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# **Optical Coherence Tomography**

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Received 27<sup>th</sup>Jul 2021, Accepted 29<sup>th</sup> Aug 2021, Online 18<sup>th</sup> Sep 2021 **The aim of the work** : is to determine the method of visualization of peripheral retinal tears, to study the presence of vitreoretinal traction using optical coherence tomography (OCT).

**Keywords:** peripheral retinal break, optical coherence tomography.

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#### Survey carried out

52 patients (76 eyes) with peripheral retinal tears, including 27 men and 25 women, aged 18 to 76 years. To visualize the periphery of the retina, we used a HOCT-1 / 1F HUVITZ spectral optical coherence tomograph (South Korea); photo registration was performed using a KANGHUA APS-BER fundus camera (China). All patients were examined with a Goldmann lens. The use of OCT made it possible to determine the structural features, the configuration of peripheral tears, the presence of vitreoretinal traction, morphometric parameters of the defects: average length, thickness of the retina at three standard points (before the break, in the region of the edge and bottom of the break), height, length of vitreoretinal adhesions and local detachment of the retinal neuroepithelium ... Two groups of peripheral ruptures were identified: 1st (23 eyes) - valvular ruptures, 2nd (43 eyes) - perforated ruptures. OCT of peripheral retinal dystrophies is a highly informative method that allows in vivo assessment of the structure, morphometric parameters of defects, vitreoretinal adhesions, the presence of vitreoretinal traction and subclinical retinal detachment. This will allow documenting research results, establishing indications for laser and surgical treatment, and monitoring long-term results.

### Optical coherent tomography in diagnosis of peripheral retinal breaks

The purpose of our study was to develop an optimal method of peripheral retinal breaks visualization and determine thepresence of vitreoretinal traction using optical coherence tomography (OCT). A total of 52 patients (76 eyes) with peripheral retinal breaks were assessed, among them 27 men and 25 women, aged from 18 to 76. To visualize the periphery of the retina, we used a HOCT-1 / 1F HUVITZ spectral optical coherence tomograph (South Korea); photo registration was carried out using a KANGHUA APS-BER fundus camera (China). All patients were examined with Goldmann lens. OCT application enabled us to determine structural features and configuration of peripheral retinal breaks, the presence of vitreoretinal traction, and morphometric parameters of the defects: the average lengthand height, retinal thickness in three standard points (prior to the break, at its edge and at the

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bottom), and also the extent of vitreoretinal fusion and local detachment of retinal neuroepithelium (NE). Two groups of peripheral retinal tears were formed: group I (23 eyes) — retinal flap tears and group II (43 eyes) — perforated breaks. Optical coherence tomography is a highly informative method which enables in vivo evaluation of structural and morphometric characteristics of retinal defects and vitreoretinal fusion, as well as possible vitreoretinal traction and subclinical detachment of the retina. Its use will ensure proper documentation of study results and also provide the possibility to determine indications for laser and surgical treatment and perform a late follow-up.

#### Introduction

Peripheral retinal tears are one of the main reasons for the development of rhegmatogenous retinal detachment [3, 6, 9]. According to the data of morphohistological and clinical studies, it has been established that the development of retinal detachment is based on the nature of the vitreoretinal relationship [7, 8, 10].

The presence of vitreoretinal traction is a risk factor for the development of retinal detachment and an indication for laser coagulation of the retina [2, 4]. Currently, optical coherence tomography (OCT) is the most reliable method of intravital quantitative and qualitative assessment of the retinal structure - biomicroretinometry [5]. The main area of OCT application is the assessment of the state of the structures of the posterior pole of the eye [1]. For the first time, OCT was used to study peripheral retinal lesions in enucleated eyes [11]. Later, in isolated studies, information appeared on the use of OCT for in vivo visualization of retinal dystrophies, such as localized peripheral retinal tears, lattice dystrophy, peripheral retinoschisis, cobblestone dystrophy, and snail marks [12, 13]. It should be noted that information on the use of biomicroretinometry of morphometric parameters for degenerative changes in the periphery of the retina using OCT in the world literature is presented fragmentarily [7, 13]. Using the high resolution OCT, it is possible to assess the state of the periphery of the retina in vivo: to record the size of the pathological focus, its localization and structure, the depth of the lesion, and the presence of vitreoretinal traction. This makes it possible to more accurately establish the indications for treatment, and also helps to document the result of laser and surgical operations and monitor long-term results.

