

Anatomic-Topographic Features of the Anterior Cortical Layers of the Vitreous Body

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Abstract

Introduction: The vitreous body (VB) is limited by cortical layers (CL), consisting of compact interconnected collagen fibers. There is no consensus on the structural organization of the front departments of the COP and their relationship with the structures of the eyeball. Purpose. Study of anatomical and topographic features of the anterior cortical layers of the vitreous body.

Materials and Methods: The proposed method contrasting structures of VB with the use of ultrafine suspensions "Vitrecontrast" on the basis of water-insoluble inorganic salt of barium sulfate in saline solution. The study was conducted on 20 cadaveric donor eyes. Dissection was carried out using the proposed original technology. Made the incision of the sclera at 4 mm from the limbus circumference. Then cut the sclera between the straight muscles. The petals of vascular and reticular membranes were formed and they were also cut off. Produced staining of the structures of the vitreous body using suspension "Vitrecontrast" sequential removal of the front CL VB to the surface of the posterior lens capsule.

Results: After removal of the COP VB in cadaveric donor eyes revealed a number (average of four) membranous structures lining retrolental space and is able to phase separation, with the places of attachment to the projection of the Wieger ligament, the zonule fibers and the flat part of the ciliary body. After removal of membranous structures and re-staining on the back of the lens capsule contrastive layer of fibers of the vitreous body in the area of the projection of the space of Berger.

Conclusion: In any case, is not revealed the full truth of the detachment front of the COP. There was a stratification of the CS with the formation of a filmy multilayer structure lining the back surface of the lens and the ciliary body. The fibres of the vitreous body, tightly connected with the rear capsule of the crystalline lens in the area of the projection space Berger, suggests the possibility of the existence retromandibular bags, one of the walls which is connected with the rear capsule of the crystalline lens.

Keywords: *Vitreous Body; Anterior Hyaloid; Berger Space*

Introduction

The vitreous body (VB) of the human eye is a complex structure consisting of the main gel - like substance into which the fibrils of the collagen-fibrous skeleton are immersed. It is limited by an elastic capsule of tightly Packed collagen fibrils, called cortical layers (CL) of the vitreous body [14,21,23]. CL is conventionally divided into front and rear sections according to their location in relation to the toothed line [16]. Front VB CL starts at 1.5 mm anterior to the ora serrata and are composed of parallel collagen fibrils with a diameter of 10 - 30 nm deposited on them c hyaluronic acid [13,20]. Since Germain Wieger in 1883 found gialo-capsular ligament, front of the COP was topographically divided into retrolateral and tolaro part [27]. During the experimental introduction of liquids into the human cadaveric eye, it demonstrated the presence of circular adhesion between the anterior CL and the posterior lens capsule (PLC) with a diameter of 8 - 9

mm, located at a distance of 1 mm from the equator of the lens. It is not known exactly whether it is a dense fusion of these structures or it is a separate true anatomical unit, but its presence is not questioned [29]. Wieger ligament separates the space of Berger's from the canal of Petit, which is retrocruial space [28]. In a number of pathological conditions, the outer edge of the ligament - the Egger line is visualized [12]. In 1887, Emil Berger described a patient with iridocyclitis, who, due to the accumulation of protein suspension in the retrolentor space, visualized the space behind the posterior capsule, named after him [6,26]. According to the most portion of the literature retroelectro space Berger (Erggelet) is a slit-like space bounded in front of posterior capsule, anterior hyaloid membrane at the rear, on the periphery of the Wieger ligament, and within this space is no adhesion between the of posterior capsule and anterior cortical layers (Figure 1a and 1b) [2,3,15,28].

