Method for the optical diagnosis of inflammatory diseases of the paranasal sinuses

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Introduction

The pathologies of the paranasal sinuses occupy a leading place among all diseases in otolaryngology (**more than 50%**).
The diagnostic methods used today have disadvantages that the digital diaphanoscopy method haven't.

Advantages of digital diaphanoscopy:

- ✓ Simplicity
- ✓ Quick analysis
- ✓ Safety (no radiation)
- ✓ Portability
- ✓ Non-invasive
- ✓ Painlessness

The aim of research

The aim of this research was to evaluate the possibility of applying the digital diaphanoscopy method for the study of the paranasal sinuses and the identification of possible disorders.
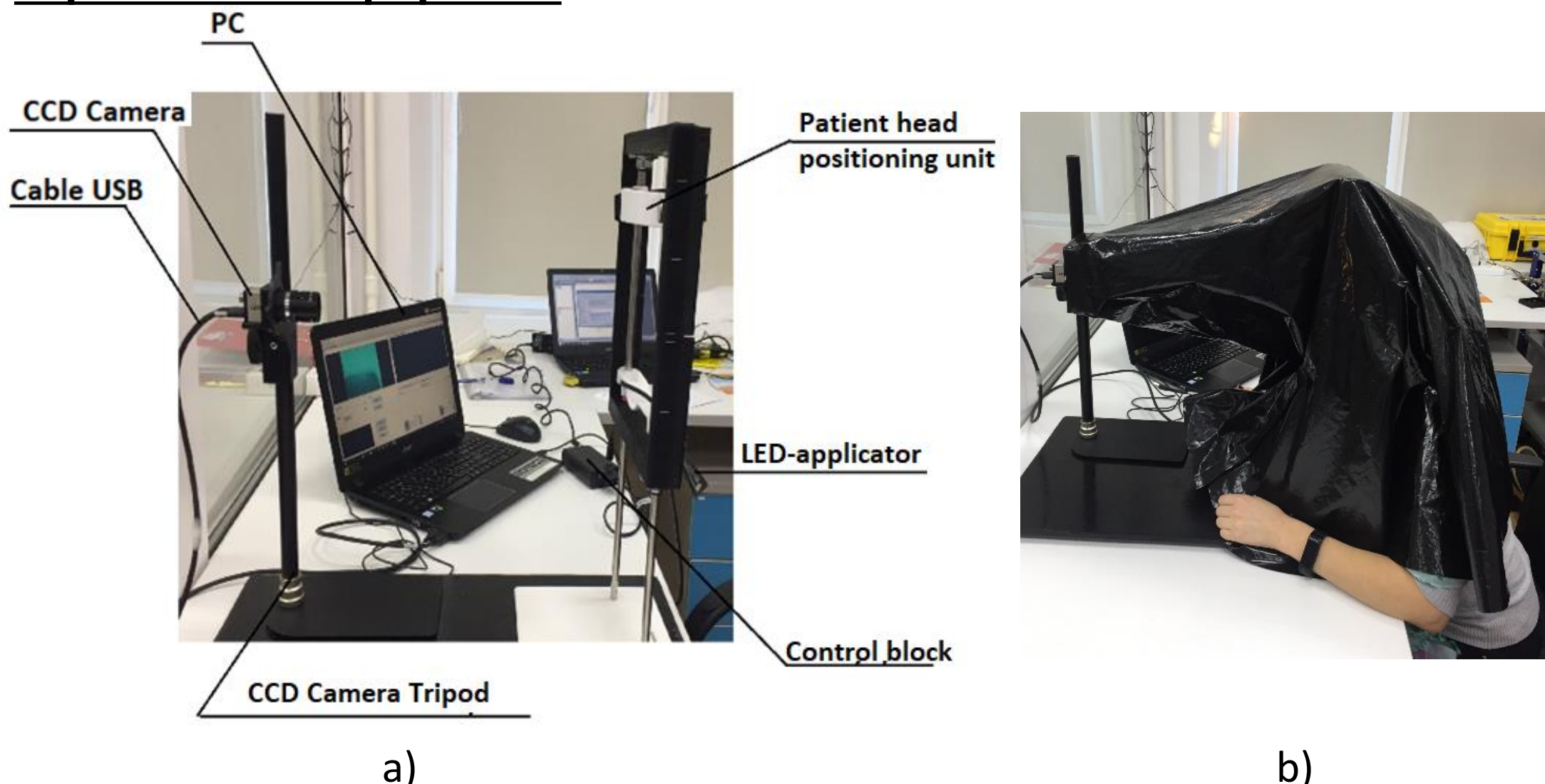
Experimental method and equipment

