Digital diaphanoscopy data processing for differentiation of maxillary sinus pathologies

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Abstract—The paper presents the results of the use of the digital diaphanoscopy method to detect the pathology of the maxillary sinuses with the participation of conditionally healthy volunteers and patients with various types of pathological changes, confirmed by CT results. The results sinuses state classifying based on a quantitative assessment of the registered scattering patterns of light are also presented.

Keywords: optical diagnostics, digital diaphanoscopy, maxillary sinuses, inflammatory diseases, purulent sinusitis, cyst, chronic rhinosinusitis with nasal polyps, computed tomography

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I. Introduction

The annual increase in maxillary sinus pathology among the population[1], the development of complications caused, among other things, by COVID-19 disease, is an urgent task of modern otolaryngology.

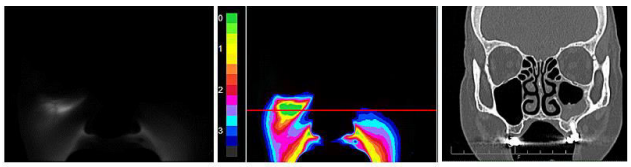
The method of digital diaphnoscopy, based on maxillary sinuses transmission by safe and painless radiation in the visible and near infrared spectrum, registration of light scattering patterns and digital processing of registered images, seems promising for the detection of maxillary sinus pathologies[2,3].

II. Material and Methods

Studies were carried out in 33 conditionally healthy volunteers, including 21 women and 12 men aged from 18 to 27 years. The group of patients included 25 subjects aged from 14 to 68 years with various types of pathology: cyst, deviated nasal septum, chronic rhinosinusitis with nasal polyps, left-sided/right-sided sinusitis, odontogenic sinusitis.

III. Experimental Results and Discussion

At the first stage of analysis, the symmetry disorder of the maxillary sinuses was taken as a diagnostic criterion. At the same time, the presence of pathology in the patients was confirmed by computed tomography (CT) results. Figure 1 shows an example of a patient study with left/right-sided sinusitis, respectively, as well as the CT diagnosis results. The value of the optical radiation power is 25 mW for 850 nm, the camera exposure time is 40 ms.



a) b) c)

Fig. 1. Example of registered scattering patterns of light (a), the results of digital image processing (b), and the results of CT examination (c) for a female patient with left-sided sinusitis.

The developed classification algorithm based on a quantitative assessment of registered scattering patterns of light allowed one to identify the boundary between a healthy sinus and a sinus with pathology.

Thus, the mean of the intensity parameter for healthy volunteers was 98.53 ± 3.27, for sinuses with pathology – 45.39±26.07. The calculated coefficient *K*, which is the percentage ratio of intensity in the eye socket to intensity in the maxillary sinus, was 1.35±0.74 and 15.78 ±13.91, respectively.

A further experimental data acquisition will allow to refine the calculated parameters separately for each disease of the maxillary sinus. This will form the basis of the classification model and will allow identifying diagnostic criteria.

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