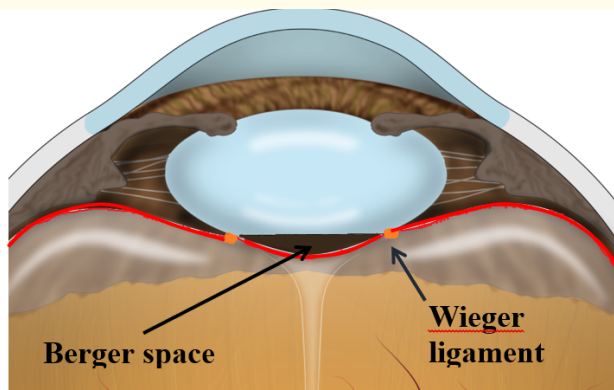


Figure 1a

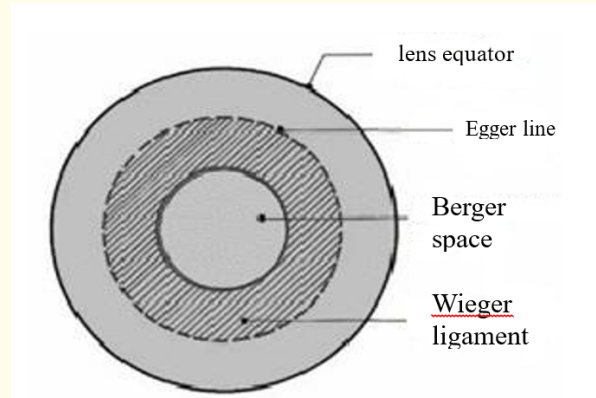


Figure 1b

Figure 1: The existing scheme of anatomy of the anterior cortical layers: a) sagittal cut of the eyeball; b) retrolental cut of the eyeball.

However, these views contradict the data of Georg Eisner, *et al.* The experimental model constructed by them allowed using a special crane connected to the anterior lens capsule to pull the lens evenly up and consistently separate it from the front hyaloid. During impregnation of the structures of the sulfide of mercury in some eyes after the detachment of the ligament of Wieger on of posterior capsule was visualized membranophone structure, not separated from of posterior capsule [5]. Later in the literature the case of biomicroscopic identification of retrolental prominence localized according to the described membrane was described [7]. It also describes the presence of adhesion between the of posterior capsule and anterior hyaloid within the space Berger, detectable at surgery of congenital cataract [25]. In modern ophthalmic surgery, various methods of induction of the anterior hyaloid detachment from the SSC are being developed to remove the substrate for fibrovascular proliferation. In 1966 Emmanuel Rosen in biomicroscopy noted cases of spontaneous detachment of the anterior hyaloid membrane from the LC [19]. In further experiments on the induction of anterior VB detachment by hydrodissection under the control of a fibroblast endoscope on cadaver eyes, a complete detachment of the anterior hyaloid was achieved in half of cases [24]. However, during the experiment on the introduction of microplasmin in the eyes of rabbits in any case was not revealed a complete true detachment of the PKS, which may indicate the impossibility of a complete mechanical separation of the PKS during vitreoretinal surgery and the need to develop new approaches to the induction of the detachment of PGM. Thus, at present there is no sufficient experimental and clinical data on the structure of the anterior CT departments and their relationship with the SCS and Zinn ligament fibers.

Purpose of the Study

Experimental study of anatomical and topographical features of the anterior cortical layers of VB on the basis of the developed method of vitreous body preparation and layer-by-layer staining of its structures.

Materials and Methods

Together with OOO “NEP “Eye microsurgery” we have proposed a method of contrast the intravitreal structures ST on cadaveric eyes of donors with use of ultrafine suspensions “Vitreokontrast” on the basis of insoluble in water and physiological liquids of neutral non-toxic inorganic salt of barium sulfate in isotonic solution with an osmolarity of 300-350 mOsm, a particle size less than 5 microns and a density of 4.4 g/cm³.

The study was conducted on 20 cadaveric donor eyes. VB preparation was carried out according to the proposed original technology [4]. Original scissors have produced the incision of the sclera in mm from limbus around the circumference, leaving the intact anterior segment of the eye. Then, the sclera was cut between the straight muscles, not reaching the projection of the yellow spot and the exit of the optic nerve disc, forming the sclera petals. Formed petals were cut off, leaving the sclera area in the posterior pole of the eye with a diameter of 10 to 11 mm. With the help of the blade and anatomical tweezers formed the petals of the vascular and reticular membranes and also cut them off. Produced staining of the structures of the vitreous body using suspension “Vitreokontrast”. The introduction of contrast material is realized by whether using 30g needles disposable insulin syringe through a flat part of the ciliary body in 4 mm from the limb. It initially stained structures in retrocrural space upper external segment, then held the needle deep into the middle of the lens and stained, lentigo-related macular channel, then retrocline tank. After staining of channels and cisterns of the cortical layers of the VB cut using scissors. Useprofile was removed and the structure of the VB, leaving the front intact cortical layers. Produced the additional introduction of “Vitreokontrast” retrolental space of Berger. Contrast and successive removal of the anterior cortical layers of VB to the surface of the posterior lens capsule were performed.

