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**THEORETICAL AND EXPERIMENTAL ESTIMATION
OF THRESHOLD VOLTAGE PARAMETERS FOR
HIGH-FREQUENCY ELECTRIC WELDING OF THE
RETINA USING A NOVEL MONOPOLAR 25-G
WELDING PROBE IN EYES WITH DIFFERENT
INTRAOCULAR CONTENT (VITREOUS BODY, AIR,
PERFLUORODECALINE)**

Chumakov Y.¹, Umanets M.¹, Ptashchenko F.², Kantser K.¹

*¹State Institution «Filatov Institute of Eye Diseases and
Tissue Therapy of the NAMS of Ukraine», Odesa, Ukraine*

*²National University «Odesa Maritime Academy», Odesa,
Ukraine*

Background. Current tendencies toward the microinvasive vitreoretinal surgery necessitate the development of new instruments with smaller caliber (25-G and 27-G) for intraocular maneuvers. High-frequency electric welding of biological tissues was previously introduced to stop intraocular hemorrhage during intraocular tumor resection and achieve retinopexy in rhegmatogenous retinal detachment repair. Thus, the progress toward less invasive operations led to the development of a new monopolar 25-G welding probe, although the exact threshold voltage parameters required to achieve retinal tissue welding similar to bigger probes (20-G and 23-G) remain unclear.

Objective. To estimate threshold voltage parameters for high-frequency electric welding of the retina using a novel monopolar 25-G welding probe, depending on the intraocular content through ophthalmoscopy and optical coherence tomography, in an experiment based on finite-element modeling of the retinal electroheating.

Materials and methods. A novel monopolar 25-G welding probe was used for the application of high-frequency electric welding of the retina in eyes with vitreous body (1 rabbit, 2 eyes) as the control group and eyes with perfluorodecaline (1 rabbit, 2 eyes) or air (1 rabbit, 2 eyes) endotamponade as the experimental group. The retinal changes (welding applications) were evaluated ophthalmoscopically in all groups and using optical coherence tomography in the control group. Finite-element modelling of the retinal electroheating was used to calculate threshold voltage parameters for high-frequency electric welding of the retina using the novel monopolar 25-G welding probe in eyes filled with vitreous body, perfluorodecaline, and air. The only changing parameter was voltage, whereas other parameters of the electric current remained unchanged (frequency: 66 kHz, current intensity: 0,3 A, exposition: 1 s)

Results. Finite-element modeling of the retinal electroheating provided the following threshold voltage parameters: 10,8 V for the vitreous body, 11,5 V for the air, and 12 V for perfluorodecaline. The experiment closely followed the theoretically obtained data, providing the following threshold voltage parameters: 11 V for the vitreous body and 12 V for the air and perfluorodecaline. Ophthalmoscopically, the applications of the high-frequency electric welding of the retina were visualized as local oval grey lesions that do not exceed the diameter of the optic disc. Optical coherence tomography showed local retinal edema, especially of the inner retinal layers, with lightly increased hyperreflectivity and preserved structural architecture of the retina. The theoretical estimation of the threshold voltage parameters through finite-element modeling justifies the obtained experimental data, considering different current and heat conductivity of different endotamponades.