

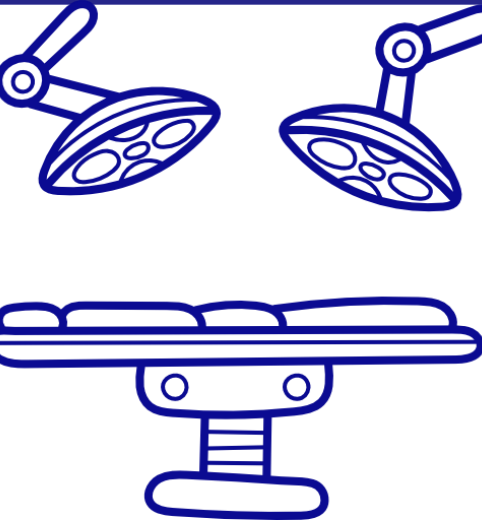
Possibilities of using dynamically controlled semiconductor light sources during surgical operations



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Introduction



In clinical practice, obtaining sufficient and correct lighting from the point of view of color in the operating room is important, as this affects the successful implementation of the operational aid. Good color rendition is vital in order to clearly define the different shapes, sizes and texture of three- dimensional objects and allow the surgeon to avoid mistakes during the execution of surgery. However, in order to improve the visualization of the operating field, the contrast of perception of various biological tissues, it is necessary to develop an LED surgical light with controllable color parameters for operating field illumination and separate regimens to improve the visibility of various tissues during system operations.

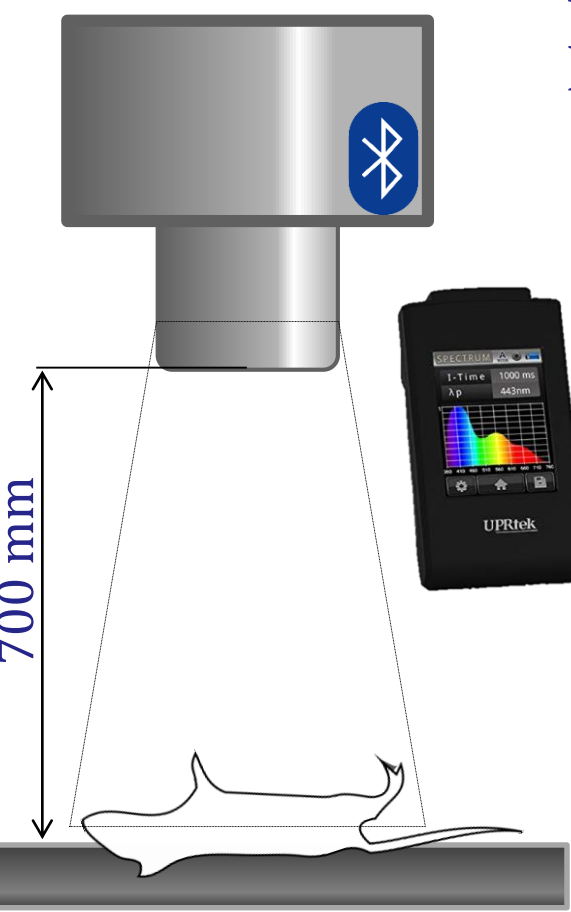
The Aim of the Research

to conduct preliminary studies of the spectral and color indices of combined LED radiation to increase the contrast of biological tissues, with the possibility of selecting the optimal lighting characteristics for laboratory investigations and surgical operations.

Experimental studies were performed on male Wistar rats (n = 5) in accordance with the principles of good laboratory practice of GLP.

Studies were carried out on the skin area after preliminary depilation, subcutaneous fat, muscle tissues of the abdominal cavity organs (intestine, liver). A color-dynamic surgical light was installed above the operating table at a distance of 70 cm, which ensured the creation of a uniform light spot of at least 20x20 cm size. Based on the subjective visual assessment of the operating team, the optimal illumination of the operating field was selected for each site of the study. The spectral characteristic of the emitted light was controlled by a mobile spectrometer MK350.