Results and Discussion

After removal of CL VB on 14 cadaveric donor eyes, a multilayer film structure extending from the ciliary body in a circle by 360 degrees, covering the back surface of the lens was revealed. This structure under traction action could be removed by a single block without visible damage, there were attachments in the area of the ciliary body and the posterior surface of the lens, starting about 2 mm from the equator of the lens, lined the entire back capsule within these boundaries. There was no dense adhesion of the membrane in the area of ciliary processes, as evidenced by the free movement of the air bubble in this space (Figure 2). After mechanical removal of this layered structure and the additional contrasting of the drug suspension “Vitreokontrast” found the following layered membranous structure that lines retrocline space and passing to the rear of the lens capsule with a dense adhesion in the projection of the Wieger ligament. It was noted a snug fit of the layer to the rear portion of the fibers of the zonule, but with some increased traction was possible its separation as a single layer with no visible separation of the fibers (Figure 3). Then this structure was turned away, an additional one was carried out. The following gentle film structure covered the entire posterior surface of the lens, Zinn ligament, covered the ciliary body, then continued to the VB basis, was tightly fixed in the projection of the Wieger ligament (Figure 4a and 4b).

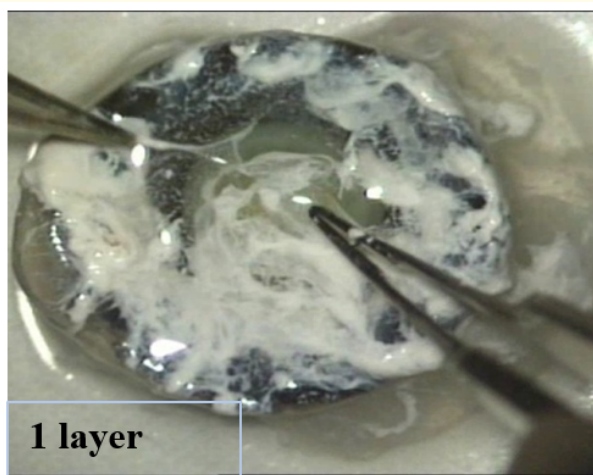


Figure 2: Front cortical layers lining the posterior capsule of the lens, zonule, ciliary body and fixed in basis of the vitreous and peripheral retina (contrast suspension “Vitreokontrast”).

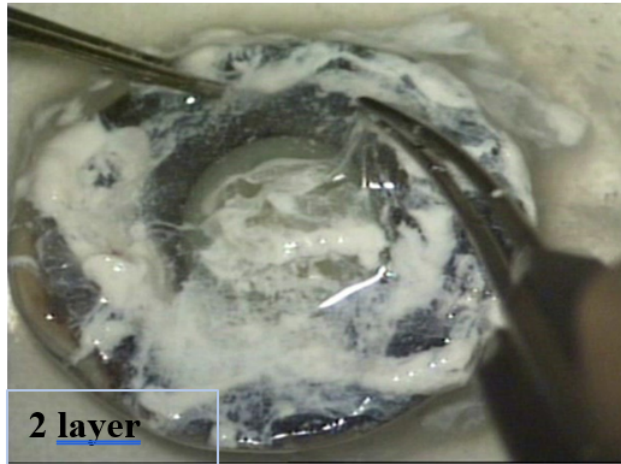


Figure 3: Layer of the vitreous body: originates from the ciliary processes, passing on the posterior capsule of the lens with dense adhesion in the projection of the ligament of Wieger contrast with "Vitrecontrast".

