# Color light therapy in the treatment and rehabilitation of certain neurological diseases

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SUMMARY

The review considers the clinical results of the use of color light therapy of various spectral composition in the treatment of certain neurological diseases: craniocerebral trauma, chronic cerebral ischemia and ischemic compression neuropathies, as well as at the stage of early medical rehabilitation in order to correct post-stroke cognitive abnormalities as a result of ischemic cerebrovascular accident. The analysis of the results of clinical observations showed a significant improvement in the objective clinical and laboratory parameters and the quality of life of patients as a result of the use of color light therapy in the treatment of neurological diseases and made it possible to identify the features of the therapeutic effect of light therapy with different wavelengths, indicating the advantage of using green light with a wavelength of 540 ± 20 nm.

Key words: color light therapy, neurological diseases, medicalrehabilitation, optical incoherent radiation of the visible range, LEDs, zones and points of the skin.

RESUME

The article reviews clinical results of application of color light therapy with different spectrum in treatment of neurological diseases: traumatic brain injury, chronic cerebral ischemia and compressionischemic neuropathies as well as early medical rehabilitation for correction of post stroke cognitive disturbances as result of cerebral blood circulation disturbances by ischemic type. Analysis of clinical observations showed a significant improvement of objective clinical and laboratory parameters and quality of life of patients as result of color light treatment of neurological diseases and allowed to reveal peculiarities of therapeutic effects achieved by application of light with various wavelength, pointing out advantages of green light with wave length 540 ± 20 nm. No side affects of color light therapy were reported in reviewed articles.

Keywords: color light therapy, neurological diseases, medical rehabilitation, optic noncoherent light emission, light emitting diode, zones and points of skin.

## INTRODUCTION

Electromagnetic radiation in the optical range has been and still remains the most common therapeutic physical factor. As a definition of a method that uses light of different spectral composition in the treatment of certain diseases, various terms are currently used, such as: phototherapy, phototherapy, spectral phototherapy, photochromotherapy, selective photochromotherapy, light therapy, light therapy, color light therapy, quantum therapy and some others [1, 2]. The prevailing views allow us to believe that the most objective role of visible light in its therapeutic use is reflected by the term "color light therapy", which will be used in the future.

Color light therapy is considered as the effect of artificial light of various spectral composition on the skin of the human body (including areas and points of the skin) in order to obtain a therapeutic effect at the local, organ, systemic or organismal levels. V

color light therapy uses a portion of the electromagnetic spectrum with a wavelength of 400 nm to 740 nm, which is perceived by the human eye as a visual sensation, respectively, from violet to red light. As the wavelength increases, red light transforms into invisible infrared radiation, which occupies the spectral region between the lower limit of visible red light and radio frequency radiation. In turn, the IR range is conventionally subdivided into three regions: near - from 740 nm to 2.5 μm, middle - from 2.5 to 50 μm, and far - from 50 to 2000 μm. Recently, in non-drug therapy, the use of visible light in combination with infrared radiation in the near region has become widespread, which has a more pronounced therapeutic effect.

Comparative analysis of color light therapy hardware allowed us to evaluate the technical principles of construction, implementation and characteristics of some therapeutic devices [7].

Light-emitting diodes (LEDs) are used as sources of optical radiation in color light therapy, which are used as separate probes or combined into matrices consisting of LEDs arranged in several rows [3–6]. For example, the basic version of the photonic matrix of A. Korobov and V. Korobov of the Barva-Flex series with dimensions of 190 × 98 × 15 mm consists of 24 LEDs arranged in 4 rows of 6 diodes each [5, 6]. Photonic arrays "Barva-Flex", depending on the LEDs included in their composition, allow you to create radiation in any part of the visible range of the spectrum with wavelengths from 400 to 660 nm, as well as in the IR range up to 1000 nm. Photonic matrices are designed to irradiate specific areas or areas of the skin, can operate in mono- or polychrome version and in continuous or pulsed mode of optical radiation. Such matrices can have various dimensions and be made on a flexible base, which makes it possible to use the radiation of LEDs with maximum efficiency on any surface of the skin due to a more snug fit to the patient's body.

