

Article

Surgical Treatment of Epiretinal Membranes: a Comparative Analysis of Various Removal Techniques.

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Abstract: In most cases, vitreoretinal surgery is the only way to treat epiretinal membrane (ERM). For a long time, surgeons only removed epiretinal fibrosis. But relapse of ERM took place in 10% of cases. Internal limiting membrane (ILM) peeling reduced the number of relapses, but this membrane is connected closely with terminal legs of Müller cells and its removal leads to mechanical and functional damage of the latter. In addition, frequent cases of "dissociation of the optic nerve fiber layer" were noticed in the long term after ILM removal, which caused a deterioration in the functional state of the retina.

Purpose. The purpose of study was to conduct a comparative analysis of various methods of surgical treatment of epiretinal membrane.

Materials and methods. On the base of the National Medical Center of Ophthalmology 75 patients with epiretinal membrane were treated with vitreoretinal surgery.

All patients were divided into 3 groups. Patients of the first group were operated according to the standard procedure with the removal both ERM and ILM. The second group included patients after ERM removal without ILM peeling. The third group of patients were operated according to the original method – after ERM removal specific "debilitating notches" were performed on ILM.

A complete ophthalmological examination was conducted for all patients in the pre- and postoperative period (1,3,6,12 months after surgical treatment). There were no significant differences between groups in age, gender, preoperative BCVA, preoperative intraocular pressure, preoperative CMT on optical coherence tomography, and cataract status.

Results. Analysis of the results in the postoperative period revealed a significant improvement in BCVA at 6 months after surgery in the 2nd and 3rd groups of patients in comparison to the 1st group of patients.

Assessment of morphological parameters of the retina in the postoperative period showed a significant improvement of condition in epiretinal fibrosis in groups 2 and 3 at 6 and 12 months after surgery. The reduce of foveolar thickness was more noticeable in groups 2 and 3 during all the period.

In the postoperative period, a statistically significant improvement in central light sensitivity was revealed in patients of the 2nd and 3rd groups in comparison to similar parameters of patients of the 1st group at 3 months after surgical treatment. The same trend took place at 6 and 12 months after surgery.

Conclusion. Our results showed that surgical treatment of ERM without ILM peeling yielded a better functional result compared to a group where peeling was performed within up to 12 months of follow-up. In order to reduce the risks of ERM relapse, we have developed an innovative technique of "debilitating notches", which allows us to achieve higher functional results than traditional ILM peeling and reduces the risks of relapse.

Keywords: epiretinal fibrosis, epiretinal membrane, internal limiting membrane, vitreoretinal surgery, microperimetry.

1. Introduction.

Idiopathic epiretinal membrane (ERM) is a fairly common disease of persons over 50 years of age leading to the low vision functions development. According to various literary data, this pathology occurs in 2% of the population under 60 years of age and already in 12% in the age over 70 years. [1].



The pathogenesis of ERM is not well studied. A number of authors suggest that ERM may develop as a result of retinal microfractures which forms after posterior vitreous detachment [2]. This process can activate the migration of fibroblasts, glial cells and astrocytes to the Internal limiting membrane (ILM), where they proliferate [3,4]. However, according to the latest hypothesis, the process of formation of ERM is more complicated. After syneresis (vitreous liquefaction) and vitreous collapse, as a result of abnormal posterior vitreous detachment (without sufficient divergence of attachment points on the vitreoretinal interface), the posterior part of the vitreous cortex (vitreoschisis) cleaves. As a result the outer layer of the posterior part of the vitreous cortex remains attached to the macula, causing the development of the membrane [5,6].

The main symptoms of this disease are: decreased visual acuity, metamorphopsia (as a result of "wrinkling" of the retina and its curvature), as well as micropsia, macropsia and monocular diplopia [7]. Unfortunately, in most cases, vitreoretinal surgery is the only way of treatment ERM. For a long time, surgeons only removed epiretinal fibrosis. But relapse of ERM took place in 10% of cases. Internal limiting membrane (ILM) peeling reduced the number of relapses, but this membrane is connected closely with terminal legs of Müller cells and its removal leads to mechanical and functional damage of the latter. In addition, frequent cases of "dissociation of the optic nerve fiber layer" were noticed in the long term after ILM removal, which led to a deterioration in the functional state of the retina [8,9].

