalized periodontitis can be improved by using cone beam computed tomography (CBCT) on "Planmeca" type equipment. Densitometry (or densitometry) of patients with periodontitis using CBCT improves the methods of diagnosis of this disease and allows you to correctly assess the effectiveness of treatment, including antibiotic therapy. The study of the dynamics of the condition of patients with periodontitis and the use of densitotometry on CBCT showed an increase in the mineral density of not only the interdental septa, but also a compact layer of bone tissue in the lateral areas of the upper and lower jaws. [7]

A study was conducted on 122 patients suffering from chronic general inflammation of the gums and varying degrees of inflammation of the tissues surrounding the teeth. The features of the symptoms of the disease and the use of three-dimensional computed tomography to diagnose the nature and severity of inflammation of the tissues around the teeth were studied. Based on the data obtained, treatment plans for various forms of the disease have been improved. For the first time, methods have been developed for using cone-beam computed tomography to diagnose pathologies of tissues surrounding teeth, including three-dimensional images and analysis of bone density in areas important for the diagnosis of inflammation around teeth with dynamic densitometry in diagnostically significant periodontal areas.[12]

The features of clinical manifestations were analyzed and three-dimensional computed tomography was used to study various degrees of chronic generalized periodontitis in 79 patients with chronic generalized gingivitis. The data obtained served as a basis for improving treatment planning for various clinical forms of chronic periodontitis. In addition, for the first time, methods for the application of an organ-oriented program of multi-plane cone-beam computed tomography in patients with periodontal tissue pathology were developed. This program included a 3D CT periodontal scan and an algorithm for analyzing computed tomography with dynamic densitometry in gum areas of diagnostic importance for periodontitis.[5]

Currently, a new high—tech diagnostic technique has appeared in outpatient dental practice - digital volumetric tomography (dental volumetric tomography, cone beam computed tomography, 3DKT). Due to the physical and technical features of volumetric tomographs (thin intermittent conical X-ray beam, image amplifier with CCD camera), this study is easy to lay (position) the patient, non-invasive, with low radiation load: from 10 mSv (for children) and up to 50 mSv (for adults). The scan time is only 14 seconds. At the same time, in one study, multiple (up to 200 radiographs, cut thickness 0.15—0.3 mm) three-dimensional (in axial, frontal and sagittal planes) images of the entire facial part of the head with dimensions of 15x15x15 cm are obtained. The software reproduces a three-dimensional image of the scanned area for 3-4 minutes on the monitor screen of a personal computer. This study significantly expands the possibilities of X-ray diagnostics, as it allows you to see an X-ray image of the anatomical structure of the roots and canals of teeth, alveolar processes of the jaws in three projections.[11]

During 2006-2010, more than 22,500 patients with various diseases of the maxillofacial system, maxillofacial region and maxillary sinuses were examined on various three-dimensional dental computers, while the use of a wide range of different methods of radiation diagnostics allows timely and with minimal radiation load on a child and adult patient to determine the diagnosis, make a treatment plan and follow the dynamics of the course dental diseases and injuries of the maxillary system, maxillofacial region and TMJ In this way, new promising areas of use in dental practice have been identified [9]

In recent years, cone beam computed tomography (digital volumetric tomography, dental volumetric tomography or 3DKT) has gained significant attention in the diagnosis and distinction of inflammatory, tumor-like diseases and tumors in the teeth, maxillary sinuses, temporomandibular joints, soft tissues and salivary glands. The capabilities of three-dimensional dental computed tomography make it possible to more accurately assess the structure of the root canals of the teeth, the alveolar processes of the jaws and to conduct a detailed assessment of the position of the teeth and the surrounding structures of the maxillofacial region. The main importance in distinguishing inflammatory, tumor-like and tumor processes in the maxillary system and the jaw and face area are the rules and algorithms for analyzing X-ray images based on 3DKT data.[10]

This article examines the use of cone beam computed tomography (CBCT) in pediatric dental practice, describing in detail its capabilities and features. Studies have shown that CBCT has a higher informative value compared to existing methods of radiological diagnostics in dentistry, maxillofacial surgery and otorhinolaryngology. It is characterized by a low radiation load on the patient and is suitable for examining a large number of dental patients. Three-dimensional dental computed tomography makes it possible to more accurately assess the structure of the root canals of the teeth, the alveolar processes of the jaws, to conduct a detailed study of the condition of the tissues around the roots of the teeth (periodontium, periodontium), as well as to assess the relative location of the structures of the maxillofacial region. These data should form the basis for the development of conservative treatment and surgical intervention plans.[13]

Vitamin D plays a key role in regulating calcium metabolism in the body and has immunotropic activity. These two factors determine its important effect on the development of periodontitis. This article provides a detailed analysis of vitamin D metabolism, its main functions and possible disorders that may contribute to the occurrence of pathologies of teeth and periodontal tissues. The experience and prospects of using vitamin D preparations in the complex treatment of inflammatory periodontal diseases are also discussed, with the help of X-ray densitometry, the condition of the periodontium and bone mineral density are determined.[3]

