

## Analysis of the Surgical Treatment Effect of Large Diameter Macular Hole on the Foveolar Zone Photosensitivity

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### Abstract

**Introduction:** The macular hole is a pathological condition resulting from a retinal defect in the central zone. The full thickness macular hole (FTMH) is today one of the reasons for the decrease in visual acuity and is detected in 3 out of 1000 people. More often, the disease affects women aged 60-70 years. Functional disorders in the macular region, as a rule, are detected using computer perimetry. This work is a clinical study, which examined the clinical and functional change in the foveolar region, namely, photosensitivity before and in the postoperative period with macular holes of large diameter.

**Materials and Methods:** The study involved 37 patients (37 eyes), with a diagnosis of "FTMH". According to optical coherent tomography (OCT) data, the size of the macular holes: the diameter at the level of the middle layers of the retina is from 450  $\mu\text{m}$  to 706  $\mu\text{m}$  ( $558.9 \pm 128.2 \mu\text{m}$ ), the diameter of the base is from 800  $\mu\text{m}$  to 1696  $\mu\text{m}$  ( $1189.6 \pm 327.9 \mu\text{m}$ ). Ophthalmological examination of patients included: determination of the maximum correctable visual acuity, measurement of intraocular pressure, macular OCT, computer perimetry. The study was conducted on a Humphrey HFA II-750i field of view analyzer (Carl Zeiss Meditec Inc., USA). The instrument used the threshold program "Macula", in which 16 points were tested in the 5° zone from the fixation point, the distance between the tested points was 2°, a stimulus of 0.43° was used (Goldman III), white, with an exposure of 200 ms, average time examinations of one patient 6 minutes. Control studies were carried out a day before surgery and 14 days after surgical treatment.

**Results:** An increase in photosensitivity from  $30.7 \pm 2.8$  decibels to  $32 \pm 2.6$  decibels is noted. According to OCT, a complete closure of the macular opening is observed in 100% of cases, which indicates a positive anatomical result. After the operation, after 14 days, BCVA increased to the following values: from 0.4 to 0.8, the average value was  $0.6 \pm 0.15$ , a significant increase in visual acuity was statistically noted ( $p \leq 0.05$ ). According to the results of the dynamics of foveolar photosensitivity, the following were obtained: 26 people who achieved a functional effect, in the preoperative period, the FSC indicators were  $32.75 \pm 2.42$  dB, 14 days after surgical treatment, the FSC increased to  $33.5 \pm 2.17$  dB, the increase was  $4.2 \pm 2.01$  ( $p \leq 0.05$ ); 11 patients with depression of central photosensitivity against the background of increased visual acuity, in the preoperative period, the parameters of computer perimetry of this group are  $30.5 \pm 0.5$  decibels, 14 days after surgical treatment of FPS within  $29.5 \pm 0.5$  dB, a decrease in FPS in an average of  $1.0 \pm 0.5$  dB.

**Conclusion:** 1. Based on the data obtained, it can be argued that the original technique proposed by us for surgical treatment of macular holes of large diameter does not adversely affect the FSF, and even vice versa leads to an improvement in its performance. 2. An increase in the FPS from  $30.7 \pm 2.8$  dB to  $32 \pm 2.6$  dB is shown, which correlates with 100% closure of the macular holes and an increase in BCVA from  $0.23 \pm 0.07$  to  $0.6 \pm 0.15$  ( $p \leq 0.05$ ).

**Keywords:** Photosensitivity; Macular Zone; Computer Microperimetry; Vitreoretinal Surgery

### Relevance

The macular hole is a pathological condition resulting from a retinal defect in the central zone. The full thickness macular hole (FTMH) is today one of the reasons for the decrease in visual acuity and is detected in 3 out of 1000 people. More often, the disease affects women aged 60 - 70 years [1]. The reason for the formation of a defect in the macular region is changes in the vitreous body, its synechia and syneresis, leading to the development of traction. In the area of the premacular sac and the preoptic cistern of the posterior hyaloid membrane (PHM) there is adhesion with the retina in varying degrees of severity [2]. The radial fibers of the vitreous body (VB) remaining on the perimacular surface after posterior detachment of VB (PVD) are contracted, which gradually leads to rupture of the round retina in the macular zone [3,4]. Decreased visual acuity is the main symptom. As the disease progresses, patients complain of a distortion of subject vision, the appearance of a spot in the central field of vision, metamorphopsia, micromorphopsia, and a decrease in light perception and color perception.

Functional disorders in the macular region, as a rule, are detected using computer perimetry. This work is a clinical study, which examined the clinical and functional change in the foveolar region, namely, photosensitivity before and in the postoperative period with macular holes of large diameter.

The only effective way to treat this pathology is surgical treatment. Various authors have proposed such methods as: vitrectomy with peeling of internal limited membrane (ILM) (was first proposed in 1997 by C. Eckardt, *et al.*) [5]; vitrectomy without peeling ILM [6]; use of "platelet-rich blood plasma" during surgery [7,8]; arcuate retinotomy [9]; rapprochement of the edges of the hole with forceps [10]; rapprochement of the edges of the macular hole using vacuum aspiration [11]; ILM free flap method [12]; the technique of "inverted flap ILM" (proposed in 2010 by Z. Michalewska, *et al.*) [13,20]; the technique we use is a modified technique of the "inverted flap of ILM" by Professor A.N. Samoylov [14].