Microperimetry is a relatively new method of research in ophthalmology, providing objective qualitative and quantitative information on the functional state of the macular region [10].

2. The purpose of the clinical study is to conduct a comparative analysis of various methods of surgical treatment of epiretinal membrane.

3. Materials and methods of research.

On the base of the Center of Ophthalmology of the N.I. Pirogov National Medical Center 75 patients with epiretinal membrane were treated with vitreoretinal surgery. All patients had a number of confirmed symptoms:

- epiretinal membrane attached to the foveolar pit according to OCT images;
- the presence of metamorphopsias, which were assessed based of subjective sensations and were tested by the Amsler grid;
- reduction of visual acuity;
- integrity of subfoveolar connection of internal and external retinal layers;
- Artifakia
- no vitreoretinal intervention in anamnesis

Exclusion criteria were:

- ERM of traumatic genesis
- macular pseudoholes
- concomitant ocular pathologies such as glaucoma, high-grade myopia, diabetic changes and retinal vascular pathology.
- eye cornea diseases in anamnesis, causing violations of the transparency of optical media.
- phakic eyes.

All patients were divided into 3 groups.



Group 1 (27 patients, 27 eyes). Patients of the first group were operated according to the standard procedure with the removal both ERM and ILM.

Group 2 (24 patients, 24 eyes). The second group included patients after ERM removal without ILM peeling.

Group 3 (25 patients, 25 eyes). The third group of patients were operated according to the original method – after ERM removal specific "debilitating notches" were performed on ILM.

The original method includes: after induction of posterior vitreous detachment and vitrectomy, ERM is painted and removed. Secondary, ILM is painted and assessment of its interface is carried out. In the places of the most pronounced deformation of the ILM and deformation of its interface, the ILM is removed locally, i.e. "weakening notches" are formed. After that the operation completes.

A complete ophthalmological examination was conducted for all patients in the pre- and postoperative period (1,3,6,12 months after surgical treatment). The examination included: biomicroscopy of the anterior segment of the eye; tonometry, b-scanning, spectral optical coherence tomography (OCT); and also subjective methods: questionnaire for assessing the level of complaints, visometry, examination with Amsler grid and microperimetry as the main functional research method.

There were no significant differences between groups in age, gender, preoperative BCVA, preoperative intraocular pressure, preoperative CMT on optical coherence tomography, and cataract status.

In OCT study, thickness of retina in the foveolar zone and average thickness of retina in the parafoveolar zone were determined.

To evaluate the central photosensitivity, a program of 37 points within 6 ° was used (0-3 ° from the point of visual fixation centered in the fovea region). In this study, the distance between luminous stimuli in the 1 ° projection from the fixation point was 0.5 °, the stimuli more distant from the center had a density of 1 °. Both studies were performed using strategy 42, a duration of 200 ms, a stimulus size of 0.43 ° (Goldmann III). The brightness of the stimuli ranged from 0 to 36 dB.

4. Statistical analysis.

Statistical processing of the results was carried out using the IBM SPSS Statistics 23 program. Paired samples t-test and Pearson correlation were used. Differences were considered statistically significant when $p < 0.05$. The results of descriptive statistics in most tables are presented as $M \pm \sigma$, where M is the mean and σ is the standard deviation.

5. Results.

Surgical intervention in all three groups of patients was performed in full, intraoperative complications were not detected, the early post-operative period in all cases was without any features. In one case in group 2, where ILM peeling was not performed, a recurrence of epiretinal fibrosis was detected and this patient was excluded from statistical account. The patient was re-operated with removal of the Internal limiting membrane.

All parameters of patients of all three groups were comparable.

Ophthalmological examination of all patients was carried out in postoperative period at 1, 3, 6 and 12 months after surgery.



Pre-operative BCVA in group 1 composed $0,37 \pm 0,12$; $0,39 \pm 0,15$ in the 2nd group and $0,40 \pm 0,11$ in the 3rd group. There was no statistical difference in functional parameters in all groups of patients ($p = 0,73$) and ($p = 0,68$).

