DIAGNOSTIC VALUE OF RADIOLOGICAL EXAMINATION METHODS IN THE DETECTION OF ODONTOGENIC SINUSITIS

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Abstract

It is emphasized that odontogenic sinusitis frequency for at least 9–11% of the total number of inflammatory diseases of the maxillofacial area, and the frequency of their complications ranges from 30% to 50%. Emphasis is placed on the fact that a frequent cause of the development of odontogenic sinusitis is errors in the endodontic treatment of teeth and errors in dental implantation, which is accompanied by the use of tools for processing root canals (root needles, drills, canal fillers, pulp extractors), as well as filling material and an implant behind the apex tooth root into the sinus cavity.

Radiological research methods play a leading role in the diagnosis of odontogenic sinusitis. Traditionally, for the evaluation of paranasal sinuses, radiography in the nasolabial projection, inspection radiographs of the skull in direct and lateral projections are used. The advantages and disadvantages of multispiral computed tomography (MCT), magnetic resonance imaging (MRI) and cone beam computed tomography (CBCT) are given separately. For a group of 130 patients, the results of the diagnostic informativeness of radiological examination methods in the detection of odontogenic sinusitis are given.

The obtained results allow to conclude that in all cases computer tomography (MCT or CBCT) made it possible to accurately diagnose the form of the disease, determine the extent of sinus damage, assess the condition of the lower bone wall of the sinus (reveal a violation of its integrity and report a tooth socket with a sinus), to determine the center of inflammation in the periodontium, as well as to detect the presence of foreign bodies in the maxillary sinus. At the same time, MCT and CBCT data were fully compared with each other, surpassed traditional radiological methods in terms of diagnostic informativeness and had such advantages as the absence of superposition, high contrast resolution, and the possibility of obtaining higher-quality image reconstructions in different planes.

The aim of study. To analyze the diagnostic value of radiological examination methods in the detection of odontogenic sinusitis.

Material and methods: We examined 130 patients in the period from 2022 to 2023. X-ray examinations were performed on a Planmeca ProMax 3D cone beam computed tomography scanner and MCT.

Results: Regarding the data of CBCT, it is possible to specify the localization of the foreign body and its connection with the odontogenic factor with high probability. It is worth noting that these sinusitis belong to the iatrogenic group of diseases.

Conclusions: CT methods (MCT or CBCT) are a necessary component of the complex diagnosis of odontogenic sinusitis.

1. Introduction

Development of interventional dentistry in recent years, there has been a trend towards an increase in the number of odontogenic sinusitis. Among inflammatory processes of odontogenic etiology, maxillary sinusitis occupies one of the leading positions [2]. Clinical studies show that physicians often underestimate the association of odontogenic sinusitis (OS) with dental disease, and odontogenic sinusitis is often considered to be rhinogenic.

The history of the study of odontogenic sinusitis is more than 100 years old, but there is no tendency to decreasing this pathology. Statistics shows that odontogenic sinusitis accounts for at least 9–11% of the total number of inflammatory diseases of the maxillofacial area, and the frequency of their complications ranges from 30% to 50%. This nosology is a serious medical, social and economic problem, because most patients are young people of working age (72% of patients aged 30–50).

This is explained by the fact that it is not always possible to establish the focus of chronic odontogenic infection during a visual examination of the oral cavity. Also, they can be concomitant with the rhinogenic form of sinusitis and increase its course. Often, chronic odontogenic sinusitis is diagnosed accidentally during X-ray examination of the facial skull due to another pathology.

2. Objective

To analyze the diagnostic informativeness of radiological examination methods in the detection of odontogenic sinusitis.

3. Material and methods

We examined 130 patients in the period from 2022 to 2023. X-ray examinations were performed on a Planmeca ProMax 3D cone beam computed tomography scanner and MCT.

