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A NOVEL POSTERIOR CAPSULORHEXIS TECHNIQUE FOR CATARACT SURGERY USING COHESIVE VISCOELASTIC STABILIZATION

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უკანა კაფსულორექსისის ახალი ტექნიკა კატარაქტის ქირურგიაში კოჰეზიური ვისკოელასტიკის გამოყენებით

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რეზიუმე

უკანა კაფსულის შემღვრევა რჩება კატარაქტის ქირურგიის ყველაზე გავრცელებულ გრძელვადიან გართულებად და ხშირად იწვევს მხედველობის დაქვეითებას, რაც საჭიროებს Nd:YAG ლაზერულ კაფსულოტომიას. მიუხედავად სხვადასხვა ქირურგიული მეთოდების არსებობისა გამჭირვალე მხედველობის ღერძის შესანარჩუნებლად, მათი ნაწილი მოითხოვს დამატებით მანიპულაციებს, სპეციალურ აღჭურვილობას ან უკანა კაფსულაზე ზემოქმედებას თვალშიდა ლინზის იმპლანტაციის შემდეგ.

მოცემულ სტატიაში წარმოდგენილია უკანა კაფსულორექსისის ახალი ტექნიკა, რომელიც ეფუძნება კაფსულის სტაბილიზაციას კოჰეზიური ვისკოელასტიკის გამოყენებით, რომელიც უზრუნველყოფს უკანა კაფსულორექსისის კონტროლირებად ფორმირებას კაფსულის სტაბილურობის შენარჩუნებით და ინტრაოკულარული ლინზის უსაფრთხო იმპლანტაციით. კოჰეზიური ვისკოელასტიკის გამოყენება ამარტივებს უკანა კაფსულაზე მანიპულაციას და ამცირებს წინა ჰიალოიდურ მემბრანასთან დაკავშირებულ რისკებს. მეთოდი წარმოადგენს მარტივ და ეკონომიურად ეფექტურ მოდიფიკაციას, რომელიც შესაძლებელია ინტეგრირდეს სტანდარტულ ფაკოემულსიფიკაციის პროცედურაში.

Introduction. Posterior capsule opacification (PCO) remains the most frequent long-term complication following cataract surgery and is primarily caused by proliferation and migration of residual lens epithelial cells across the posterior capsule. Despite advances in intraocular lens design and surgical techniques, clinically significant PCO still occurs in a considerable proportion of patients following cataract surgery [1,2]. Although Nd:YAG laser capsulotomy is an effective treatment for visually significant PCO, the procedure may be associated with and increased healthcare costs and several adverse effects - patients frequently report symptomatic floaters (muscae volitantes), and the procedure carries a risk of intraocular lens damage, displacement, decentration, or tilt. In addition, posterior segment complications such as cystoid macular edema, retinal breaks, and retinal detachment have been reported. such as transient intraocular pressure elevation, retinal detachment, cystoid macular edema, and increased healthcare costs [3-5].

Several surgical approaches have been proposed to maintain a clear visual axis, including primary posterior capsulotomy and posterior capsulorhexis techniques. These methods aim to remove the central posterior capsule during surgery, thereby preventing the formation of visually significant opacification within the optical zone. However, conventional posterior capsulorhexis techniques may involve technical complexity, additional surgical steps, or increased risk of vitreous disturbance [6,7].

The purpose of this paper is to describe a modified posterior capsulorhexis technique that utilizes cohesive viscoelastic stabilization of both capsular planes to facilitate safe and controlled removal of the central posterior capsule while maintaining standard intracapsular intraocular lens implantation.

Surgical Technique. All procedures were performed using standard phacoemulsification instrumentation under an operating microscope. Standard phacoemulsification cataract surgery is typically performed through a clear corneal incision with creation of a continuous curvilinear anterior capsulorhexis, followed by phacoemulsification of the crystalline lens and irrigation–aspiration of cortical material. In conventional surgery, the posterior capsule is preserved intact and the intraocular lens (IOL) is implanted within the capsular bag. Although this approach provides stable IOL positioning, the intact posterior capsule may later develop posterior capsule opacification due to proliferation and migration of residual lens epithelial cells.

