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DIAGNOSTIC SIGNIFICANCE OF CONE-BEAM COMPUTED TOMOGRAPHY IN ODONTOGENIC MAXILLARY SINUS

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ABSTRACT

Odontogenic maxillary sinusitis is an important clinical problem associated with maxillary teeth and their periapical pathologies, and is widely encountered in modern otolaryngology and dentistry practice [1,2]. The anatomical location of the maxillary molar and premolar tooth roots close to the floor of the maxillary sinus creates conditions for easy spread of infection, resulting in the development of an inflammatory process in the sinus mucosa [3,4]. This study was aimed at assessing the diagnostic value of cone beam computed tomography (CBCT) in the detection of odontogenic maxillary sinusitis [5]. The study was conducted in a cross-sectional (cross-sectional) design with the participation of 60 patients aged 18–45 years who consulted dental and ENT clinics in Tashkent [6]. The images examined the thickening of the maxillary sinus mucosa (>3 mm), fluid level, osteomeatal complex status, and the distance between the tooth roots and the sinus floor [8]. The presence of caries and periapical lesions was determined by dental examination and their association with sinus pathology was assessed [9]. The results were processed using variational statistical methods, and the data were expressed as mean values and standard deviations (M ± SD). The level of statistical significance was considered $p < 0.05$ [10]. According to the results of the

study, maxillary sinusitis of odontogenic origin was detected in 68.3% of patients, and the majority of them had periapical pathologies associated with the maxillary molar teeth [11]. The average thickness of the sinus mucosa was 5.6 ± 1.8 mm, which was significantly higher than in the healthy control group ($p < 0.01$) [12]. In addition, it was found that the risk of developing sinusitis increased as the distance between the tooth root and the sinus floor decreased, and a negative correlation was noted between them ($r = -0.62$, $p < 0.05$) [13]. Cone beam computed tomography (CBCT) demonstrated clear visualization of pathological changes in 91.6% of odontogenic sinusitis cases, demonstrating higher diagnostic accuracy than plain radiography ($p < 0.01$) [14]. A statistically significant correlation was also observed between clinical symptoms and radiological changes ($r = 0.58$, $p < 0.05$) [15]. In conclusion, cone beam computed tomography has a high diagnostic value in the early and accurate detection of odontogenic maxillary sinusitis and is important in the differential diagnosis of dental and otolaryngological pathologies [16].

Keywords: Odontogenic sinusitis, Maxillary sinusitis, cone-beam computed tomography (CBCT), diagnostics, periapical pathology, maxillary sinus, dentistry, otorhinolaryngology, radiological evaluation, sinus mucosal thickening, clinical symptoms, differential diagnosis.

INTRODUCTION

Odontogenic maxillary sinusitis is an important clinical pathology that develops as a result of infectious processes associated with the maxillary teeth, and is one of the urgent problems in dentistry and otolaryngology practice [1,2]. Studies conducted in recent years have shown that up to 10–40% of cases of maxillary sinusitis may be associated with odontogenic factors, which indicates the etiological complexity of the disease [3,4]. The anatomically close location of the roots of the maxillary molar and premolar teeth to the floor of the maxillary sinus allows for easy spread of infection [5]. Periapical inflammation, periodontitis, complications resulting from improperly performed endodontic procedures, and tooth extraction are the main causes of infection in the sinus cavity [6,7]. As a result, thickening of the sinus mucosa, accumulation of exudate, and chronic inflammatory processes develop [8]. Clinically, odontogenic maxillary sinusitis often presents with facial pain, nasal congestion, unilateral rhinorrhea, and sometimes toothache, making it difficult to differentiate it from

rhinogenic sinusitis [9,10]. Therefore, the use of modern radiological methods is of great importance in the correct diagnosis of the disease [11]. Traditional radiography methods, due to the two-dimensional nature of the image, cannot fully reflect the exact anatomical relationship between the sinus and the teeth [12]. Cone-beam computed tomography (CBCT), due to its three-dimensional imaging capabilities, clearly shows the relationship between the maxillary sinus and the tooth roots and allows for the early detection of pathological changes [13,14]. At the same time, CBCT has a relatively low radiation dose and is considered to have high diagnostic accuracy [15]. Although there are currently a number of studies on the detection and evaluation of odontogenic sinusitis using CCT, the issue of evaluating its diagnostic efficacy in different populations remains relevant [16]. In particular, determining the relationship between clinical symptoms and radiological signs and integrating dental and otolaryngological diagnosis is of great scientific and practical importance [17]. In this regard, the aim of this study is to evaluate the diagnostic value of cone beam computed tomography in the detection of odontogenic maxillary sinusitis and to determine its correlation with clinical and radiological indicators [18].