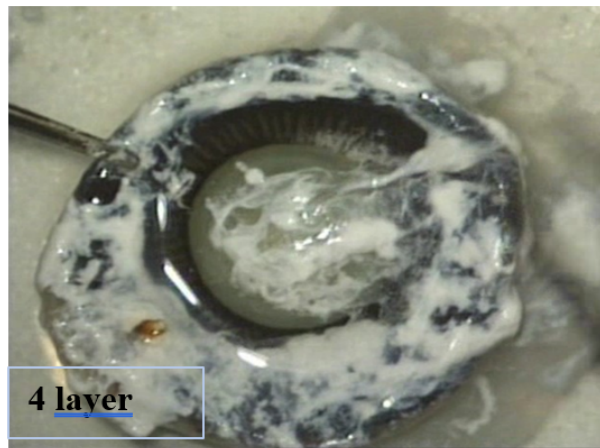
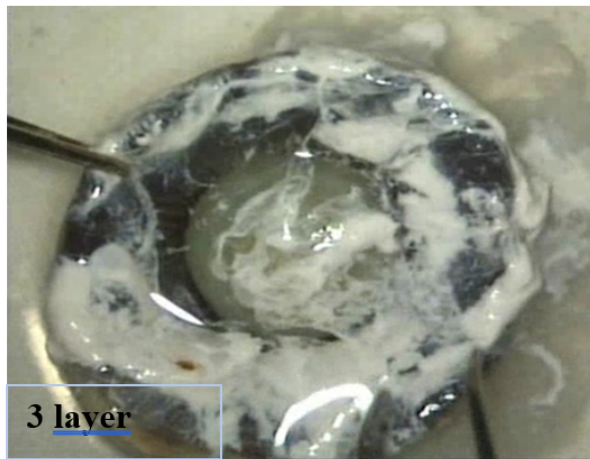


Figure 4: (a, b) layers of vitreous covering the entire posterior surface of the lens, Zinn ligament, the ciliary body having a fixation in the projection of the Wieger ligament.

Conducted the deletion turned away membranous structure and was performed again the contrast with the help of suspension "Vitrecontrast". At the same time, a thin membrane-like film covering the posterior surface of the lens, Zinn ligaments, the ciliary body was determined, reaching the VB basis, which was fixed in the projection of the Viger ligament (Figure 5).

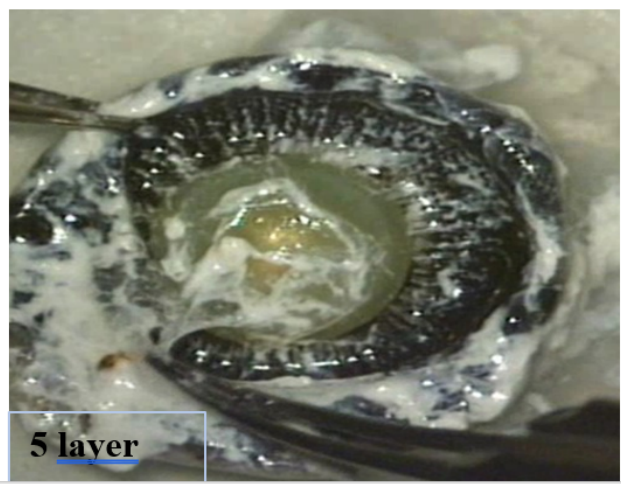


Figure 5: Layer of the vitreous body, fixed to the Wieger ligament and the base of the vitreous body.

When removing it with tweezers, the opening of the Berger space (Figure 6) occurred with the expiration of the excess of the contrasting substance, then the removal of the fibers Of the Wieger ligament was performed (Figure 7).



Figure 6: Berger space.

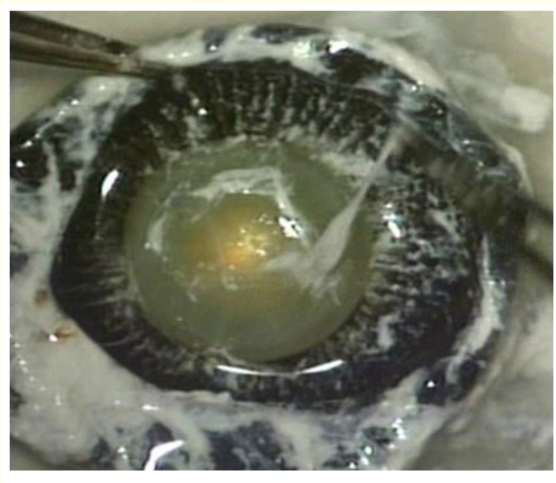


Figure 7: Deletion of the Wieger ligament.

After removal of the membranous structures and the re-instillation of suspension “Vitrecontrast” on the back of the lens capsule revealed a multi-layered membrane, consisting of fibers of VB, which is removed as a single unit (Figure 8). After the second contrast of the posterior lens capsule, a thin layer of VB fibers is revealed, the mechanical separation of which is not possible due to its dense adhesion to the LC (Figure 9a and 9b).