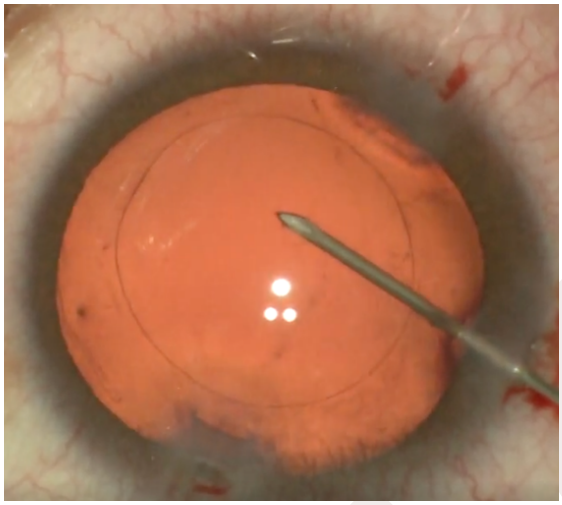

Figure 1. Creation of a Puncture with a 22-gauge needle.

In the technique described in this report, the initial stages of surgery are identical to standard phacoemulsification. After completion of phacoemulsification and removal of cortical material by irrigation–aspiration, a cohesive viscoelastic agent (sodium hyaluronate 1.6% or 1.8%) is simultaneously injected into the anterior and posterior chambers. This maneuver stabilizes the capsular bag and allows the anterior and posterior capsules to align within the same plane, while inducing posterior rotation of the lens–iris diaphragm. Following stabilization of the capsular planes, a small central puncture is created in the posterior capsule using the tip of a 22-gauge needle (Figure 1). The posterior capsule flap is gently elevated anteriorly and carefully separated from the anterior hyaloid membrane.

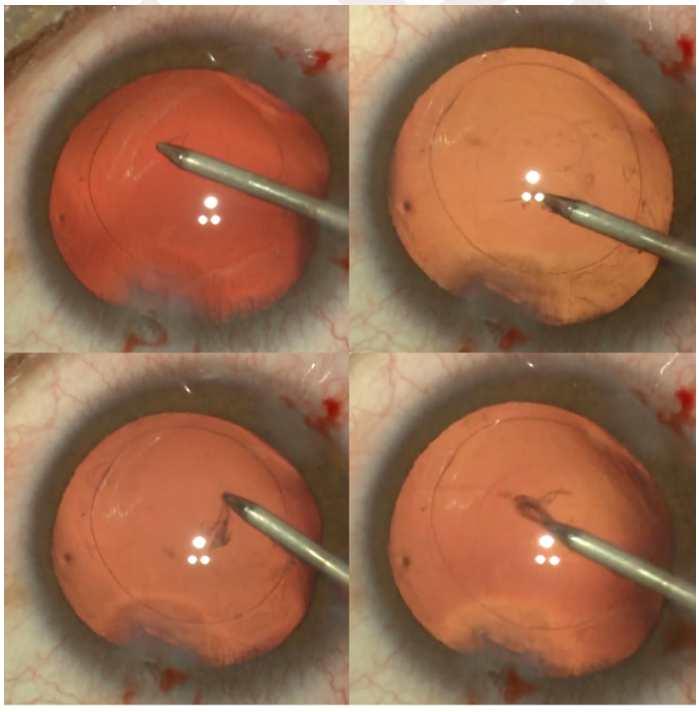

Figure 2. Steps of the Posterior Capsulorhexis

Using capsulorhexis forceps, the posterior capsule is then grasped and removed in a circular fashion to create a continuous and symmetrical posterior capsulorhexis (Figure 2). During the circular movement of the capsulorhexis, the capsule may be regrasped several times to maintain controlled traction and minimize stress on the anterior hyaloid membrane. Under microscopic visualization, vitreous fibers may be observed separating naturally from the posterior capsule surface during this maneuver.

In some cases, a mild protrusion of vitreous fibers above the plane of the posterior capsule may occur. When this is observed, additional cohesive viscoelastic material is injected into the capsular

bag, allowing the anterior hyaloid membrane and vitreous fibers to be displaced posteriorly back into the vitreous cavity.

After completion of the posterior capsulorhexis, the capsular bag is expanded with viscoelastic to separate the anterior and posterior capsule surfaces and facilitate implantation of the intraocular lens. A foldable intraocular lens is implanted intracapsularly within the capsular bag. The diameter of the posterior capsulorhexis is created approximately 1.5–2.0 mm smaller than the anterior capsulorhexis, ensuring that the opening remains centrally located within the optical zone of the implanted lens.