The Duna-T color light therapy device is designed for exposure to red (632.7 nm) and IR (840 nm) wavelengths with a radiation area of at least 10 $cm^2$ with a total power of 2.0 mW / $cm^2$... The LED color therapy device "GESKA-polytsvet-mag" is designed to influence biologically active points and zones with radiation at wavelengths of 895 ± 55 nm and from 430 ± 30 nm to 660 ± 15 nm with an effective emitting area of at least 5 $cm^2$ and a power of 0.2-5.0 mW / $cm^2$... The ADFT-4 "RAINBOW" device intended for light therapy uses flat matrices with dimensions of 95 × 45 × 16 mm, consisting of 48 LEDs, 8 rows of 6 diodes in each. Each matrix contains red, green, yellow, cyan or blue LEDs with an average brightness of one color of 200-300 μJ. The operating mode of each matrix when switching LEDs can be running, stochastic or continuously-pulsing.

The MINI-EXPERT-TsT device is designed for color, IR and UV therapy in the mode of constant or pulsed point exposure with the possibility of combining with magnetic therapy. The combined electrode for color therapy contains sources of blue (450–485 nm), green (505– 550 nm) and red (610–700 nm) colors, which allows you to create any color combinations for therapy in the RGB color model. The infrared and ultraviolet therapy point electrodes contain separate sources of IR (900–1200 nm) and UV (315–400 nm) radiation.

Color light therapy is successfully used in the treatment of such diseases of the central and peripheral nervous system as the consequences of traumatic brain injury and stroke, chronic cerebral ischemia, compression-ischemic neuropathies, as well as in the practice of neurorehabilitation [8–10] (Table 1).

Color light therapy, as a rule, does not cause negative side effects, has no obvious contraindications, and can be used with high efficiency in outpatient and clinical conditions, in sanatoriums, as well as by the patients themselves at home. In accordance with this, it seems appropriate and relevant

consider the areas of using the methods of color light therapy in the treatment of various pathologies and evaluate the effectiveness of their application.

The review presented below is based on publications in the domestic and foreign press, available through the Internet resources (eLibrary.ru, PubMed.com). The search was carried out for the period from 1990 to October 2019 using the keywords: color light therapy, neurological diseases, medical rehabilitation, optical incoherent radiation of the visible range, LEDs, zones and points of the skin.

Table 1

Clinical Results of Color Light Therapy in the treatment of neurological diseases

| No. | Disease | author (authors) | Options impact (length waves, nm; area and time of exposure) | results | Literature |
|---|---|---|---|---|---|
| 1. | Cranial brain injury | Mustafaeva A.S., Ivanova N.E., Kiryanova V.V., Mustafaev B.S. | 540 ± 20 nm, power 0.5 mW / cm², dose 0.6 J / cm², collar zone (10 minutes) and transorbit with two sides (5 minutes each), 10 procedures for total time 20 minutes | More distinct dynamics recovery engine violations, neurovegetative and psycho-emotional and neurovegetative statuses, normalization peripheral glucose ric blood and, as a consequence of this, quality improvement life of patients. | [12, 13] |
| 2. | Chronic ischemia brain | Ivanova N.E., Kiryanova V.V., Mashkovskaya Ya.N., Novoseltsev S.V., Yesterday's D.B. | 540 ± 20 nm, radiation power 2.8 mW, cervical area sympathetic ganglia (failure circulation in basin internal carotid artery) and collar area (vertebral basilar-failure), 10 treatments | Positive treatment results patients main group in 85.8% of cases, control group - in 56.3%. | [fourteen] |
| 3. | Chronic ischemia brain | Ivanova N.E., Kiryanova V.V., Mashkovskaya Ya.N., Novoseltsev S.V., Yesterday's | 540 ± 20 nm, 10 sessions for 3-5 minutes each, impact on reflex segmented area C4 - Th4 and zones carotid ganglia | Pulse bias side pressure normal values, decline in index Kerdo, normalization work of the heart. | [15, 16] |