Materials and Methods



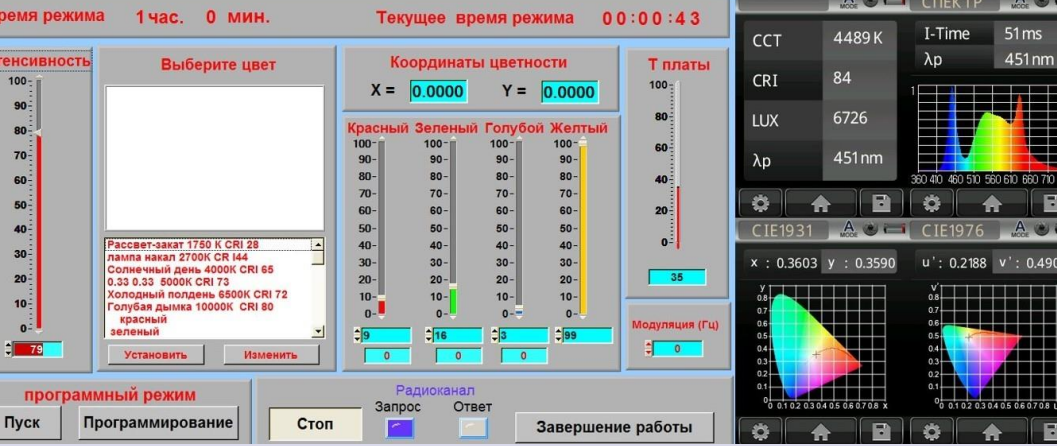
Specially designed controlled color-dynamic surgical light based on the powerful RGBW LED Phlatlight CBM-360 Luminus Inc.

- Characteristics:
- the output luminous flux up to 4000 lm,
 - the illumination of the area 200x200 mm up to 25000 lx (in white light),
 - the output optical system, which allows to perform a shift of radiation of different colors from discrete sources and to form a homogeneous intensity and color illuminating zone,
 - four types of LEDs: cold white (5000 K), red (630 nm), blue (460 nm) and green (520 nm).

Management of light parameters of the surgical light during the research was carried out from a remote computer using the developed software associated with the illuminator over the radio interface Bluetooth class 2 with a range of up to 30 m.

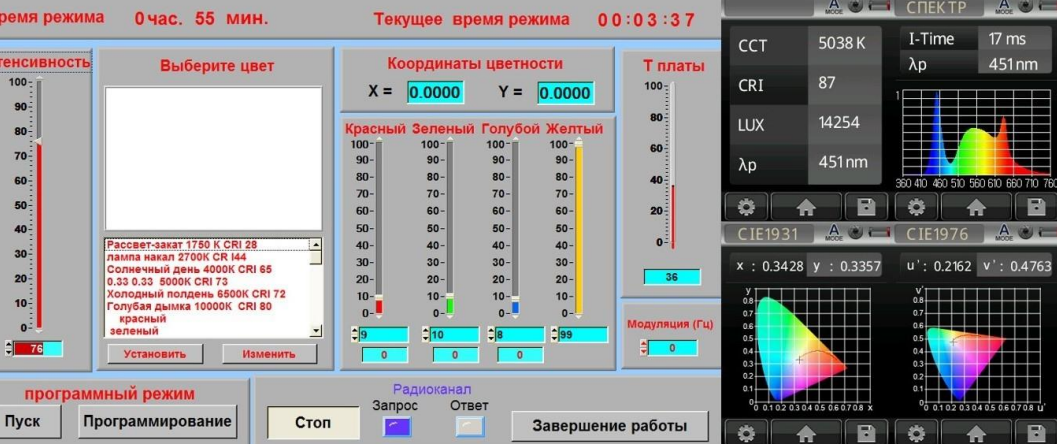
Results

The skin



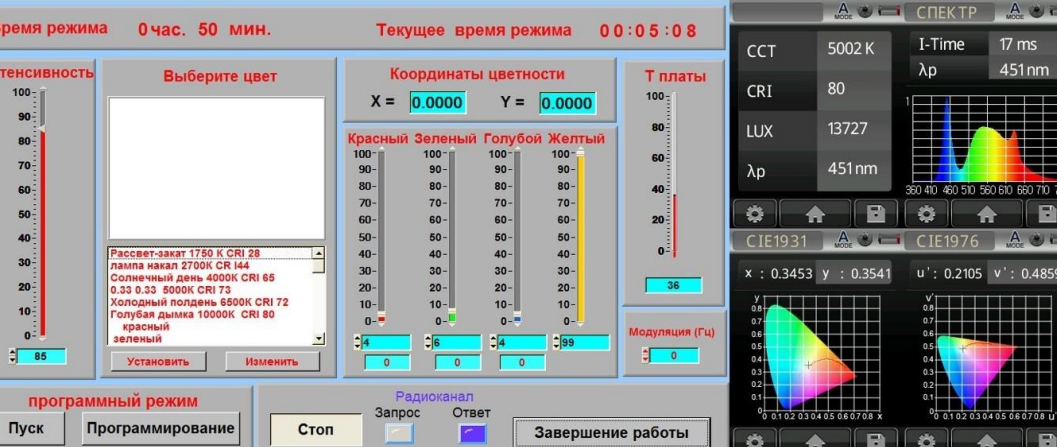
The parameters from the lamp control program: Intensity 79, Red 9, Green 1, Blue 3, Yellow 99.

