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Assessment of technical parameters of the domestic solid-state laser system for refractive surgery "Olimp -2000"

Actuality

The use of laser installations based on solid-state emitters is a new step in the technical provision of refractive surgery. Investigation of reliability parameters and operational features of solid-state systems is necessary to determine the possibility of their application in clinical practice.

Goal

To evaluate the technical resource of the replaceable optical elements (crystal of the 5th harmonic, an optical pump) of the installation. Determine the stability of energy parameters during long-term operation under operating conditions.

Material and methods

A prototype of a domestic solid-state laser installation with λ = 213 nm, a 100 Hz generation frequency, a scanning forming system, an active pupil and limb tracking system was studied. Resource technical tests were conducted for 18 months. The stability of the energy characteristics was determined using a digital energy meter OPHIR NOVA-2 with a pyroelectric sensor PE50-BB. Stability of ablation parameters was determined by measuring the optical strength of test lenses made of polymethylmethacrylate using an automatic digital dioptimeter Huvitz CLM-3100P.

Results

Operating the device for 18 months revealed a high stability of energy parameters, reliability of replaceable optical elements of the solid-state laser design and the possibility of their uninterrupted operation for at least 1.5 years under the standard operating conditions.

Conclusion

The technical life of the replaceable optical elements and the stability of the plant's energy parameters are recognized as sufficient for use in clinical practice.

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The first domestic solid-state laser system for refractive surgery "Olimp -2000"

Actuality

Today, the main instrument of refractive surgeons is the excimer-laser systems with λ = 193 nm. Disadvantages of this type of radiation are its high absorption by oxygen molecules, water vapor and high sensitivity to the hydration of the cornea.

There is a positive foreign experience in the use of solid-state laser refractive devices.

Goal

To develop a domestic laser installation for refractive surgery with an alternative source of UV radiation and a wavelength that is less sensitive to environmental factors.

Material and methods

The radiation source was a solid-state pulsed nanosecond Nd: YAG crystal with Q-SW modulation and a nonlinear radiation conversion system. Infrared radiation with λ = 1064 nm, generated by a YAG crystal, was converted to UV radiation with λ = 213 nm using three nonlinear crystals of the second, third, and fifth harmonics.

Results

Radiation with λ = 213 nm is practically not absorbed by oxygen and water molecules, which allows to more accurately dose ablation irrespective of air humidity and degree of hydration of the cornea. The maximum closeness of radiation with λ = 213 nm to the peak of corneal collagen absorption allows to significantly reduce the energy load on the cornea. The reliability of the optical elements of a solid-state laser ensures the durability of work and the convenience of servicing the installation, and the absence of gas mixtures and toxic fluorine enhances its ergonomics.

Conclusion

The combination of technical properties of a solid-state laser refractive system allows to improve the quality and safety of refractive operations and to reduce operating costs.