Various variants of bone densitometry are currently widely used in clinical practice to confirm or deny bone loss and to monitor therapy. The use of densitometry allows you to study the bone density in the area of the pathological process of the maxillofacial region, make a treatment plan and further evaluate its result based on the restoration of the bone structure. Bone density in patients with destructive processes in the maxillofacial region is 29.00 ±7.45% in the anterior part of the mandible (incisor region), 35.02 ±7.46% in the posterior part of the mandible (molar region), which is statistically significantly lower compared with bone density in persons without pathology. Thus, bone densitometry using digital orthopantomograms is a diagnostically informative available research method and can be used to diagnose the condition of the bone tissue of the jaws and evaluate the treatment. [1]

In this paper, a comparative analysis of the use of traditional methods of examination of a dental patient with modern methods of radiation diagnostics in favor of the latter is carried out. In outpatient dentistry, CBCT has a huge potential for use in all areas of dentistry. Visualization in three planes makes it possible to detect a great variety of cysts, tumors, infectious processes, developmental abnormalities and traumatic injuries in the maxillofacial region. Today, it is widely used to assess the damage to the maxillary system, in diseases of the TMJ, and for planning bone grafting and dental implantation operations of varying complexity. [6]

This study compares the effective radiation doses and their absorption by tissues obtained using Veraviewepocs 3D and 3D Accuitomo cone beam computed tomography (CBCT) devices in various protocols. The radiation doses received from both devices using a 4x4 cm field of view turned out to be in similar ranges. It is recommended to use a narrower field of view to create dental images, whereas an extended field of view should only be used in cases where a more extensive view is needed. [15]

In 2011, the Swiss Society of Maxillofacial Radiology (SGDMFR) organized the first consensus conference on the recommendations for the use of cone beam computed tomography (CBCT). The event discussed issues of maxillofacial surgery, dysfunctions and disorders of the temporomandibular joint, as well as orthodontics. In 2014, the second consensus conference was held on the use of CT in endodontics, periodontology, reconstructive dentistry and pediatric dentistry. The created guide is intended for all dentists in order to facilitate the decision-making process on the appropriateness of using CBCT. Usually, the use of CT is limited for reasons of radiation protection, so it should be used in difficult cases where it can be expected to provide additional information for choosing the optimal therapy.[16]

Cone beam computed tomography (CBCT) has led to a change in approaches in endodontics and improved the decision-making process in complex clinical cases. Despite technical advances in CBCT hardware, interpretation of the resulting images still remains difficult due to software limitations, which are often limited in navigation tools and lack suitable filters to overcome CBCT technology problems such as artifacts. This study examines the current limitations of CBCT and the potential of the new CBCT software package (e-Vol DX, CDT- Brazil) to overcome these problems and support the diagnosis, planning and treatment of endodontic cases. This visualization method provides highly resolved images through the use of voxels with a size of less than a millimeter, dynamic navigation of the image in several planes and the ability to

change volume parameters such as slice thickness and slice intervals, as well as adjust data using visual filters and brightness and contrast control. The main differences between e-Vol DX and other software packages include compatibility with modern CBCT scanners and the ability to export DICOM data, as well as a wider range of brightness and contrast settings. Effective image quality improvement contributes to a more informed use and interpretation of CBCT scan results.[18]

The purpose of this study was to assess the prevalence of the number of roots, root canals and apical openings in human permanent teeth using cone beam computed tomography (CBCT). To determine the frequency of occurrence of roots, root canals and apical openings, CT scans of 1400 teeth from a pre-compiled database were analyzed. All teeth were examined by viewing the sagittal, axial and crown planes. Navigation in axial sections with a thickness of 0.1 mm/0.1 mm was carried out from the crown to the apex and back. Two specialists evaluated all CBCT images. The data were analyzed taking into account statistical information, including frequency distribution and cross-tabulation. The largest number of cases with four root canals and apical openings were found in the first upper molars (76% and 33%, respectively), followed by the second upper molars (41% and 25%, respectively). The frequency of occurrence of four root canals in the first lower molars was 51%. The first premolars of the mandible had two root canals and two apical openings in 29% and 20% of cases, respectively. The central and lateral incisors and canines of the lower jaw had two root canals in 35%, 42% and 22% of cases, respectively. [17]

The accuracy of the diagnosis of cone beam computed tomography (3DX) and spiral computed tomography (spiral CT) in the detection of bone abnormalities of the condyle of the mandible was compared using macroscopic observations as a reference method. To visualize the condyles of the mandible, twenty-one samples were scanned using both 3DX and spiral computed tomography. The samples were then evaluated for cortical erosion, osteophytosis and sclerosis at the macroscopic level. The results showed no significant differences between the effectiveness of 3DX and spiral CT in assessing bone changes in the condyles of the mandible.

3DX cone beam computed tomography equipment is a more dose-effective and cost-effective alternative to spiral computed tomography for the diagnosis of bone abnormalities of the condyles of the mandible. [19]

CONCLUSION

The analysis of the use of modern technologies for the examination of dental pathologies has shown the need and justification for the use of new devices and methods in the daily practical work of dentists, despite the comparative cost and scarcity, because the results justify the costs.

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