The subcutaneous tissue



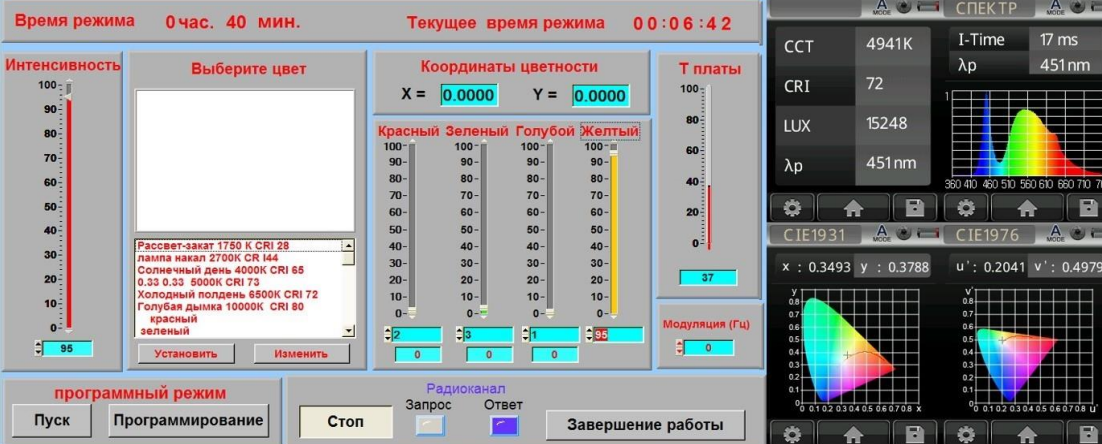
The parameters from the lamp control program: Intensity 76, Red 9, Green 10, Blue 8, Yellow 99.

The anterior abdominal wall



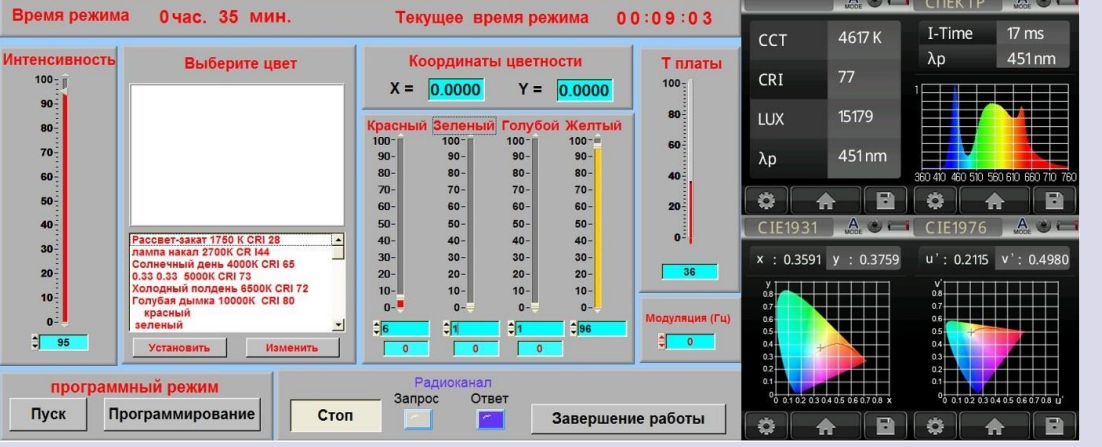
The parameters from the lamp control program: Intensity 85, Red 4, Green 6, Blue 4, Yellow 99.

The serous shell of the intestine



The parameters from the lamp control program: Intensity 95, Red 2, Green 3, Blue 1, Yellow 95.

The liver



The parameters from the lamp control program: Intensity 95, Red 6, Green 1, Blue 1, Yellow 96.

In general, the spectral evaluation of the operating field is subjective in view of the fact that the assessment of illumination in the visualization of biological tissues is due to the individual features of the visual perception of the surgeon.

Conclusion

The use of dynamic control of light and color parameters of the illumination of the operating field has the potential for contrasting visualization and a differential approach to the illumination of specific anatomical structures in the course of surgical manipulations. At present, data are being collected on an extended range of biological objects, including in vivo, in order to develop optimal operating illumination algorithms for surgical interventions on various organ systems. There is a need to conduct studies to study the contribution of each factor to the visualization of biological tissues for a correct interpretation of the intraoperative situation and further development of this direction within the framework of the concept of "Optical Imaging".

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