In a previous work, we described that our proposed method of surgical treatment of macular holes of large diameter provides good anatomical and functional results [15,16,18].

### Purpose of Work

To study the effect of surgical treatment according to the original technique proposed by us on the parameters of the foveolar photosensitivity (FPS) of the macular zone.

### Materials and Methods

The study involved 37 patients (37 eyes), all female patients who applied to the Republican Clinical Ophthalmological Hospital of the Ministry of Health of the Republic of Tatarstan with a diagnosis of "FTMH". The average age of the patients was  $66 \pm 2.98$  years. The duration of the disease according to patients varies from 6 months or more. According to optical coherent tomography (OCT) data, the size of the macular holes: the diameter at the level of the middle layers of the retina is from 450  $\mu\text{m}$  to 706  $\mu\text{m}$  ( $558.9 \pm 128.2 \mu\text{m}$ ), the diameter of the base is from 800  $\mu\text{m}$  to 1696  $\mu\text{m}$  ( $1189.6 \pm 327.9 \mu\text{m}$ ). Ophthalmological examination of patients included: determination of the maximum correctable visual acuity, measurement of intraocular pressure, macular OCT, computer perimetry. The study was conducted on a Humphrey HFA II-750i field of view analyzer (Carl Zeiss Meditec Inc., USA). The instrument used the threshold program "Macula", in which 16 points were tested in the 5° zone from the fixation point, the distance between the tested points was 2°, a stimulus of 0.43° was used (Goldmann III), white, with an exposure of 200 ms, average time examinations of one patient 6 minutes.

Control studies were carried out a day before surgery and 14 days after surgical treatment.

The threshold of photosensitivity at the age of 20 years is about 35 decibels (dB), the sensitivity is assessed by adjusting for age, since after 20 years the annual decrease in light sensitivity is 0.065 dB [17]. The average value of the norm of foveolar photosensitivity, taking into account the age of patients participating in our sample, is  $32.01 \pm 0.15$  dB.

As a result of computer perimetry in the preoperative period, changes were revealed: single absolute scotomas in 4 patients, relative scotomas in 2 cases.

The average level of the FPS was  $30.1 \pm 1.9$  dB, the deviation from the individual level of photosensitivity was  $11.3 \pm 6.7$  dB.

Prior to surgical treatment, the best-corrected visual acuity (BCVA) of patients was  $0.23 \pm 0.07$ .

All patients underwent surgery according to our proposed technique, performed on the surgical system Constellation Vision System, Alcon, USA, by one surgeon. A standard 25-port, three-port subtotal vitrectomy was performed. Triamcinolone acetonide was used in order to drill down on PHM and ILM. Induction of PHM detachment and its removal by the aspiration method, starting from the optic disc to the periphery. Separation of the ILM fragment around the macular opening with forceps, keeping it intact at the edges of the opening. Depending on the diameter of the gap, a circular flap was cut with scissors or a vitrector. With the help of forceps, the remaining truncated flap of the ILM fit into the gap. Replace fluid with sterile air. After the operation was completed, patients were advised to take the position face down for one day.

Statistical data processing was performed using Microsoft Office Excel 2010. The data obtained are presented in the form  $M \pm \sigma$ . To assess the significance of differences between groups, Student t-test was used. The results were considered statistically significant at  $p \leq 0.05$ .

**Results and Discussion**

An increase in photosensitivity from  $30.7 \pm 2.8$  decibels to  $32 \pm 2.6$  decibels is noted (Figure 1). Deviation from the individual level of photosensitivity does not exceed 10 decibels. According to the results of perimetry, it can be noted that there were no photosensitivity defects, only in one case did the part of the scotoma, which is parafoveolar, was preserved. Statistically, these differences in the pre- and postoperative parameters of the FSC in general turned out to be unreliable.