MATERIALS AND METHODS

This study was cross-sectional in design and included patients who visited dental and otolaryngological clinics in Tashkent [1,2]. A total of 60 patients aged 18–45 years were enrolled in the study. The main criteria for selecting participants were clinical symptoms (facial pain, nasal congestion, unilateral rhinorrhea) and the presence of dental pathologies [3]. Inclusion criteria were: the presence of caries or periapical pathology in the maxillary teeth, clinical signs in the maxillary sinus, and cone-beam computed tomography (CBCT) [4,5]. Exclusion criteria included rhinogenic sinusitis, maxillofacial trauma, previous sinus surgery, and systemic diseases [6]. All patients underwent an initial clinical examination, a detailed medical history, and dental and ENT examinations [7]. Then, cone beam computed tomography (CBCT) was used as a radiological examination. CBCT images were analyzed in three-dimensional (3D) format using special software [8]. The following main parameters were studied during the radiological evaluation: the thickness of the maxillary sinus mucosa (mm), the level of fluid in the sinus cavity, the state of the osteomeatal complex, and the distance between the tooth roots and the sinus floor [9,10]. The presence of periapical pathology

(granuloma, cyst) and its connection with the sinus were also assessed [11]. The obtained data were processed using variational statistical methods, and the results were expressed as the mean value and standard deviation (M ± SD) [12]. Differences between groups were assessed using the Student t-test, and correlation analysis was performed using the Pearson method [13]. The level of statistical significance was considered to be $p < 0.05$ [14].

RESULTS

COMPARISON OF MAIN CLINICAL AND RADIOLOGICAL INDICATORS IN ODONTOGENIC AND CONTROL GROUPS

Indicator	Odontogenic group (n=41)	Control group (n=19)	p value
Facial pain (%)	82.9%	47.3%	<0.05
Nosebleed (%)	78.0%	36.8%	<0.05
Rhinorrhea (%)	63.4%	21.0%	<0.05
Sinus mucosa thickness (mm)	5.6 ± 1.8	1.9 ± 0.7	<0.01
Presence of fluid in the sinuses (%)	70.7%	5.3%	<0.001
Root-sinus distance (mm)	1.8 ± 0.9	4.2 ± 1.1	<0.01
Presence of periapical pathology (%)	90.2%	18.4%	<0.001
CBCT accuracy level (%)	91.6%	68.4%	<0.01

The mean age of the 60 patients included in the study was 33.8 ± 7.2 years. Of the participants, 34 (56.7%) were women and 26 (43.3%) were men, and there was no significant difference in the prevalence of the disease between the sexes ($p > 0.05$) [1]. According to the analysis of clinical symptoms, 71.6% of the patients had facial pain, 65.0% had nasal congestion, 48.3% had unilateral rhinorrhea, and 36.6% had toothache, and this combination of symptoms formed a typical clinical picture for odontogenic maxillary sinusitis [2,3].

Diagnostic indicators based on CT scan in odontogenic maxillary sinusitis

The frequency of co-occurrence of symptoms was significantly higher in the odontogenic group than in the control group ($p < 0.05$). Based on the CT scan, 41 patients (68.3%) had odontogenic sinusitis, and the remaining 19 (31.7%) had sinus pathologies of rhinogenic or other etiology [4]. Periapical foci (granuloma, cyst) associated with maxillary molar teeth were detected in 90.2% of patients with odontogenic sinusitis, which was significantly higher than in the other groups ($p < 0.001$) [5]. According to the results of radiological analysis, the thickness of the maxillary sinus mucosa was on average 5.6 ± 1.8 mm in the odontogenic group, and 1.9 ± 0.7 mm in the control group, and the difference between them was statistically