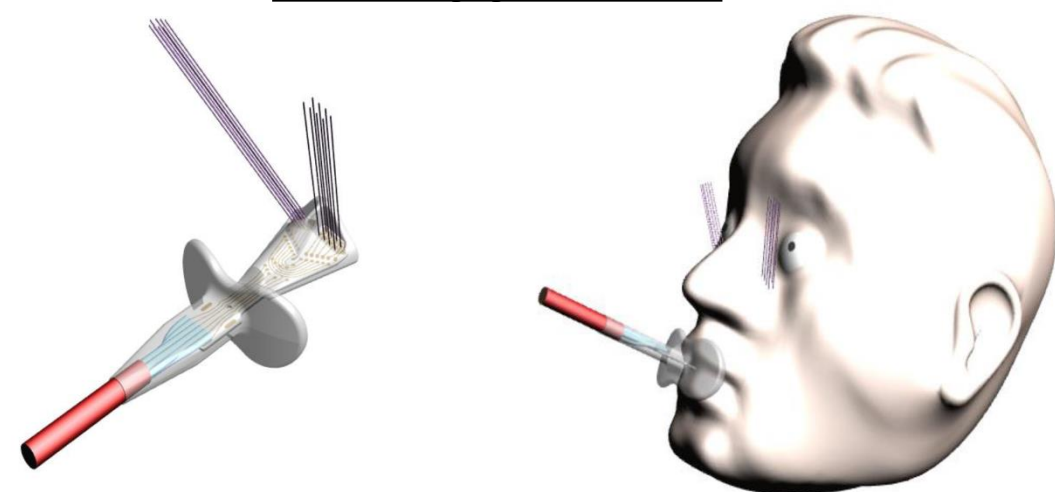**Diagnostics method – digital diaphanoscopy**
21 healthy volunteers
15 patients with pathologies of the paranasal sinuses

Experimental equipment

a)   b)

Scheme of the experimental setup without (a) and with a protective case (b)

LED-applicator

LED-applicator has wavelengths:
- ✓ 650 nm
- ✓ 860 nm

Camera: UI-3240CP Rev.2
Quantum efficiency:
75% (650 nm); 45% (860 nm)

Study protocol
Studies were conducted in a sitting position, a pre-disinfected LED applicator was placed in the oral cavity of the patient. Then, the patient's head was installed in the patient's positioning unit and covered with a protective screen.
In the course of experimental studies, images were recorded at 40 different camera time of exposure values from 0.76 ms to 39.76 ms in increments of 1 ms.

Acknowledgments

Results and Discussion

Examples of registered (top) and processed (bottom) images for volunteer at time of exposure value 20.76 ms for 650 nm (a), 860 nm (b) and combination 650 and 860 nm (c) radiation sources