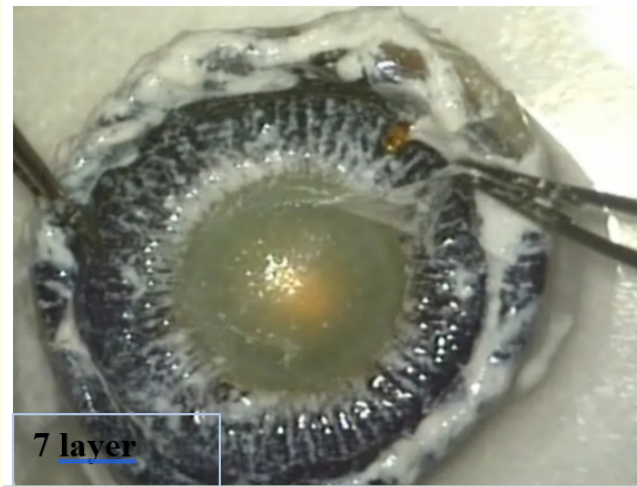


Figure 8: The layer of vitreous fibers on the surface of the posterior lens capsule after removal of the Wieger ligament.

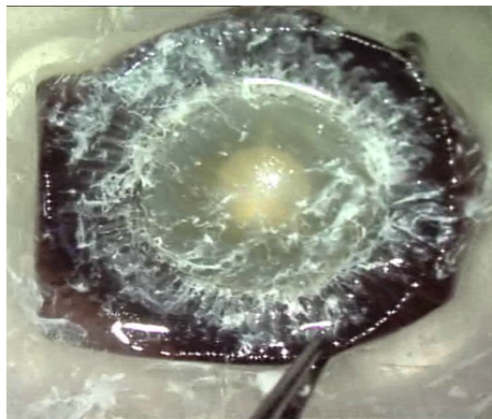


Figure 9a: Vitreous fibers fixed to the posterior lens capsule after complete separation of cortical layers.



Figure 9b: Anterior lens capsule.

Figure 9: The fibers of the vitreous body, fixed to the back of the lens capsule after complete separation of the cortical layers, in the area of attachment of the front portion of Zinn ligaments.

In 6 eyes, VB destruction was revealed during the contrast of intravitreal structures. In this case, the retrolental space was not contrasted due to defects of the anterior cortical layers of VB. In the case of a defect of CS, the topography of intravitreal structures changes: they change their location and rush to the zone of the defect of CL with the formation of a hernia of vb and the gradual formation of the anterior VB detachment. After removal of CL and their residues, a fibrous film structure covering the fibers of Zinn ligament, a flat part of the ciliary body and the lens was also found. After its removal contrasted ligament of Wieger with "Vitrecontrast". On the rear surface of the lens was contractibility portions of the fibers of the vitreous body in the zone in projections of the Berger space, complete removal of which was not mechanically possible (Figure 10).

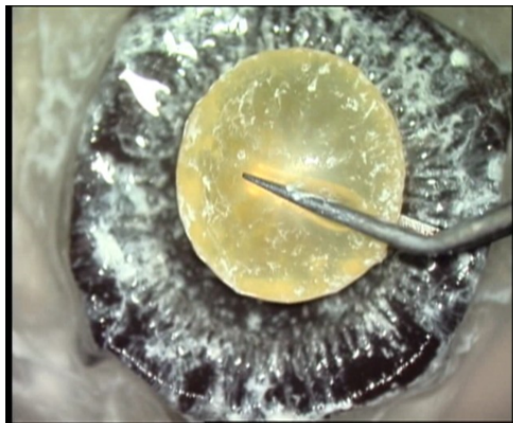


Figure 10a: Posterior lens capsule.

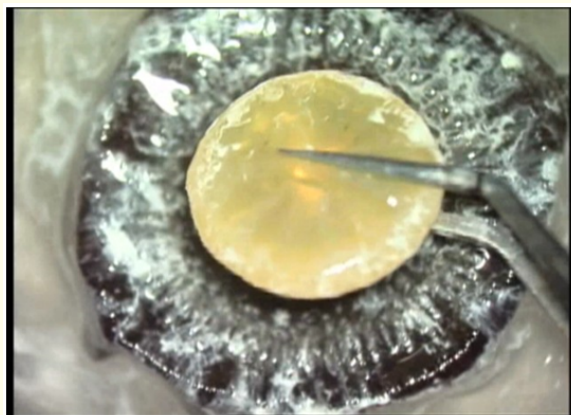


Figure 10b: Anterior lens capsule.