The most frequent cause of odontogenic sinusitis is errors in the endodontic treatment of teeth and errors in dental implantation, which is accompanied by the use of tools for processing root canals (root needles, canal fillers), as well as filling material, dental implants that extend into the sinus cavity. Rarely, foreign bodies in the sinus cavity are fragments of tooth roots [5]. The causes of the development of odontogenic sinusitis also include infection of the sinus during surgical intervention with perforation of the floor of the maxillary sinus cavity: most often (up to 80%) during accidental opening of the sinus during extraction and curettage of the hole after extirpation of the first and second molars of the upper jaw, less

often - during resection of the apex of the root, cystectomy, removal of impacted teeth, sequestrectomy, placement of a dental implant, removal of a tumor in this area.

Radiological methods have a leading role in the diagnosis of odontogenic sinusitis. Traditionally, for the assessment of paranasal sinuses, radiography in the nasolabial projection, the skull in direct and lateral projections are used. In the period of the absence of three-dimensional radiological methods in medical practice, there was a standard according to which the state of the sinuses was assessed using a semi-axial image of the skull, and the state of the teeth by the method of orthopantomography or intraoral contact radiography [4].

After the introduction of three-dimensional methods (multispiral computed tomography (MCT), magnetic resonance imaging (MRI) and cone beam computed tomography (CBCT)), most doctors abandoned the classical algorithm in favor of new methods, and the diagnostic standard described above lost its relevance .

Currently, the lack of a new standard leads to late diagnosis, the occurrence of complications and the conduct of inappropriate research in the form of radiation exposure to the patient [9]. Untimely diagnosis of odontogenic sinusitis can lead to incorrect patient management tactics, as well as various local complications (the frequency of various allergic manifestations (pollinosis) has increased by 20% over the past 10 years).

4.Results

X-ray research methods are a quality standard in the diagnosis of a number of traumatic and inflammatory processes of the maxillofacial area and are used in various fields of dentistry (order of the Ministry of Health of Ukraine No. 566 dated 23.11.2004).

In the period from 2022 to 2023, we examined 130 patients, whose main complaints were difficulty breathing through the nose, heaviness in the location of the maxillary sinuses, and pain when biting the teeth (molars). The analysis of the distribution of patients according to age and gender showed that the majority of the examined patients with OS - 94 (51.2%) people - were young - from 21 to 60 years old. There were 21 (14.7%) patients older than 60 years. The average age of patients was 48 years (from 21 to 81 years). The study was dominated by female patients (62 (47.7%) and 68 (52.3%) males of working age.

The criteria for odontogenic sinusitis were the following signs: the presence of a foreign body, removed filling material or an implant in the sinus cavity; clinical signs of periodontitis of premolars and molars of the upper jaw; destruction of the lower bony wall of the maxillary sinuses in the location of pathologically changed teeth.

Global trends in the field of medical equipment have undergone significant changes in recent years, which is primarily due for improving the quality of diagnostics. This led to the

creation of a new highly informative method - computed tomography (CT), which significantly expanded the diagnostic possibilities of multi-plane and three-dimensional imaging of the maxillofacial region.

Functional endoscopy of maxillary sinuses (Functional Endoscopic Sinus Surgery) makes it possible to establish a diagnosis, verify it morphologically, assess the extent and prevalence of the inflammatory process, and determine the optimal treatment tactics. Among the significant advantages, it is necessary to note the atraumaticity and safety of the method, as well as high-quality visualization of the pathology. During the examination, the doctors assess the condition of the mucous membrane of the sinus, the presence of inflammatory processes and hypertrophy, determine the nature of the exudate, violations of anatomical structures, and the presence of polyps. However, endoscopic equipment does not always provide a sufficient view of the nasal cavity through the widened middle nasal passage, visualization of the anteromedial parts of the sinus and areas of the alveolar bays - the location of cyst-like formations, polyps, foreign bodies and fungal masses - is a certain difficulty.

We agree with the scientists' opinion that the use of the semi-axial (nasolabial) projection used in the study has advantages, including, in particular, a well-developed methodological base, a wide range of equipment, ease of staff training, and low radiation exposure. However, this technique is gradually losing its relevance due to the fact that only two-dimensional images of three-dimensional objects are obtained when using it, which reduces the diagnostic value to a conditional interpretation of what is seen without a clear understanding of the cause and prevalence of pathological changes in the maxillary sinuses [6].