The post-operative analysis of the results showed a significant improvement in BCVA in groups 2 and 3 compared with the data of group 1 at 6 months after surgery ($p = 0,038$) and ($p = 0,041$), respectively, and at 12 months after surgical treatment ($p = 0,035$) and ($p = 0,037$), respectively (Figure 1).

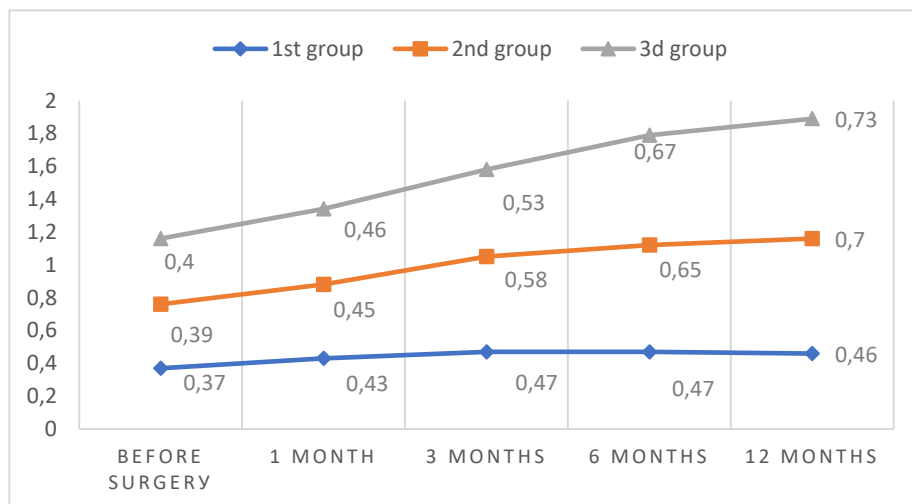


Figure 1. BCVA and its dynamics in patients after surgery, (M±σ)

When analyzing the morphological parameters of the retina in patients with epiretinal fibrosis, two parameters were evaluated: the thickness of retina in the foveolar zone (CRT - central retinal thickness) and the degree of its decrease during postoperative period (DCRT - decrease central retinal thickness).

Parameters of central retina thickness at the preoperative stage were statistically comparable in all 3 groups.

When assessing the morphological parameters of the retina in the postoperative period, a statistically significant improvement was revealed within 6 and 12 months after surgery in epiretinal fibrosis in groups 2 and 3. In Groups 2 and 3, there was more impressive reduction of foveolar thickness during the entire follow-up period. So in 6 months after surgical treatment, retinal thickness in group 2 decreased by $135,9 \pm 25 \mu\text{m}$ ($p = 0,035$), and in group 3 by $130,6 \pm 27$ ($p = 0,029$) compared to similar data of group 1. The difference is statistically significant. The more pronounced dynamic of the central retinal thickness decrease had patients of the 2nd and 3rd groups, and it was associated with the lack of Müller cell microtraumatization due to ILM peeling in the central zone. (Figure 2, 3.)



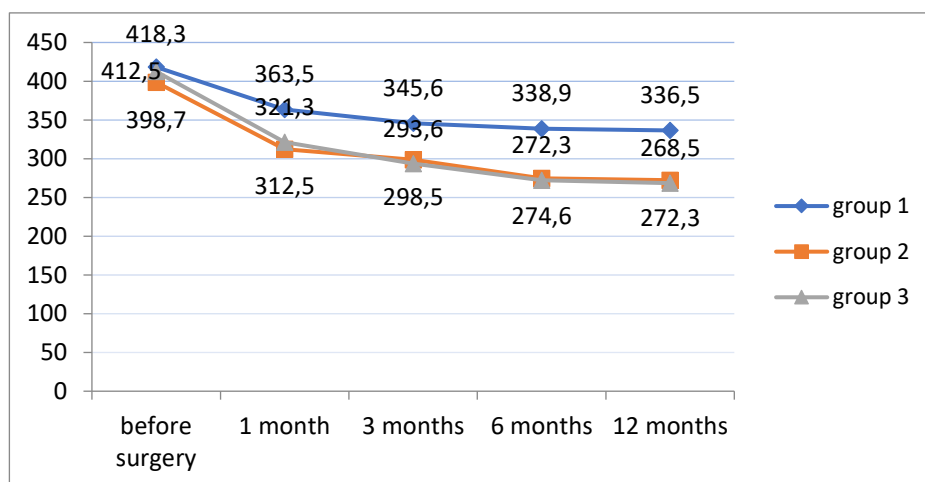


Figure 2. Central retinal thickness (CRT) and its dynamics in patients after surgery, (M+σ)