The remaining surgical steps, including removal of the viscoelastic substance by irrigation–aspiration and hydration of the corneal incisions, are performed according to standard phacoemulsification procedures.

Technical Considerations and Differences from Existing Techniques. Several techniques for primary posterior capsulotomy or posterior capsulorhexis during cataract surgery have been described. Many of these approaches involve additional surgical steps, specialized instruments, or manipulation of the posterior capsule after intraocular lens implantation. Some techniques require injection of dispersive viscoelastic into Berger's space to separate the posterior capsule from the anterior hyaloid membrane, while others perform capsulotomy under continuous irrigation, which may increase the risk of vitreous disturbance.

The technique described in this report differs in several important aspects. Stabilization of the capsular bag is achieved by simultaneous injection of cohesive viscoelastic into the anterior and posterior chambers, aligning the anterior and posterior capsular planes and improving posterior capsule stability during manipulation. Posterior capsulorhexis is performed before intraocular lens implantation, allowing direct visualization and controlled capsule removal. If mild vitreous protrusion is observed, additional cohesive viscoelastic can be injected into the capsular bag to displace the anterior hyaloid membrane posteriorly.

Unlike femtosecond laser capsulotomy or techniques requiring specialized devices, this method can be performed using standard surgical instruments and commonly available viscoelastic materials.

Advantages of the Technique. The technique provides improved stabilization of the capsular bag through simultaneous injection of cohesive viscoelastic into the anterior and posterior chambers, facilitating controlled manipulation of the posterior capsule. Controlled regrasping of the capsule during capsulorhexis distributes traction forces more evenly and allows gradual separation of the posterior capsule from the anterior hyaloid membrane, reducing the risk of vitreous traction.

The use of cohesive viscoelastic also improves surgical safety, as these agents are easier to remove during irrigation–aspiration and are less frequently associated with postoperative intraocular pressure elevation. Because the technique relies on standard surgical instruments and commonly available materials, it can be incorporated into routine phacoemulsification procedures without additional equipment and may represent a cost-effective approach for maintaining visual axis clarity.

Indications. The described posterior capsulorhexis technique may be considered in patients undergoing routine phacoemulsification cataract surgery when long-term maintenance of a clear visual axis is desired. It can be applied in uncomplicated cataract surgery with adequate capsular support and planned intracapsular intraocular lens implantation.

Because the technique does not require specialized devices, it can be incorporated into standard surgical workflow without modification of the surgical setup.

Limitations. Despite its potential advantages, several limitations should be considered. As with any posterior capsule manipulation, careful surgical technique is required to avoid disturbance of the anterior

hyaloid membrane and vitreous body. The procedure may be technically more challenging in eyes with zonular weakness or capsular instability.

The technique is primarily intended for uncomplicated cataract surgery, and caution is recommended in eyes with posterior capsule abnormalities or previous intraocular surgery. In addition, long-term outcomes and complication rates require further investigation in larger prospective studies.

Discussion. The described technique introduces a modification of primary posterior capsulorhexis that emphasizes stabilization of the capsular planes through simultaneous injection of cohesive viscoelastic into the anterior and posterior chambers. This maneuver facilitates controlled separation of the posterior capsule from the anterior hyaloid membrane and enables the creation of a continuous posterior capsulorhexis while minimizing vitreous traction.

Compared with previously described approaches, the present technique avoids additional surgical steps such as viscoelastic injection into Berger's space or manipulation after intraocular lens implantation. Performing the capsulorhexis before lens implantation allows better visualization and control of the capsular flap [8,9].

Another advantage of this method is its simplicity and compatibility with standard phacoemulsification procedures. The technique does not require specialized instruments or expensive technology such as femtosecond laser systems, making it accessible in routine clinical practice.

Conclusion. The modified posterior capsulorhexis technique described in this report provides a simple and reproducible approach for removal of the central posterior capsule during cataract surgery while maintaining intracapsular intraocular lens implantation. Stabilization of the capsular planes with cohesive viscoelastic allows safe manipulation of the posterior capsule and controlled separation from the anterior hyaloid membrane. This may represent a practical and reproducible approach for maintaining long-term visual axis clarity following cataract surgery.