Assessment of the condition of the sinuses on the basis of such X-ray images always makes it difficult to determine a diagnosis. The presence of shadows, low contrast of liquid and soft tissues make it difficult to describe images. Thus, the interpretation of X-rays becomes quite subjective and depends on the individual perception of the doctor, because the two-dimensionality of the data disrupts the understanding of the spatial relationships of anatomical structures.

Orthopantomogram (OPTG), or dental panoramic tomography (dental panoramic tomography) is a technique that simultaneously reproduces the state of teeth, bone tissue of the upper and lower jaws in occlusion. A significant advantage of this technique is informativeness, speed of diagnosis, low material costs, low level of radiation exposure. The main disadvantages of panoramic radiography during the clinical diagnosis of odontogenic

sinusitis include planar transmission of information of the studied three-dimensional object; lack of examination of the entire volume of anatomical structures, in particular all walls and the maxillary sinus, because the lack of objectivity in assessing the degree of prevalence of the pathological process can be the reason for unjustified radical treatment and vice versa; poor examination of the alveolar bay of the sinus and the alveolar bud, and in the distal areas – its complete absence; a certain difficulty in identifying the causative teeth [5].

The creation of cone-beam computed tomography (CBCT) today makes it possible to study in detail the condition of the mucous membrane of the paranasal sinuses, as well as to differentiate the odontogenic or rhinogenic etiology of maxillary sinusitis in most clinical cases. With the help of this method of diagnosis, the characteristics and structure of the sinuses, the assessment of the dimensions of destructive processes and the localization of neoplasms are significantly detailed [8]. In this study, a three-dimensional image is obtained in the sagittal, frontal and horizontal planes. Regarding to this, the doctor receives an image of bone structures and soft tissues, which makes it possible to perform a comparative densitometry of the periapical tissues of the teeth and alveolar processes of the jaws, to visualize the cortical plate of the floor of the maxillary sinus.

With the help of CBCT, it is possible to specify the localization of the foreign body and its connection with the odontogenic factor with high probability. It is worth noting that these cases belong to the iatrogenic group.

We did the following for 130 patients: In the control group of 45 (35%) patients, CBCT was performed for 21 (47%) patients and MSCT was performed for 24 (53%) patients. According to the examination data, rhinosinusitis was detected in 10 (22%) patients, pansinusitis was diagnosed in 9 (20%) subjects, and maxillary sinusitis was present in 26 (58%) patients

For the second group of 33 (25%) people, 15 (45%) patients underwent intraoral imaging, and 18 (55%) patients underwent an orthopantomogram. These images showed darkening in the projection of the maxillary sinuses (3 (9%) patients). In 11 (33%) people, we found a cyst of the maxillary sinus and a foreign body of metallic density, which is most characteristic of the filling material (location of molars). 5 (15%) patients had a defect of the lower wall of the maxillary sinus in the projection of the extracted tooth (molar, premolar) and darkening of the sinus was observed.

The results of diagnostics using radiological methods for 4 patients revealed a defect in the lower wall of the maxillary sinus in the projection of the extracted tooth (molar, premolar) and darkening of the sinus with the presence of a foreign body was observed. 13

patients were diagnosed with an inflammatory process in the apical third of the tooth roots (molars) and darkening of the sinuses of the corresponding side.