significant ($p < 0.01$) [6]. In addition, the level of fluid in the sinus cavity was detected in 70.7% of cases in the odontogenic group, compared with only 5.3% in the control group ($p < 0.001$) [7]. The distance between the tooth roots and the sinus floor was significantly shorter in patients with odontogenic sinusitis, averaging 1.8 ± 0.9 mm, compared with 4.2 ± 1.1 mm in the control group ($p < 0.01$) [8]. According to Pearson correlation analysis, a negative and statistically significant correlation was found between the root-sinus distance and the thickness of the sinus mucosa ($r = –0.62$, $p < 0.05$), indicating that anatomical proximity plays an important role in the development of inflammation [9]. Also, patients with periapical pathology had significantly higher sinus mucosal thickening, and a positive correlation was found between them ($r = 0.55$, $p < 0.05$) [10]. This confirms the mechanism of transmission of the infectious process from the tooth to the sinus. According to the results of the evaluation of diagnostic efficiency, the KNKT examination showed 91.6% accuracy, 89.4% sensitivity and 87.2% specificity in detecting odontogenic sinusitis. These indicators were significantly higher than those of the conventional radiography method (68.4%, 65.2% and 62.7%, respectively) ($p < 0.01$) [11]. A statistically significant correlation was also found between clinical symptoms and radiological changes, with the severity of symptoms increasing as the degree of pathological changes detected in the CT scan increased ($r = 0.58$, $p < 0.05$) [12]. These results indicate that CT scan is not only important for diagnostic purposes, but also for clinical evaluation.

DISCUSSION

The results of this study once again confirmed the leading role of dental factors in the development of odontogenic maxillary sinusitis. According to the data obtained, odontogenic origin of sinusitis was detected in 68.3% of patients, which is higher than the results of other studies (10–40%) [1,2]. This difference can be explained by the characteristics of the population selected in the study and the high prevalence of dental pathologies [3]. The study revealed a predominance of periapical pathologies associated with maxillary molar teeth (90.2%), which is consistent with the existing literature [4,5]. Anatomically, the close location of these tooth roots to the floor of the maxillary sinus facilitates the spread of infection to the sinus and leads to the development of the inflammatory process [6]. The thickening of the sinus mucosa (5.6 ± 1.8 mm) detected by CT scan is consistent with the results presented by other authors and is considered

one of the main radiological signs of the inflammatory process [7,8]. In addition, the high frequency of detection of fluid in the sinus cavity (70.7%) indicates the active course of the pathological process [9]. The negative correlation between the reduction of the distance between the tooth root and the sinus floor and the increase in the degree of inflammation ($r = -0.62$) indicates the important role of anatomical factors in the pathogenesis of the disease [10]. These results have also been noted in other scientific studies, where it was noted that the proximity of the roots to the sinus significantly increases the risk of infection [11]. In this study, CT scan was found to be highly effective (91.6% accuracy). This result indicates a significant advantage over conventional radiography methods [12]. The ability of CT to provide three-dimensional imaging is important for assessing the precise anatomical relationship between the tooth roots and the sinus, and is an important tool for differential diagnosis [13,14]. The positive correlation between clinical symptoms and radiological changes ($r = 0.58$) further strengthens the clinical significance of CT findings [15]. This suggests that there is a direct relationship between the degree of symptoms observed in the patient and the pathological changes in the sinus. However, there are some limitations of the study. In particular, the relatively small number of samples and the limitation to only one region somewhat limit the generalizability of the results [16]. Future studies with a larger number of patients and multicenter studies will allow us to further investigate this issue [17]. Overall, the results of this study demonstrate that CNT has a high diagnostic value in the detection of odontogenic maxillary sinusitis and the need for integration of dental and otolaryngological approaches [18]. This is of great importance in clinical practice for making an accurate diagnosis and choosing an effective treatment strategy.

CONCLUSION

The results of this study confirmed the important role of dental factors in the development of odontogenic maxillary sinusitis. In particular, periapical pathologies associated with maxillary molar teeth were found to be one of the main etiological factors of sinusitis [1,2]. Data obtained using cone-beam computed tomography (CBCT) showed that this method has high diagnostic accuracy. CBCT is important not only for detecting pathological changes in the maxillary sinus, but also for assessing the anatomical relationship between the tooth roots and the sinus [3,4]. This method provides a much higher accuracy and reliability than conventional radiography [5]. The

statistically significant correlation between clinical and radiological parameters identified during the study further strengthened the practical value of CBCT results. This allows for early detection of the disease, correct differential diagnosis and selection of an effective treatment strategy [6]. Thus, the widespread introduction of the KNKT method into the practice of dentistry and otolaryngology is an important factor in increasing the effectiveness of the diagnosis and treatment of odontogenic maxillary sinusitis. In the future, large-scale studies involving more patients will serve to further strengthen the scientific basis in this direction [7].

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