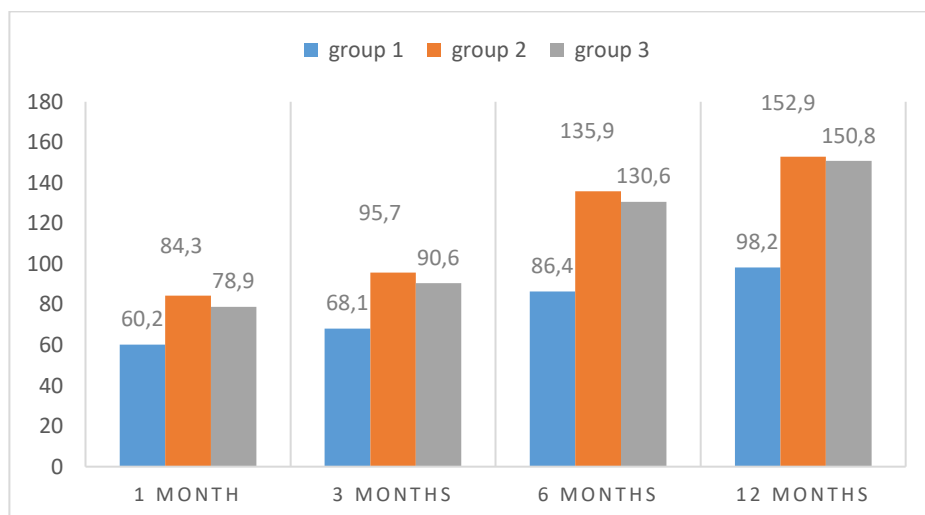


Figure 3. Retinal thickness reduction (DCRT) dynamics in patients after surgery, (M+σ)

Among the microperimetric parameters, the central and common light sensitivity of the retina was evaluated. All parameters were comparable at the pre-operative stage. There was a statistically significant improvement in central light sensitivity parameters of the 2nd and 3rd groups of patients in the postoperative period, compared to similar data of the 1st group within 3 months after surgical treatment. In addition, this trend continued at 6 and 12 months after surgery (Tables 1, 2).

Parameters	Group 1	Group 2	Group 3
Before surgery	23,45±2,76	22,96±2,55	23,73±3,35
1 month	22,58±2,53	23,10±2,23	23,65±3,43
3 months	22,72±1,78	25,50±1,51	25,73±1,12
6 months	22,65±1,14	26,72±1,47	26,34±1,15



12 months	23,11±1,23	26,98±1,43	27,11±1,90
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Table 1. Microperimetric characterization of central light sensitivity before and after surgery, dB (M+σ)

Parameters	Group 1	Group 2	Group 3
Before surgery	23,73±2,23	22,43±2,83	22,89±2,49
1 month	23,58±2,43	23,10±2,54	23,71±1,87
3 months	23,52±1,78	24,80±1,89	24,73±1,45
6 months	23,14±1,14	24,70±2,17	24,78±1,89

Table 2. Microperimetric characterization of common light sensitivity before and after surgery, dB (M+σ)

Conclusion.

Our results showed that surgical treatment of ERM without ILM peeling yielded a better functional result compared to a group where peeling was performed within up to 12 months of follow-up. However, the absence of ILM peeling may increase the risk of epiretinal membrane recurrence. To reduce the chance of ERM recurrence, we developed an innovative technique for "weakening notches" at ILM. Using of this technology allows to achieve higher functional results compared to traditional ILM peeling and allows to reduce the risks of relapse. Thus, the obtained data confirm that the preservation of the Internal limiting membrane during the surgical treatment of epiretinal fibrosis is preferable.

Conflict of interest: The authors declare no conflict of interest.

The use of artificial intelligence: the article is written without the use of artificial intelligence technologies.

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