a)   b)   c)
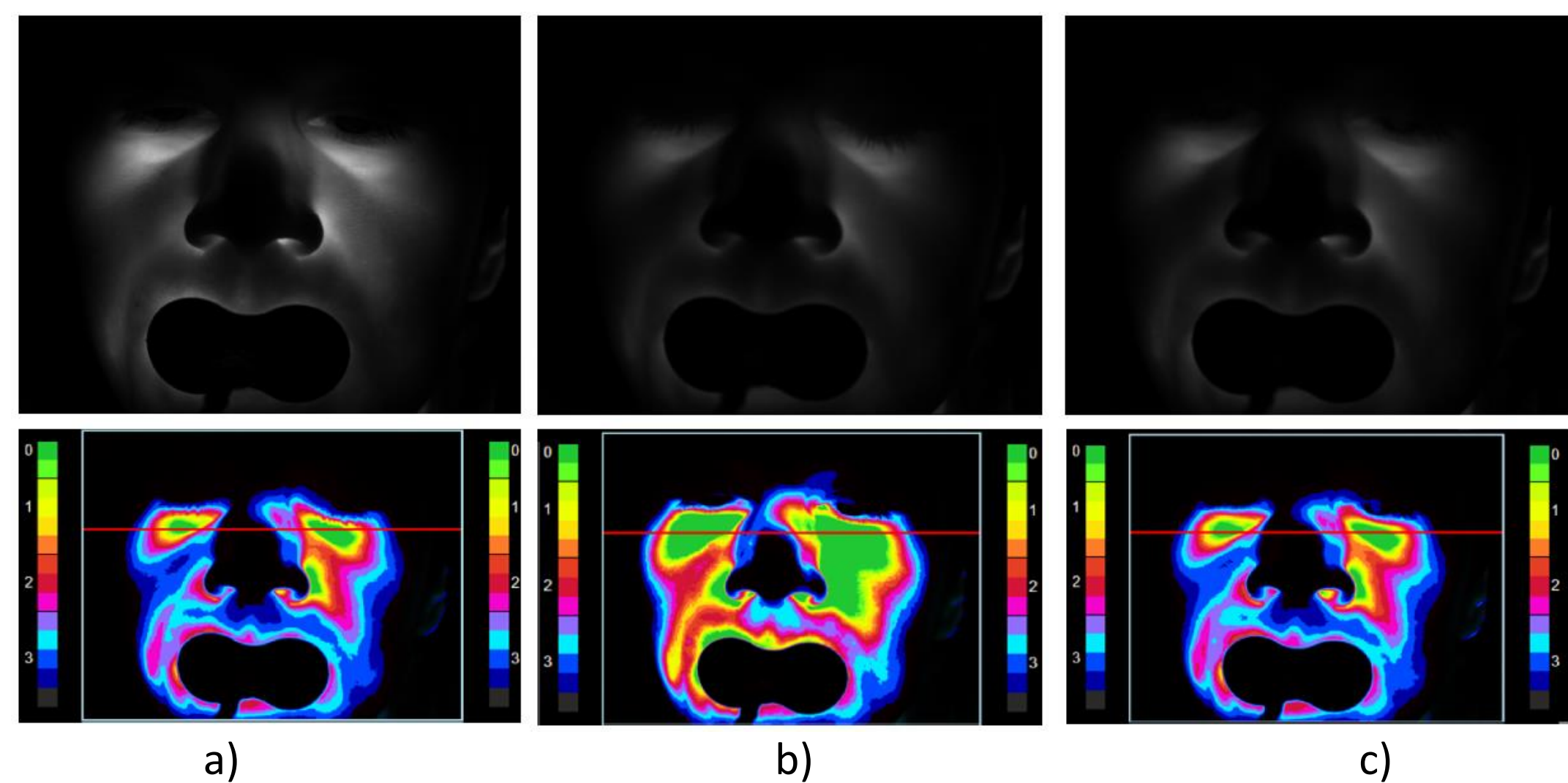
- ✓ Variations in the scattering patterns of light of different volunteers with the same exposure value of CCD-camera.
- ✓ The relationship of the registered scattering patterns with the structure of the skin, the thickness of the skull bone tissue, the size of the sinuses and their asymmetry, as well as their optical properties.

