APPLICATION OF CONVOLUTIONAL NEURAL NETWORKS FOR THE DETERMINATION OF MAXILLARY SINUS PATHOLOGIES IN DIGITAL DIAPHANOSCOPY

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The digital diaphanoscopy method is used in various fields of medicine, particularly in otorhinolaryngology, to determine the pathological changes of the maxillary sinuses. This method is based on optical probing of the sinuses and registration of scattering patterns of light. It excludes the disadvantages of classical imaging methods, such as the presence of artifacts during ultrasound examination, high radiation load during computed tomography (CT) and low availability of magnetic resonance imaging (MRI). At the same time, diagnostic information can be obtained by analyzing the recorded scattering patterns of light in real time as a result of fast digital processing.

This method is a budget diagnostic method like the rhinoscopy method that is painful and has subjectivity of diagnosis. Compared to other methods, the digital diaphanoscopy method is easy to use, easy to interpret, and also painless. It can be used in telemedicine, as well as for screening the population to divide the group of asymptomatic persons into two classes: with the presence and absence of pathology of the maxillary sinuses.

Using the developed digital diaphanoscopy technology, 55 conditionally healthy volunteers and 27 patients with maxillary sinuses pathologies were studied. The obtained results were compared with the results of CT and MRI studies.

To differentiate the condition of the maxillary sinuses (presence or absence of pathology), the use of pattern recognition theory, namely convolutional neural networks, seems promising. This approach can be used because of the structure of the area of interest, where the points of the main parts of the face are located in close proximity to each other. In addition, such an image recognition algorithm is resistant to small shifts and rotations of test subjects in the input images that take place during research.

The ResNet34 network was used as a classification model. The results obtained showed that the use of two wavelengths of probing the maxillary sinuses (650 and 850 nm) makes it possible to register light scattering patterns and differentiate of maxillary sinuses conditions into two classes (healthy and with pathological changes) with the following accuracy indicators: sensitivity – more than 70% and specificity – more than 90%.

These indicators exceed the values typical for the rhinoscopy method. According to the data from the literature, the values of rhinoscopy sensitivity and specificity for the detection of various pathologies of the maxillary sinuses are equal to 21-69% and 66-80%, respectively.

Thus, the use of convolutional neural networks to detect maxillary sinuses pathologies during digital diaphanoscopy has prospects for the diagnosis of patients, and also for the screening of the population.

The reported study was funded by RFBR according to the research project № 20-32-90147.