All patients from this group underwent a CBCT examination prior to the examination, as a result of which pathological changes in the maxillofacial area were studied in detail, and for 13 patients the diagnosis was established - "odontogenic maxillary sinusitis" and "radicular cyst-like destruction of the alveolar process of teeth 1.6, 2.6, 1.7, 2.7 (Fig. 1.)
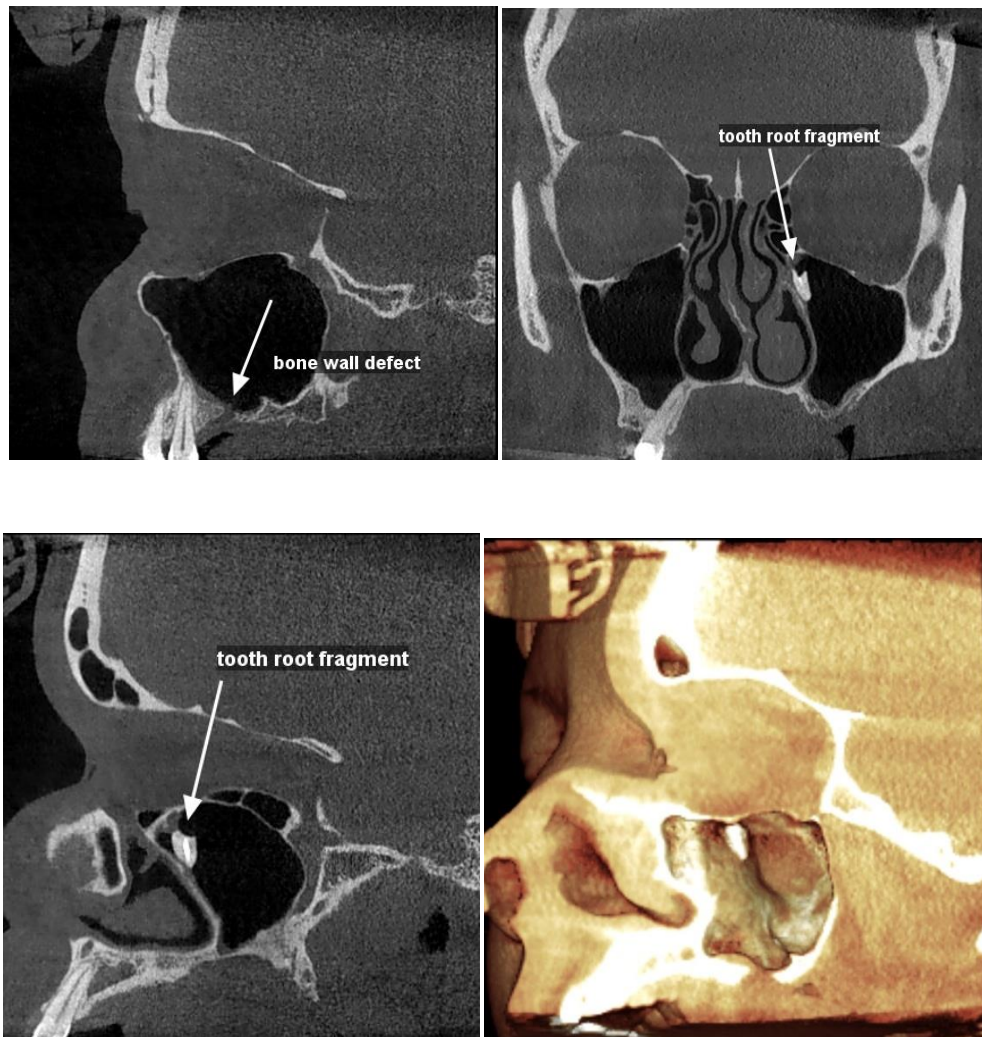
Fig. 1. Patient S. is 46 years old. A fragment of a tooth root located in the upper parts of the maxillary sinus is noted on the CBCT of the paranasal sinuses. Bone defect of the alveolar regurgitant of the upper jaw in the location of the secondary dentition of the molars.

At the initial examination, 52 (40%) patients underwent computed tomography, which included MSCT for 32 (62%) patients and CBCT for 20 (38%) individuals. Based on the results of using these diagnostic methods, we obtained the following data.

6 (12%) patients were diagnosed with "odontogenic maxillary sinusitis" and had foreign bodies of the maxillary sinus (dental implants). In 8 (15%) patients, a diagnosis of "odontogenic maxillary sinusitis" was established, and osteoplastic material was present after osteoplasty of the alveolar process of the upper jaw in the area of molars and premolars. For 5 (9.6%) patients, the diagnosis was established - "odontogenic cyst from a retained, dystopian tooth 1.8", the roots of which are located in the sinus cavity. 3 (5.7%) patients had a diagnosis of "cyst of the incisor canal" with spread to the nasal cavity and "rhinitis".