In this regard, **the purpose of our work** was to determine the method of visualization of peripheral retinal tears, to study the presence of vitreoretinal traction using OCT.

### Material and methods

The study involved 52 patients (76 eyes) with peripheral retinal tears, including 27 men and 25 women aged 18 to 76 years. Ophthalmological examination, in addition to traditional methods, included: OCT using a HOCT-1 / 1F HUVITZ spectral optical coherence tomograph (South Korea), photo registration was performed using a KANGHUA APS-BER fundus camera (China). All patients were examined with a Goldman lens. the study of the morphometric parameters of peripheral ruptures on OCT is as follows.

1. At the maximum dilation of the pupil, the exact localization of the retinal rupture is carried out using the Goldman lens.

2. When scanning on a HOCT-1 / 1F HUVITZ optical coherence tomograph, the patient's gaze is fixed in the direction of the lesion, to the localized area of the rupture. For better adaptation of the scan position on the upper / lower parts of the posterior pole of the eye, in some cases it was necessary to tilt backward / forward of the patient's head. The operator performs several scans, and then selects the best image in terms of quality and information content. We used the Line technique (scans up to 6 mm in length were used), 3D Macular (scan zone size up to  $6 \times 6$  mm). In the study, the direction and linear size of the scanning zone / line was adapted by the operator depending on the localization of the

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process. Tomographic examination parameters: longitudinal resolution from 5 microns, transverse resolution 15 microns, scanning speed 26000 A-scans in 1 s, A-scan resolution up to 2048 pixels, obtaining linear retinal scans in 0.038 s.

The thickness of the retina is measured using the V 4.0 software, in the Thickness protocol, which allows the thickness of the retina to be determined using a measuring notch from the level of the pigment epithelium to the vitreoretinal interface.

The following morphometric parameters were assessed: configuration, size of the defect, thickness of the retina before the break, in the region of the edge and bottom of the break. In addition, the height and length of vitreoretinal fusion and local neuroepithelial detachment (NE) of the retina were determined. For the convenience of practical work, peripheral retinal tears (76 eyes) were distributed according to the zones of location: equatorial - 30 eyes, in the region of the middle periphery - within 4DD (disc diameter) - 31 eyes, extreme periphery (paraoral - 1.5 DD) - 15 eyes ... To obtain high-quality OCT scans, the following factors were important: orbital depth, localization of discontinuities, transparency of optical media, and operator qualifications. The presented method for the study of OCT of peripheral ruptures made it possible to obtain effective scans in 49 (84.7%) eyes. The reasons for poor-quality scans in 27 eyes were: technical - localization of the defect in the upper, in the upper-inner segments in the extreme periphery in the presence of a deep orbit - 13 eyes; low transparency of optical media: cataract - 8 eyes, vitreous fibrosis - 6 eyes.

#### **Results and discussion**

In the study of refraction in 52 patients in 76 eyes with breaks on the periphery of the retina, myopia was revealed in 42 cases: weak degree - 5 eyes, moderate degree - 17, high degree - 20; hyperopia - in 28 cases: low degree - 8 eyes, medium degree - 12, high degree - 8; emmetropia was diagnosed in the 6th eye.

The majority (80.3%) of patients complained of photopsies, floating opacities, visual impairment of varying severity. According to clinical signs, patients with peripheral tears were divided into two groups:

Group 1 consisted of 23 patients (23 eyes) with valvular ruptures (Fig. 1), group 2 - 29 patients (53 eyes) with perforated ruptures (Fig. 2).

Valve ruptures (23 eyes) in all patients were detected monocularly, they were localized most often in the upper-external segment (47.8%), less often in the upper-external segment (21.7%), lower-external (17.4%), lower-internal (13.1%). %). They were U-shaped (21 eyes), J-shaped (1 eye), L-shaped (1 eye). Analysis of photo-registration and OCT data of valvular ruptures in all patients made it possible to record the presence of vitreoretinal traction at the valve apex, the implementation of which led to the formation of retinal ruptures with raised or curled edges. The length of the valve, according to OCT, was 351-2330  $\mu$ m. The heterogeneity of the retinal thickness was noted: before the retinal rupture - from 185 to 210  $\mu$ m, along the edge of the gap - from 165 to 295  $\mu$ m, at the apex of the valve - from 125 to 168  $\mu$ m, the height of the valve distance - from 281 to 841  $\mu$ m. In the region of the bottom of the rupture, the layer of NE and photoreceptors was not detected.