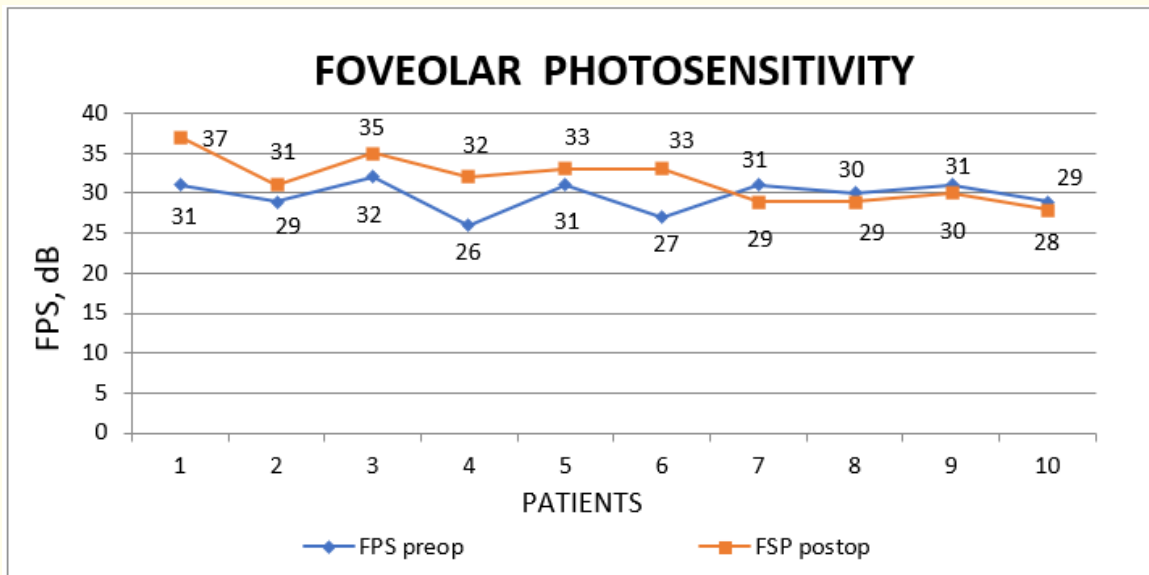


Figure 1

According to OCT, a complete closure of the macular opening is observed in 100% of cases, which indicates a positive anatomical result.

After the operation, after 14 days, BCVA increased to the following values: from 0.4 to 0.8, the average value was  $0.6 \pm 0.15$ , a significant increase in visual acuity was statistically noted ( $p \leq 0.05$ ) (Figure 2).

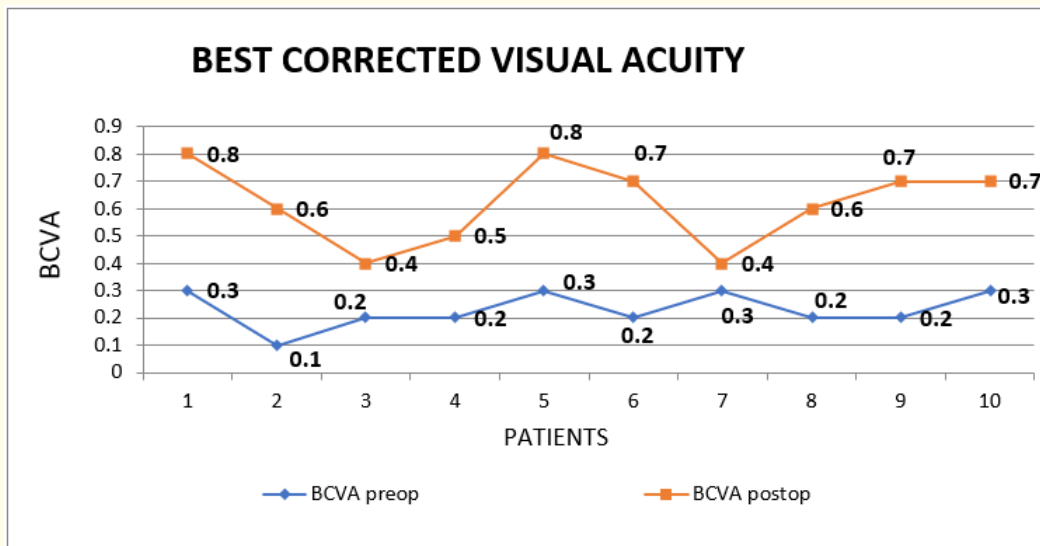


Figure 2

According to the results of the dynamics of foveolar photosensitivity, the following were obtained: 6 people who achieved a functional effect, in the preoperative period, the FSC indicators were  $32.75 \pm 2.42$  dB, 14 days after surgical treatment, the FSC increased to  $33.5 \pm 2.17$  dB, the increase was  $4.2 \pm 2.01$  ( $p \leq 0.05$ ); 4 patients with depression of central photosensitivity against the background of increased visual acuity, in the preoperative period, the parameters of computer perimetry of this group are  $30.5 \pm 0.5$  decibels, 14 days after surgical treatment of FPS within  $29.5 \pm 0.5$  dB, a decrease in FPS in an average of  $1.0 \pm 0.5$  dB.

It is likely that a decrease in photosensitivity is associated with postoperative macular edema, damage to Mueller cells that occur after peeling with ILM, or the preservation of a neurosensory defect that we do not see in OCT.

Earlier, in the available literature, the central photosensitivity after surgical treatment of macular holes of large diameter was not studied, which prompted us to study the dynamics of these indicators. It is worth noting that according to the results of this study, an increase in the FS after surgical treatment of macular holes of large diameter is noted according to the method proposed by us.

**Conclusion**

1. Based on the data obtained, it can be argued that the original technique proposed by us for surgical treatment of macular holes of large diameter does not adversely affect the FSF, and even vice versa leads to an improvement in its performance.
2. An increase in the FPS from  $30.7 \pm 2.8$  dB to  $32 \pm 2.6$  dB is shown, which correlates with 100% closure of the macular holes and an increase in BCVA from  $0.23 \pm 0.07$  to  $0.6 \pm 0.15$  ( $p \leq 0.05$ ).

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