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| | | D.B., Mokhov D.E. | | | |
| 4. | Compression-traumatic neuropathies | Veselovsky A.B., Kiryanova V.V., Mitrofanov A.S., Fefilov G.D. | 540 ± 20 nm, 10 sessions of 5 minutes each, impact per region nerve compression or above the projection site the affected nerve dose 3 J / cm2 | Reverse development subjective and objective manifestations of disorders sensitivity, reduction of pain syndrome, positive dynamics of motor violations, mainly group full recovery in 30% of patients, in the control at 17%. | [17] |
| 5. | Compression-ischemic and traumatic neuropathies | Guzalov P.I., Kiryanova V.V., Mitrofanov A.S. | 470 nm, irradiation over the affected area nerve for 8 minutes with a power of 5 mW / cm2 and a dose of 3 J / cm2 for one procedure, 10 procedures daily | Quick docking neurological symptoms (2-3 days), decrease average, minimum and maximum pain level levels, quality improvement life. | [18, 19] |
| 7. | Rehabilitation sick with tunnel neuropathies | Guzalov P.I., Nikischenkova A.S., Kiryanova V.V., Zhulev S.N., Zhulev N.M. | incoherent low intensity radiation 470 nm | Decrease intensity of pain syndrome, improvement clinico-neurophysiological status and positive dynamics of assessment quality of life. | [twenty] |
| eight. | Sharp stage compression-ischemic neuropathies facial nerve | Guzalov P.I., Kiryanova V.V., Nikischenkova A.S., Jio Yu. | 540 nm, power 5 mW / cm2, 630 nm power 7.5 mW / cm2 .470 nm power 15 mW / cm2, impact on goose area paws "(in front of the ear shell) and along the branches of the facial nerve, 10 minutes | The greatest efficiency color therapy at 540 nm, smaller at 630 nm, minimum at 470 nm, antinociceptive action at 470 nm. | [21] |
| nine. | Rehabilitation patients with sharp violation of cerebral circulation | Tereshin A.E., Kiryanova V.V., Sieve D.A., Ivanova N.E., Efimova M.Yu., | 530 nm impact on the collar area and transorbital, 10 procedures every other day | Reliably improves attention indicators, verbal thinking and speech, does not cause side effect (headache). | [22] |

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|---|---|---|---|---|---|
| | | Karyagina M.V., Savelieva E.K. | | | |
| ten. | Focal defeat brain | Tereshin A.E., Kiryanova V.V., Sieve D.A., Efimova M.Yu., Savelieva E.K. | 530 nm impact transorbital by 2 minutes from power of 90 mW for each eye socket, cervical collar zone 8-10 minutes power 120 mW, 10 procedures every other day | Positive influence in patients with ischemic nature head injury brain at rebuilding common functional states, attention, verbal counting, reading and speech, lack of significant effect on cognitive functions in patients with hemorrhagic stroke but improves general functional condition, absence positive influence on cognitive status of patients with removed tumors brain on the background of deceleration restorative processes. | [23] |

Traumatic brain injury

In the general structure, traumatic injuries of the central nervous system account for up to 30–40%, the neurorehabilitation of the consequences of which is an urgent problem of modern medicine. An important achievement of recent decades is the use of one of the new directions of physiotherapy - color light therapy in early rehabilitation in the acute period of patients with severe traumatic brain injury [11].