Hole tears (53 eyes) were detected in both eyes in 24 patients (48 eyes) and monocularly in 5 patients. They were diagnosed in different segments of the retinal periphery: in the upper-outer - 10 (28.1%) eyes, in the lower-outer - 8 (21.6%), in the upper-inner - 7 (20.9%), in the lower-inner - 8 (13.1%). %), in the outer - 8 (5.2%), in the upper - 6 (3.9%), in the inner - 4 (3.3%), in the lower - 3 (3.9%) eyes. were observed in 40 (47.1%) eyes.

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Rice. 1. Retinal valvular rupture.

a - optical coherence tomogram: perforating retinal rupture, encircling slit-like detachment of the neurosensory retina. The valve will penetrate into the vitreous, the wrapped edge creates a "shadow" effect on the underlying media; b - fundus image: U-shaped valvular rupture with emerging local retinal detachment. Here and in Fig. 2-8 rupture zones are indicated by an arrow.

According to the clinical form, the following types of perforated ruptures were identified: single ("mute") -14 (35.3%) eyes, with a lid -11 (13.7%), isolated breaks with subclinical limited retinal detachment -16 (23.5%), as well as in the composition of other peripheral vitreochorioretinal dystrophies (PVCRD) - 12 (27.5%) eyes. areas of atrophic foci (14 eyes), "snail trace" - 7 eyes (Fig. 4), degenerative retinoschisis - 5 eyes.

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**Rice. 2. Isolated peripheral tears.** 

a - optical coherence tomogram: rupture with a "lid" - along the edges of the gap a slit-like detachment of the neurosensory retina, a hyperreflective "lid" is determined in the vitreous body. Complete posterior detachment of the vitreous body within the scan with adhesion to the `` operculum "; b - optical coherence tomogram: rupture with subclinical retinal detachment - a through retinal tear, along the edges of the gap there is a more pronounced slit-like detachment of the neurosensory retina without visible vitreoretinal fusion.

According to the OCT scan data, the following break parameters were determined. The length of the perforated ruptures varied from 185 to 1610  $\mu$ m; the thickness of the retina before the rupture ranged from 117 to 163  $\mu$ m, the thickness along the edge of the gap - from 139 to 222  $\mu$ m, the NE layer in the bottom region was not detected, the height of vitreoretinal fusion - from 172 to 733  $\mu$ m.

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### Rice. 3. "Lattice" dystrophy.

a - optical coherence tomogram: thinning zones, microcysts, through and through breaks, vitreoretinal adhesions and traction along the edges of dystrophy (asterisk). Signal hyperreflectivity in the focal zone, the zone of pigment epithelium dystrophy (PE). In the vitreous body, numerous small hyperreflective inclusions are determined; b - fundus-image: a dystrophic area penetrated by obliterated vessels, blind retinal breaks with hyperpigmentation, along the edges, stripes of vitreoretinal fusion and vitreoretinal traction are visible.

Dynamic observation of patients for 5 years made it possible to identify two types of the course of the dystrophic process: 1st - stable non-vitreoretinal traction in 29 (45.1%) eyes, 2nd - progressive with the presence of vitreoretinal traction in 47 (54.9%) eyes ... In addition, OCT scanning of peripheral ruptures revealed 4 forms of changes, which morphologically resemble the stages of macular ruptures: pre-rupture, blind, through, complicated with the development of subclinical flat retinal detachment.

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### Rice. 4. Trail of the snail.

a - optical coherence tomogram: numerous zones of thinning of the neurosensory retina, areas of thickening and hyperreflectivity of PE, zones of disturbance of the homogeneity of the choroidal signal. Along the edge of dystrophy, a site of vitreoretinal fusion and traction (asterisk) is determined; b - fundus-image: translucent whitish areas with numerous rounded and oval blind gaps.

