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DIAGNOSTIC VALUE OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL RADIOLOGICAL IMAGES

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ABSTRACT

This article presents a comparative analysis of the diagnostic value of two-dimensional and three-dimensional X-ray examinations in outpatient dental practice. The clinical advantages of cone-beam computed tomography in diagnosing periapical lesions, root canal anatomy, root cracks and fractures, and planning dental implantation surgery are shown. Clinical recommendations are given regarding the expansion of indications for computed tomography.

Keywords: X-ray examination, intraoral targeted radiography, panoramic radiography, computed tomography.

INTRODUCTION

In modern outpatient dentistry, X-ray examination is used to diagnose most diseases. Relatively recently, a new diagnostic technique has appeared in dental practice – three-dimensional dental computed tomography.

MATERIALS AND METHODS

Two-dimensional images have been used in dentistry since the first intraoral X-ray was taken in 1896. For many decades, two-dimensional images have been the main research methods reflecting the course of patient treatment. Traditional dental X-ray examinations (targeted intraoral radiography and orthopantomography) allow obtaining two-dimensional images of the area of interest, displaying projections of volumetric objects on the selected plane. Between the radiation source (X-ray tube) and the receiver (X-ray film) there are tissues of different densities, the projections of which are summed up and superimposed on a planar image. Due to the resulting overlaps of tissues of different densities, as well as the inevitable projection distortion in size or configuration, standard X-ray examinations do not always show the true picture of the processes taking place and lead to a significant loss of their diagnostic information content. These images provide basic information to the dentist and remain insufficient for a more detailed analysis [1].

To achieve the set goal, a study of two-dimensional and three-dimensional X-ray examination data was conducted of 28 patients undergoing examination at the Dental Clinic. The analysis considered 64 X-ray images, of which 32 were two-dimensional images (orthopantomogram), 32 - three-dimensional in the same areas. The work analyzed the results of the X-ray examination of 80 teeth and 10 dental implants. The study took into account the radiological differences between the studies of the patient. All studies were conducted on the X-ray machine My Ray (Italy).

Cone beam computed tomography (CBCT) is a new type of imaging technology. This imaging technique uses a cone beam of X-rays directed at a two-dimensional detector, which makes one revolution around the subject, creating a series of two-dimensional images. The three-

dimensional image is reconstructed from these two-dimensional images using a modification of the original algorithm developed by Feldkamp et al. in 1984. This method often produces images with higher resolution than is possible with a conventional CT scanner. In addition, the new systems are easier to use because they are smaller in size. Unlike standard techniques, CT allows for the evaluation and analysis of true anatomical images. Over the last decade, cone beam computed tomography has become an indispensable source of information for obtaining three-dimensional images in dentistry. This research method significantly expands the possibilities of X-ray diagnostics, as it allows one to see an image of the anatomical structure and pathological changes in the maxillofacial region in three projections: frontal, sagittal and transverse.

RESULTS AND DISCUSSION

The following results were revealed as a result of the study. (Cone Beam Computed Tomography) (CBCT) is a very useful tool in the diagnosis of periapical lesions. In most cases, three-dimensional dental computed tomography allows a more reliable assessment of the areas of destructive changes in the periapical region and periodontal tissues than traditional radiographic methods. During the two-dimensional study, periapical foci of bone rarefaction with the possibility of conservative treatment were detected in the area of 46 teeth. CBCT was performed for detailed diagnosis and clarification of the treatment plan. After a comparative analysis of the two-dimensional image and CBCT, in 78% of cases (20 teeth) the causative tooth was indicated for extraction (Fig. 1).

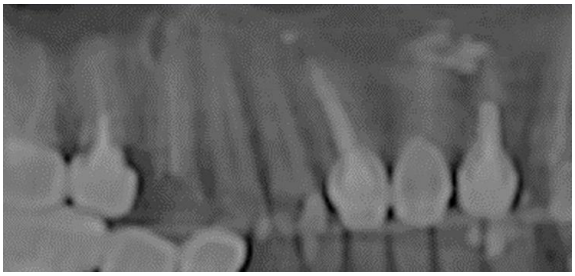

Fig. 1. Diagnosis of periapical lesions

CBCT can also be used to study root morphology, determine the number of roots and canals, and determine the working length and degree of curvature of the roots and canals. CBCT capabilities allow for a more reliable assessment of the structural features of the root canals of teeth, in particular, to identify the degree of their curvature, the presence of additional canals, and the quality of root canal obturation. Due to its accuracy, CBCT is useful in identifying instrument fragments in the canals. We conducted a comparative analysis of two-dimensional and three-dimensional X-ray images regarding the morphology of the root canals. In 24% of cases (8 patients), additional root canals were detected in the teeth subject to examination on three-dimensional X-ray images [3].

Fig. 2. Diagnostics of cracks and root fractures

Special attention should be paid to the problem of diagnosing tooth root cracks, which are quite difficult or even impossible to see on a two-dimensional image. Thus, CBCT is indispensable in determining buccolingual or mesial-distal root fractures. Six patients underwent diagnostics to identify a possible root crack or fracture. In 100% of cases, the two-dimensional image was uninformative, while CBCT provides accurate information.

The accuracy of displaying the objects of study was assessed by comparing the data of the technical characteristics of dental implants with their visualization on OPG and CBCT (see table).

Results of the study of the sizes of dental implants

In the area of the tooth	Dental Implant Sizes		Study of dental implants based on the results of OPG, mm	Study of dental implants based on CBCT results, mm	
	Length	Diameter	Length	Length	Diameter
3.6	10	3,75	11,8	9,6	3,6
4.6	10	3,75	12,9	9,8	3,6

According to the results of the conducted study, the greatest number of distortions of the geometric parameters of the objects under study when compared with the technical characteristics of dental implants is found in the X-ray picture of the OPG. At the same time, a comparison of the results obtained using measuring instruments and with the help of computer tomograph software revealed reliable differences only in certain positions.

CONCLUSION

1. In everyday dental practice, the X-ray examination method still retains its high diagnostic significance, and the main technique remains two-dimensional dental radiography, but in many cases it is not informative enough.
2. Computed tomography provides the opportunity for a highly informative study of the maxillofacial region and is the most rational method of X-ray examination of a dental patient when planning a dental implantation operation, as well as verifying the diagnosis in endodontics.
3. The conducted study indicates the need to expand the indications for the use of the CBCT technique and the possibility of increasing the efficiency, quality and optimization of the examination, further treatment of outpatient dental patients.

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