MRI study examples (a) and examples of processed image for patient 1 (top) and 2 (bottom) for near-infrared (b) radiation source

a)   b)
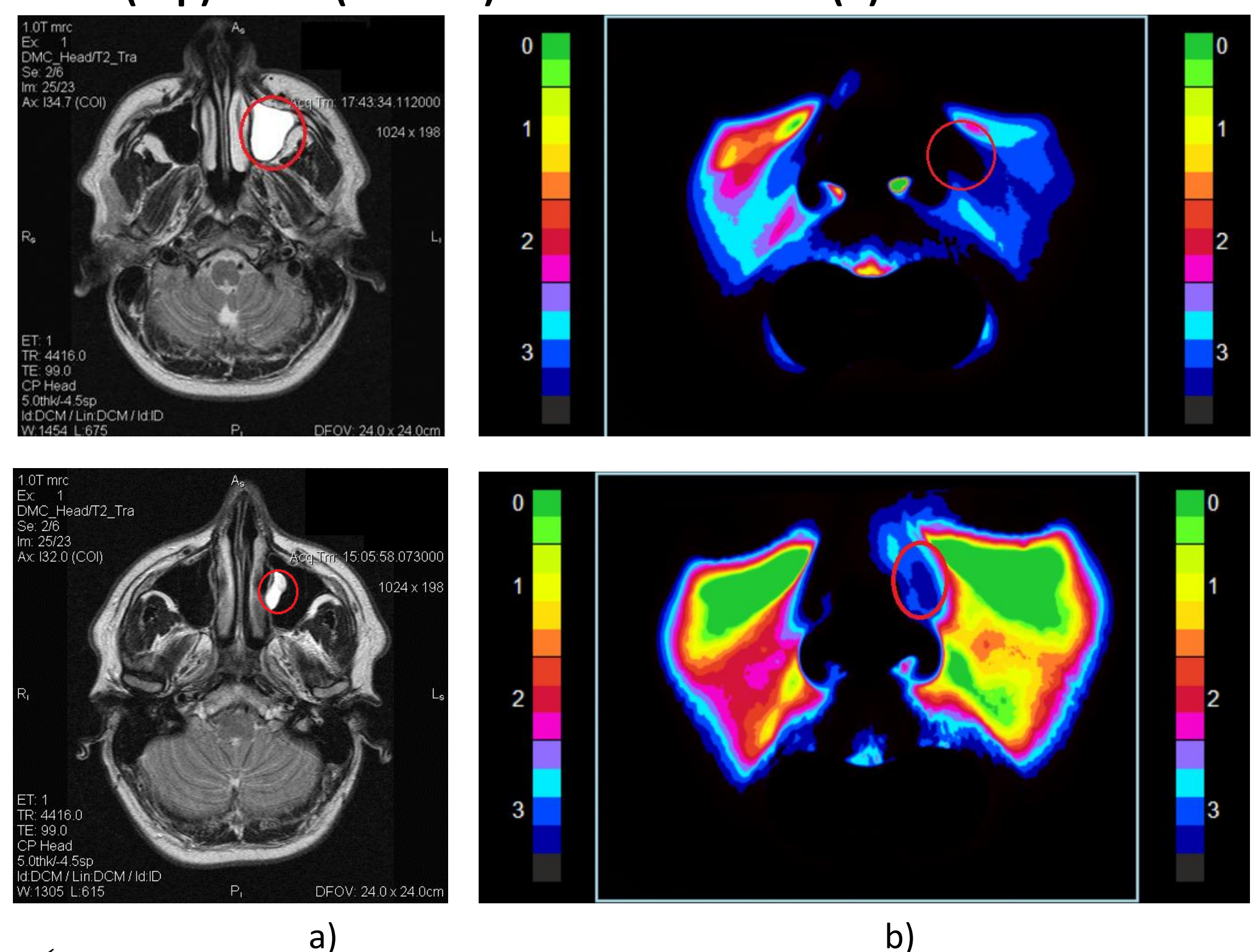
- ✓ In 4 patients out of 15, cysts were found in the right sinuses in two studies.

Conclusion

The obtained results let to conclude that the digital diaphanoscopy has potential to separate normal and pathological conditions of the paranasal sinuses.
For separation of pathological conditions, namely cysts, tumors, inflammations and air-filled cavities, the formation model of the recorded signals will be created using the Monte Carlo method. Using results of modeling the instrumental part of the digital diaphanoscop will be modernized.