References:

1. Awasthi N, Guo S, Wagner BJ. Posterior Capsular Opacification: A Problem Reduced but Not Yet Eradicated. *Arch Ophthalmol.* 2009;127(4):555–562. doi:10.1001/archophthalmol.2009.3
2. Karahan E, Tuncer I, Zengin MO. The Effect of ND:YAG Laser Posterior Capsulotomy Size on Refraction, Intraocular Pressure, and Macular Thickness. J Ophthalmol. 2014;2014:846385. doi: 10.1155/2014/846385. Epub 2014 Mar 3. PMID: 24724016; PMCID: PMC3958711.
3. Kamushadze G, Shengelia D, Gorgadze G, Shengelia B, Ibragimova S. Posterior Capsulorhexis as a Preventive Strategy: A Case of Bilateral Congenital Cataract With Divergent Outcomes. Cureus. 2025 Aug 31;17(8):e91325. doi: 10.7759/cureus.91325. PMID: 41035590; PMCID: PMC12481467.
4. Shin K.-S., Park H.-J., Jo Y.-J., Kim J. Y. Efficacy and safety of primary posterior capsulotomy in combined phaco-vitrectomy in rhegmatogenous retinal detachment. PLoS One. 2019;14(3):1–13. doi: 10.1371/journal.pone.0213457.e0213457
5. Gao C., Lyu F. Tilt of IOLs and change of axial length in patients of posterior capsular opacification after Nd: YAG laser capsulotomy. Guoji Yanke Zazhi. 2017;17(8)
6. Pereira, Ana Cláudia; Porfírio, Francisco Jr.; Freitas, Lincoln Lemes; Belfort, Rubens Jr. Ultrasound energy and endothelial cell loss with stop-and-chop and nuclear preslice phacoemulsification. Journal of Cataract & Refractive Surgery 32(10): 1661-1666, October 2006. DOI: 10.1016/j.jcrs.2006.05.006
7. Kamushadze G., Shengelia D., Gorgadze G., Shengelia B. Prevention and Treatment of Posterior Capsule Opacification Following Artificial Lens Implantation. *Georgian Scientists*, 2025;*7*(1):424–436.
8. Köhler J, Köhler K, Köhler J. Primäre hintere Kapsulorhexis in schwierigen Situationen [Primary posterior capsulorhexis in difficult situations]. Ophthalmologe. 2020 Nov;117(11):1138-1142. German. doi: 10.1007/s00347-020-01245-9. PMID: 33026528.

9. Eid AM, Abd-Elhamid Mehany Elwan S, Sabry AM, Moharram HM, Bakhsh AM. Novel Technique of Pneumatic Posterior Capsulorhexis for Treatment and Prevention of Posterior Capsular Opacification. J Ophthalmol. 2019 Dec 21;2019:3174709. doi: 10.1155/2019/3174709. PMID: 31949950; PMCID: PMC6948290.

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SUMMARY

Posterior capsule opacification remains the most common long-term complication following cataract surgery and may lead to decreased visual acuity requiring Nd:YAG laser capsulotomy. Although several surgical approaches have been proposed to maintain a clear visual axis, many techniques involve additional surgical steps, specialized equipment, or manipulation of the posterior capsule after intraocular lens implantation.

A novel posterior capsulorhexis technique based on stabilization of the capsular planes using cohesive viscoelastic is presented. After completion of phacoemulsification and removal of cortical material, cohesive viscoelastic (sodium hyaluronate 1.6–1.8%) is simultaneously injected into the anterior and posterior chambers to align the anterior and posterior capsules within the same plane and induce posterior rotation of the lens–iris diaphragm. A central puncture is created in the posterior capsule, followed by formation of a continuous circular posterior capsulorhexis using capsulorhexis forceps. During the circular maneuver, the capsule is regrasped as needed to maintain controlled traction and minimize stress on the anterior hyaloid membrane. In cases of mild vitreous protrusion, additional cohesive viscoelastic is injected into the capsular bag to reposition the hyaloid fibers posteriorly. The intraocular lens is subsequently implanted intracapsularly within the capsular bag. The posterior capsulorhexis is created approximately 1.5–2.0 mm smaller than the anterior capsulorhexis.

The described technique allows controlled formation of posterior capsulorhexis while maintaining capsular stability and intracapsular intraocular lens implantation. By stabilizing the capsular planes with cohesive viscoelastic, the method facilitates safe manipulation of the posterior capsule and controlled separation from the anterior hyaloid membrane. This approach represents a simple and cost-effective modification of cataract surgery that can be integrated into routine phacoemulsification procedures.

Keywords: Posterior Capsulorhexis, Cataract Surgery, PCO, Phacoemulsification, Viscoelastic