In the clinic, 100 patients aged 19 to 80 years with severe traumatic brain injury were under observation, of which 2 groups were allocated by randomization: the main (55 people) and control (45 people) [12, 13]. In the complex of early rehabilitation treatment, the main group of patients received color light therapy in green (wavelength 540 ± 20 nm) using the LED matrix of the Spectrum LTS-02 apparatus at a power of 0.5 mW / $cm^2$ and a dose of 0.6 J / $cm^2$. The impact was carried out by contact on the collar zone for 10 minutes and transorbital on both sides for 5 minutes with a total exposure time of 20 minutes. The control group of patients received only basic rehabilitation treatment. After the end of the course of treatment of 10 procedures, a repeated complex study was carried out,

The results of treatment of patients were assessed based on the dynamics of clinical and neurological symptoms using the Swedish version of the Glasgow Outcome Scale, neurovegetative status using the Kerdo vegetative index, and the state of the sympatho-adrenal and pituitary-adrenal systems - according to the dynamics of glucose levels in

blood. The results of comparison of patients of the main and control groups showed that the patients of the main group showed more distinct dynamics of restoration of motor disorders, neurovegetative and psycho-emotional and neurovegetative statuses, normalization of peripheral blood glucose levels and, as a consequence, an improvement in the quality of life of patients.

Thus, the use of color light therapy in green with a wavelength of 540 ± 20 nm makes it possible to create the most adequate conditions for early rehabilitation of patients in the acute period of severe traumatic brain injury, to obtain more favorable outcomes and improve the quality of life of patients.

## Chronic cerebral ischemia

Therapy of diseases such as chronic cerebral ischemia with a progressive course requires the inclusion of non-drug methods in the treatment complex, which are focused on restoring the functional reserves of the body. One of the most relevant approaches to the treatment of such a pathology is a modern, physiological method of color light therapy that does not have side effects.

The tactics of using color light therapy in the recovery period of the treatment of chronic cerebral ischemia as a result of atherosclerotic lesions of the arteries has shown its effectiveness [14]. Such an assessment was based on the results of treatment of 75 patients (58 men and 17 women, mean age 52.9 ± 1.9 years) with chronic cerebral ischemia on the background of atherosclerosis of the precerebral arteries. The main group (43 patients), against the background of complex drug therapy, received green color therapy with an incoherent monochrome study (Spectrum LTS-02 apparatus) with a wavelength of 540 ± 20 nm and a total radiation power of 2.8 mW. The impact was carried out by contact on the area of the cervical sympathetic ganglia in case of circulatory failure in the basin of the internal carotid artery and on the collar zone in case of vertebrobasilar insufficiency. The entire course of color therapy consisted of 10 procedures against the background of complex drug therapy. The control group included 32 patients who received conventional complex drug therapy.

Patients in the main and control groups underwent examination, which included an assessment of the dynamics of neurological symptoms using a quantitative indicator "mean score", Doppler sonography, EEG, assessment of cognitive functions using the MMSE questionnaire and stabilometry. A survey taking into account the dynamics of all estimated indicators showed positive results of treatment of patients in the main group in 85.8% of cases, while in the control group, an improvement was noted only in 56.3% of cases. Thus, the tactics of using color light therapy in green with a wavelength of 540 ± 20 nm in conjunction with conventional drug therapy turned out to be very effective and increased the overall effect of restorative treatment.

The effect of color light therapy on hemodynamic parameters and the Kerdo autonomic index was studied in the complex treatment of patients with chronic cerebral ischemia with a predominant lesion of the vertebrobasilar basin and the internal carotid artery [15, 16]. The study was carried out on 75 patients aged 24 to 73 years, of which two groups were formed: the main (43 people) and control (32 people). The therapy of patients of both groups was carried out according to the standard scheme of drug treatment, but for the main group, an additional course of color therapy was carried out using the Spectrum LC-02 apparatus. The impact was carried out on the reflex-segmental zone C4 – Th4 and the zone of the carotid ganglia for 10 sessions, 3-5 min each in green color with a wavelength of 540 ± 20 nm.