In the case of the 1st form of changes (pre-rupture), the retinal layers are lifted due to vitreoretinal traction, a slit-like detachment of NE is formed in the center with residual connection along the edges of the defect (Fig. 5).

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![](_page_7_Picture_2.jpeg)

Rice. 5. Optical coherent tomogram of pre-fracture (1st form).

Elevation and compaction of the area of the neurosensory retina, slit-like detachment of the NE in the central zone with the preservation of the NE layer along the edges of the defect; the shadow effect in the underlying media is seen.

The 2nd form (blind rupture) is characterized by a sharp thinning of NE, damage to the outer parts of the retina and signs of destruction of the retinal pigment epithelium (Fig. 6).

![](_page_7_Picture_6.jpeg)

Rice. 6. Optical coherent tomogram of blind rupture (2nd form).

Non-penetrating rupture with slit-like elevation of the neurosensory retina; the edges of the rupture are raised (asterisk) due to vitreoretinal traction. There is a defect in the outer layers of the retina in the zone of elevation. Dystrophy zones Retinal NE.

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In the third form (through break), the NE layer and the photoreceptor layer are absent in the defect area (Fig. 7).

The 4th form (complicated) is detected with subclinical limited detachment of NE around the through rupture (Fig. 8).

![](_page_8_Picture_4.jpeg)

Rice. 7. Optical coherence tomogram of the through rupture (3rd form).

The complete absence of layers of the neurosensory retina in the area of rupture is determined by the effect of "shadow" in the underlying media from the "operculum" in the vitreous body.

![](_page_8_Picture_7.jpeg)

Fig. 8. Optical coherence tomogram of a through tear with subclinical flat retinal detachment (4th form).

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The edges of the gap are raised; cystic changes (asterisk), slit-like detachment of NE along the edges of the rupture are determined.

In 2006 N. Ghazi [11] et al. for the first time performed the analysis of OCT scans of histological sections of peripheral retinal dystrophies in enucleated eyes and compared them with morphological studies. 11 specimens were examined, among which three types of peripheral retinal dystrophies were identified: cystic dystrophy, localized retinal detachment and cobblestone dystrophy. between them.

A. Kothari et al. [12] for the first time published the results of a study in 2012 in which they analyzed OCT images in vivo in 36 eyes with peripheral retinal dystrophies, performed in the period from November 2009 to April 2010. The authors were able to scan such peripheral retinal disorders on OCT as "lattice" dystrophy, "snail track", "cobblestone pavement", localized retinal breaks, senile retinoschisis, choroidal nevus. For each type of disorder, specific characteristics and configurations identified by OCT scans were presented. However, morphometric measurements during OCT scanning of dystrophies were not presented.

A number of authors [13] examined patients with lattice retinal dystrophy in the period from October 2009 to January 2010; identified four main signs of this disease: 1) U-shaped vitreoretinal traction; 2) retinal ruptures; 3) focal retinal thinning; 4) the formation of the vitreous membrane. Based on the results obtained, they concluded that spectral OCT is an informative method for visualizing the spectrum of retinal andvitreal changes in the area of "lattice" dystrophies. In addition, the authors showed a single morphometric measurement of the extent of subclinical retinal detachment during OCT scanning.

S. Cheng et al. [7] conducted a study in 2010 in eyes with myopia (from sph -, 0 diopters to sph -4.0 diopters) and in the absence of myopia (from sph +3.0 diopters to sph-, 5 diopters), measuring the thickness of the retina in the field of view up to 40 °. The authors concluded that in myopic eyes, compared to non-myopic eyes, the retina is thicker in the macula, but thinner in other regions, and at 40 ° it is 7% thinner than in patients without myopia. The thickness of the retina in both groups at the studied level did not depend on the presence of peripheral retinal dystrophy. The authors did not measure the thickness directly in the area of the peripheral dystrophy itself, since their scanning method did not allow visualizing these dystrophies.

### Conclusion

Thus, OCT of peripheral retinal dystrophies is a highly informative method that allows in vivo assessment of the structure, morphometric parameters of defects, vitreoretinal adhesions, the presence of vitreous traction and subclinical retinal detachment. This will allow the documentation of research results,

establish indications for laser and surgical treatment, monitor long-term results. For a more detailed clarification of the structural features of peripheral dystrophies and their morphometric parameters, additional studies are required.

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