For 30 (58%) patients - "odontogenic sinusitis" and the presence of removed filling material in combination with inflammatory changes in the roots of teeth of various sizes (from 1 mm to 8 mm) and a defect of the cortical layer of the maxillary sinus.

As an additional method of diagnosing odontogenic sinusitis and a detailed study of the root canal system before endodontic treatment, CPCT was successfully performed after MSCT for a group of 15 patients. The analysis of all additional methods of examining patients for OS demonstrates the importance of diagnostic methods that detail the clinical picture of the disease. This fact greatly contributes to establishing a diagnosis, but does not guarantee the avoidance of various complications and relapses.

The obtained results allow us to conclude that in all cases computer tomography (MSCT or KPCT) made it possible to accurately diagnose the form of the disease, determine the extent of sinus damage, assess the condition of the lower bone wall of the sinus (reveal a violation of its integrity and report a tooth socket with a sinus), to determine the foci of inflammation in the periodontium, as well as to detect the presence of foreign bodies in the maxillary sinus.

At the same time, MSCT and KPCT data were fully compared with each other, surpassed traditional radiological methods in terms of diagnostic informativeness and had such advantages as the absence of superposition, high contrast resolution, and the possibility of obtaining higher-quality reconstructions of images in different planes and 3D images of the area of interest, as well as significant reduction of patient examination time and reduction of radiation exposure. After performing computer tomography, treatment tactics were adjusted in 38 (29.2%) patients.

5.Conclusions

Radiological methods (MCT or CBCT) are a necessary component of the complex diagnosis of odontogenic sinusitis. Computer tomography (MSCT or KPCT) is necessary to determine the cause of sinusitis and, thus, choose the right tactics for managing patients. MCT or CBCT should be recommended to patients before and after endodontic treatment of teeth

and dental implantation, as well as during surgical interventions on the upper jaw to detect possible pathological changes in the maxillary sinuses (including asymptomatic ones).

6.Discussion

Considerable studies of odontogenic sinusitis and the study of methods of its diagnosis were carried out by such scientists as S. D. Varzhapetyan [1], Y. E. Vares [2], S. M. Grigorov, A. G. Gulyuk, D. M. Keyan [5], Pokhodenko-Chudakova I. O. [6], Synekop Y. S., Shvets E. Ya., Kiselyov E. M., Sorokivskyi I. S. [7], Fedirko I. V. [8], Kozlovskyi S.M., Yashchenko M.I. [9], Kalashnyk M.V.

Voloshan O.O. [3] found about 65% (out of 674 patients) of iatrogenic factors in the study of the causes of the disease. In the scientific conclusions of the study by S. D. Varzhepetyan [1] (2019), it was found that iatrogenic inflammations in the maxillary sinus (MS) of orthogenic origin reliably prevail over odontogenic ones: $75.3 \pm 4.7\%$ of cases against $24.7 \pm 4.6\%$, of which therapeutic manipulations significantly more often caused sinusitis than surgical ones ($79.7 \pm 5.0\%$ vs. $20.3 \pm 5.0\%$).And the frequency of odontogenic sinusitis is only from 2 to 25% of the total number of patients with maxillary sinus pathology. Among the clinical methods of examining the maxillary sinuses, S. V. Kiyak [2] prefers cone-beam computed tomography and the endoscopic method of examination.

In the period of the absence of three-dimensional radiological methods in medical practice, there was a standard according to which the state of the sinuses was assessed using a semi-axial (nose-chin) image of the skull, and the state of the teeth by the method of orthopantomography or intraoral contact radiography [4]. After the introduction of three-dimensional methods (multispiral computed tomography (MCT), magnetic resonance imaging (MRI) and cone beam computed tomography (CBCT)), most doctors abandoned the classical algorithm in favor of new methods, and the diagnostic standard described above lost its relevance .

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