Patients of both groups underwent a standard neurological examination, EEG was recorded, as well as transcranial Doppler sonography and duplex scanning of the main arteries of the carotid and vertebro-basilar regions. Hemodynamic

indicators were recorded using a blood pressure monitoring system. According to their data, the pulse pressure was calculated, and the Kerdo index was determined. Comparison of the dynamics of pulse pressure in patients of the main and control groups showed that as a result of the course of color therapy, the value of pulse pressure shifts towards normal values, which was not observed without its use. There was also a significant decrease in the Kerdo index in the main group of patients, while in the control group there was only a tendency, which indicates a shift towards parasympathicotonia and eutonia, a decrease in heart rate and a relative normalization of the heart.

## Compression-ischemic neuropathies

One of the leading problems in neurology is diseases of the peripheral nervous system, among which the most common should be considered compression-ischemic neuropathies of the nerve trunk and its branches. In the structure of diseases of the peripheral nervous system, injuries of the nerve trunks caused by local irritation, compression and ischemia in the most vulnerable places of the nerve passage are the cause of neuropathies, accompanied by pain syndrome of varying intensity and localization. Recently, the low-energy effect of incoherent light - color light therapy, which is one of the most natural, safe and comfortable methods of treatment, is increasingly used in the complex therapy of diseases of the peripheral nervous system.

In the complex therapy of tunnel neuropathies on 92 patients, clinical studies of the effect of the action of a green LED matrix (wavelength 540 nm) were carried out using the Spectrum LC-02 apparatus [17]. The exposure was carried out by contact on the area of nerve compression or over the projection site of the affected nerve at a radiation dose of 3 J / $cm^2$... The entire course of treatment consisted of 10 procedures, carried out daily for 5 minutes.

Evaluation of the effectiveness of color light therapy in the main group of patients was assessed by a number of clinical and other indicators against the background of the control group, in which such therapy was not carried out. The examination showed that under the influence of complex treatment in the main group there was a more pronounced reverse development of subjective and objective manifestations of sensitivity disorders, reduction of pain syndrome, positive dynamics of movement disorders caused by muscle paresis. Comparative analysis of the results of the therapy showed that among the patients of the main group, complete recovery occurred in 30% of patients, while in the control group - only in 17%. Thus,

The effect of blue radiation on the course of neuropathic pain syndrome was studied in 47 patients with compression-ischemic and traumatic neuropathies at the age from 18 to 75 years [18, 19]. All patients were randomized into two groups: the main group (26 people) and the control group (21 people). All patients of the main and control groups received basic drug therapy, while the patients of the main group additionally underwent a course of color light therapy, which consisted of 10 daily procedures with a break for the weekend. Irradiation with blue color (average wavelength - 470 nm) was carried out using a LED radiation apparatus "Spectrum LC-M" contact over the nerve affected area for 8 minutes with a power of 5 mW / $cm^2$ and a dose of 3 J / $cm^2$ in one procedure. All patients underwent standard clinical and neurological

examination. In addition, the intensity of pain syndrome was studied using the Quadruple Visual Analogue Scale and the neuropathic pain diagnostic questionnaire (DN4). The quality of life indicators were assessed using the SF-36 questionnaire.

After the course of color therapy, the patients of the main group showed a more rapid relief of neurological symptoms (by 2–3 days). The decrease in the average, minimum and maximum level of pain was more pronounced in the main group of patients in comparison with the control group. The patients of the main group showed an improvement in the quality of life to a greater extent in comparison with the control group. Thus, the use of blue color light therapy in patients with peripheral nerve lesions and the presence of neuropathic pain syndrome contributes to a significant reduction in pain syndrome and an improvement in the quality of life.