Figure 10: The fibers of the vitreous body, fixed to the back of the lens capsule after complete separation of the cortical layers, in the area of attachment of the front portion of Zinn ligaments.

Further, the prepared structures of the anterior segment of the eyeball were turned over so as to visualize the anterior surface of the top of the lens and the iris. Conducted trial colouring of the anterior lens capsule suspension "Vitrecontrast", while noting the delay of the dye at the periphery of the anterior capsule, about 2 mm from equator.

Thus, the developed method allowed to obtain new data on the anatomy retrolateral division of the anterior layers of the vitreous, the presence of fibers of the vitreous body, tightly connected with the rear capsule of the crystalline lens in the area of the projection space Berger, suggests the possibility of the existence of not previously described in the literature separate anatomical structures - retrolental bags, the front, also a multi-layer wall which is tightly connected with the rear capsule of the lens and cannot be separated from it by mechanical means (Figure 11). These residues of the anterior CL may play a role in the formation of anterior proliferative vitreoretinopathy and opacification of the posterior lens capsule. In this regard, the question arises about the truthfulness of the identification biomicroscopic opacities in retrolental area and the security of the traditional techniques of laser dissection data of haze, calls into question the existing classification of secondary cataract [1,18]. The data obtained are consistent with the results of studies on endoscopic identification of undetectable primary persistent radial and circular adhesion between the CCL and the anterior cortical layers during the treatment of secondary endovitreous intervention in retinal detachment due to the development of anterior proliferative vitreoretinopathy [9,10]. In addition, new data on the mutual location of the posterior portion of the ligamentous apparatus of the lens and the anterior cortical layers of the vitreous body were revealed. In contrast to the classical concepts, Zinn ligament fibers did not go directly to the posterior

lens capsule, but intertwined into the anterior cortical layers, ending on the posterior capsule as part of the detected vitreous body film structure, which is consistent with some experimental data of recent years [8,11,17]. At present, the search for new methods of studying the structure of VB and its relationship with intraocular structures continues. The use of ultrafine suspensions “Vitrecontrast” to contrast the intravitreal structures opens up new opportunities to expand understanding of the role of the vitreous in accommodation and the development of age-related changes.

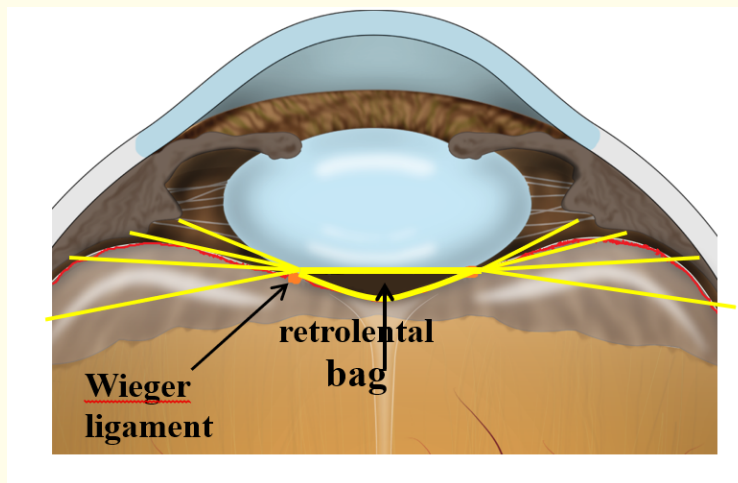


Figure 11

Summary

1. For the first time to study the structure of the vitreous body was used in the original method of preparation from the posterior to the anterior pole of the eye with subsequent gradual enhancement of intravitreal structures by use of ultrafine suspensions based on barium sulphate - “Vitrecontrast” - for serial mechanical separation of the anterior vitreous cortical layers .
2. The study revealed for the first time that the anterior cortical layers consistently line the flat part of the back surface of the lens, Zinn ligament fibers, the ciliary body and the retina.
3. For the first time a separate anatomical structure in the zone was revealed projections of Berger’s space, which suggest the possibility of the existence of a retrolental bag not previously described in the literature, the anterior, also multilayer wall of which is tightly connected with the posterior lens capsule and is inseparable from it by mechanical means. Further analysis of the data obtained in the preparation of VB will reveal the nature of its pathological changes, expand existing ideas and determine its role in the pathogenesis of vitreoretinal diseases.

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