In the following studies, the results of treatment with color light therapy in 25 patients aged 20 to 65 years with various types of tunnel neuropathies were obtained. The action was applied with incoherent low-intensity light radiation with a wavelength of 470 nm [20]. Before and after treatment, all patients with tunnel lesions of nerves underwent a standard clinical and neurological examination, the intensity of pain syndrome was assessed using a visual analogue scale of pain (VAS), a diagnostic questionnaire of neuropathic pain (DN4), and quality of life indicators were assessed (questionnaire SF36) ... With the help of electroneuromyography, the speed of impulse conduction along sensitive afferent and motor efferent fibers, residual latency and parameters of the M-response were determined. The results showed

The use of LED radiation with different wavelengths (green, red and blue) in the treatment of the acute stage of compression-ischemic neuropathy of the facial nerve was studied in patients aged 15 to 76 years [21]. All patients were divided into 4 clinical groups depending on the treatment complex used: 3 main groups and one control group. Patients of all groups received basic drug therapy, and in addition, in 3 main groups, an additional course of color light therapy was carried out using the Spectrum LC-M apparatus at the same radiation dose at all wavelengths, equal to 3 J / $cm^2$... The impact was carried out on the “crow's feet” area (in front of the auricle) and along the branches of the facial nerve for 10 minutes.

Group 1 (34 patients) underwent a course of color light therapy with an average wavelength of 540 nm (green color) and a maximum power of 5 mW / $cm^2$... Patients of the 2nd group (32 people) received color therapy with an average wavelength of 630 nm (red color) at a maximum power of 7.5 mW / $cm^2$... In group 3 (31 patients), color therapy was carried out with an average wavelength of 470 nm (blue color) with a maximum power of 15 mW / $cm^2$... The last 4th group, consisting of 25 patients who did not receive color therapy, was the control.

All patients before treatment and 3 weeks after were examined to monitor the effectiveness of therapy. Neurological examination, psychological testing (including a four-part visual analogue pain scale), electroneuromyography, and surface skin temperature thermometry were performed. The degree of functional lesion of the facial nerve was assessed by the amplitude of the M-response withm. nasaliswhen stimulating the affected nerve in comparison with the amplitude of the M-response from the intact side. The results of complex treatment using color light therapy showed a pronounced positive effect on the clinical manifestations of compression-ischemic neuropathy of the facial nerve in patients of the main groups in comparison with the control group. The analysis of the results obtained made it possible to reveal the features of the therapeutic effect of light therapy with different wavelengths in the acute stage of facial nerve neuropathy. The greatest

the effectiveness of color therapy with a wavelength of 540 nm (green), in which the positive dynamics of clinical manifestations coincided with objective neurophysiological data. The influence of exposure to red color (wavelength 530 nm) showed less efficiency, but in comparison with the control group, the effect of color therapy was quite pronounced. The use of blue light (wavelength 470 nm) did not lead to a significant therapeutic effect, however, it caused a pronounced antinociceptive effect.

## Medical rehabilitation of patients with the consequences of cerebrovascular accident

Evaluation of the effectiveness of the use of color light therapy in the complex of early rehabilitation methods in patients with post-stroke cognitive impairment was carried out in comparison with transcranial magnetic stimulation [22]. The study involved 58 patients (26 women and 32 men) aged 33 to 78 years, who were treated in the early recovery period of acute ischemic cerebrovascular accident. The patients were divided into two groups comparable by sex and age - the main and the control. In the main group (23 people), the patients were exposed to a green color with a wavelength of 530 nm on the collar zone and transorbital 10 procedures every other day from the device "SHUTL-Combi IK +", VEGA modification. In the control group (32 people), patients underwent transcranial magnetic stimulation bitemporally with an induction of 45 mT, carrier frequency 50 Hz with 10 Hz modulation for 10 procedures every other day. All patients in both groups received basic nootropic therapy in combination with 10 sessions with a neuropsychologist.

The assessment of the dynamics of the state of cognitive functions in patients, carried out before and after the course of treatment, included: neuropsychological testing according to tests: a short scale for assessing mental functions MMSE, a 5-point test for drawing a clock, Schulte's test, a battery of frontal tests FAB, Roshchina's scale and general state of function speech in points. As a result of the study, it was found that by the end of the course of treatment, both methods statistically significantly improved the cognitive profile in patients on all scales assessed.

Comparison of the effectiveness of color light therapy and transcranial magnetic stimulation in restoring cognitive functions showed a greater degree of increase in attention, verbal thinking and a decrease in the level of disorders in oral speech in patients after a course of color therapy than after magnetic stimulation. In addition, the development of headaches was noted in 5 patients (15% of cases) with the use of transcranial magnetic stimulation, while none of the 23 patients from the color therapy group had headaches.

The results of the use of color light therapy in green in the restoration of cognitive functions in patients with post-stroke impairment showed its greater efficiency in comparison with transcranial magnetic stimulation. At the same time, the course treatment with color therapy, in contrast to transcranial magnetic stimulation, did not lead to such side effects as headache.

The study of the effect of color light therapy as a medical and psychological technology in addition to standard (nootropic therapy and classes with a neuropsychologist) was carried out as part of the rehabilitation of cognitive impairments in patients with focal brain lesions [23]. The study involved 141 patients with verified cognitive impairments as a result of focal brain lesions of various origins. In accordance with the principle of randomization, two groups comparable in gender and age were formed. The main group consisted of 51 patients (30 women and 21 men) with an average age of 54.39 ± 15.37 years, the control group consisted of 90 patients (50 women and 40 men) with an average age of 57.25 ± 14.15 years. Experienced patients

carried out color therapy in green with a wavelength of 530 nm for 10 procedures every other day using the SHUTL-Combi IR + apparatus, VEGA modification. The exposure was carried out transorbital for 2 minutes with a power of 90 mW per eye socket with the patient's eyes closed. Then, for 8–10 minutes, the neck-collar zone was irradiated with a similar radiation with a radiation power of 120 mW.

The state of cognitive functions of patients was assessed before and 30 ± 3 days after the completion of the course of rehabilitation measures. The assessment included: an integral assessment of health status according to the Bartel's index of daily activity, the Rivermead mobility index, the Rivermead daily activity scale (ADL), the modified Rankin scale (mRS) and the Karnofsky scale. The quality of life was assessed using the SF-36 questionnaire, the emotional-volitional sphere - according to the Hamilton scale for assessing depression (HDRS), cognitive functions - according to the MMSE, FAB, Roshchina scales, attention - according to the Schulte test.

The obtained research results indicate that the use of color light therapy with a wavelength of 530 nm is highly effective in restoring cognitive functions in patients with focal brain lesions. Green color therapy has a positive effect on patients with an ischemic nature of brain damage when restoring general functional state, attention, verbal counting, reading and speech. Color therapy does not have a significant effect on cognitive functions in patients with hemorrhagic stroke, but it helps to improve the general functional state. At the same time, no positive effect of color therapy with a wavelength of 530 nm on the cognitive status of patients with resected brain tumors was found, and, moreover,

## CONCLUSION

The analysis of the studies examined made it possible to reveal the features of the therapeutic effect of color light therapy when using visible optical radiation of various wavelengths. The positive effect of green with a wavelength of 540 ± 20 nm was observed in the treatment of the consequences of craniocerebral trauma, in the treatment of patients with chronic cerebral ischemia, in the treatment of the acute stage of compression-ischemic neuropathy of the facial nerve and in the rehabilitation of patients with the consequences of cerebrovascular accident and focal lesions. brain.

The performed analysis of the results of the use of color light therapy in the treatment of neurological diseases showed significant efficacy and a pronounced positive effect on the clinical manifestations of the course of the disease. An improvement in objective clinical and laboratory parameters was observed in patients both when using only color therapy with visible optical radiation, and in combination with drug and traditional physiotherapy. It should be noted that the use of the method of LED color light therapy in patients with post-stroke disorders was more effective in restoring cognitive functions than transcranial magnetic stimulation.

Reflex-segmental zones are one of the localizations of the effect of light therapy in the complex treatment of patients with chronic cerebral ischemia.

None of the analyzed clinical studies found side (non-therapeutic) effects with the use of color light therapy.

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