Endoillumination aided scleral buckling combined with intravitreal injection of hyaluronate for treatment of rhegmatogenous retinal detachment

Tong Zhao
China-Japan Friendship Hospital https://orcid.org/0000-0002-2528-1019
Zhijun Wang (wangzhijuncj@sina.com)
China-Japan Friendship Hospital https://orcid.org/0000-0001-8087-6050

Research Article

Keywords: Rhegmatogenous retinal detachment, scleral buckling, noncontact wide-angle viewing system, endoillumination, intravitreal injection of hyaluronate

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Abstract

Background: To evaluate the efficiency and safety of 25-gauge illumination aided scleral buckling surgery combined with intravitreal injection of hyaluronate for treatment of rhegmatogenous retinal detachment

Methods: This study was undertaken in a prospective, nonrandomized, and uncontrolled manner. Patients of rhegmatogenous retinal detachment were performed scleral buckling surgery with the aid of intraocular illumination and noncontact wide-angle viewing system. Hyaluronate was injected into the vitreous cavity to maintain intraocular pressure stable after subretinal fluid drainage through the external sclerotomy when necessary. Best corrected visual acuity(BCVA), intraocular pressure, fundus examination and complications were observed and recorded.

Results: Twenty-eight consecutive patients (28 eyes) were enrolled. Subretinal fluid drainage and hyaluronate injection was performed in 12 eyes. The final reattachment ratio was 100%. BCVA increased after operation ($P<0.001$) and no significant difference was observed between preoperative and postoperative intraocular pressure ($P=0.149$). No iatrogenic retinal break, choroidal hemorrhage or endophthalmitis were observed.

Conclusions: Endoillumination aided buckling surgery combined with intravitreal injection of hyaluronate could be an option for treatment of rhegmatogenous retinal detachment especially for the cases of highly elevated retina.

Trial registration: ChiCTR1800020055. Retrospectively registered on December 12, 2018.

Key words: Rhegmatogenous retinal detachment, scleral buckling, noncontact wide-angle viewing system, endoillumination, intravitreal injection of hyaluronate.

Background

Primary rhegmatogenous retinal detachment(RRD) is the most common type of retinal detachment and is an acute vision-threatening disease in ophthalmology [1]. Scleral buckling has been the leading approach since introduced by Schepens in the 1950s [2] until the 1980s with the advancement of pars plana vitrectomy [3]. A successful repair surgery relies mainly on the accurate scleral location of the retinal breaks [4]. However, inverted images observed by indirect ophthalmoscope and low magnification [5] bring difficulties for less experienced surgeons, which may lead to omission of minimal retinal lesions resulting in unsuccessful operation [6]. Endoillumination with a wide angle viewing system has been introduced as successful alternative methods for retina visualization in scleral buckling [7]. Another concerned question is the air injection after subretinal fluid drainage. The air bulb may influence the observation and easily escape from vitreous cavity [8]. To overcome the drawbacks of air injection we try to use hyaluronate to maintain the intraocular pressure instead of air and to observe the safety and efficacy of scleral buckling with endoillumination and intravitreal injection of hyaluronate.

Methods

Patients

This study was undertaken in a prospective, nonrandomized, and uncontrolled manner. All patients of RRD who needed scleral buckling surgery were enrolled in the study and signed informed consents before the surgery. this study was conducted based on the approval of the Ethics Committee of China-Japan Friendship Hospital and in accordance with the tenets of the Declaration of Helsinki. Exclusion criteria were as follows: (1) recurrent retinal detachment, (2) vitrectomized eyes, (3) macular hole retinal detachment or retinal holes of posterior pole, (4) marked proliferative vitreoretinopathy (PVR) grade C2 [9] or more severe, (5) large retinal tear ranging more than 3 clock hours, and (6) obvious opacity of cornea or/and lens.

Surgical methods

The conjunctiva peritomy was performed 180° to 360°according to the site of retinal break and the range of RRD, and the extra-ocular muscle was isolated. A 25-G valved trocar cannula (Alcon Surgical Inc) was placed 4.0 mm behind the limbus, keeping away from the location of the retinal breaks. A noncontact wide-angle viewing system (Resight 700; Carl Zeiss Meditec AG) was activated. A fiber optic illuminator (Alcon Surgical Inc, Fort Worth, TX) was inserted through the valved trocar. Full examination of the fundus was performed to locate all the retinal breaks and detect the all 360° peripheral areas to prevent omission of minimal lesions (Fig. 1). Cryopexy was performed if there was no significant fluid in the area of retinal breaks. Otherwise, subretinal fluid drainage (Fig. 2) through the external sclerotomy was performed under the operating microscope. Drainage was performed at some distance away from retinal breaks to minimize the passage of vitreous through the breaks. Viscoelastic solution (Pe-Ha-Luron® F 1.8%, Albomed GmbH) was injected into the vitreous cavity through the trocar to maintain intraocular pressure stable (Fig 3). The segmental buckling procedure was performed using silicone sponge after marking the retinal breaks on the sclera. A circumferential scleral buckling was performed in case of multiple breaks or wide-range degeneration areas. The fiber illuminator was inserted once again to confirm the buckle position and re-examine the fundus. The cannula was removed and conjunctiva was closed with an 8-0 absorbable suture.

Essential information of all patients were recorded: age, gender, time of onset, ocular and systemic disease history, preoperative visual acuity, lens status, number of retina breaks, location of retinal breaks, number of quadrant involved, the presence or absence of the macular detachment. Routine examinations were performed at 1, 3, 7 days and 1, 3, 6 months postoperatively, including BCVA, intraocular pressure, fundoscopy, and complications. The decimal value of visual acuity was converted into the logarithm of the minimum angle of resolution (LogMAR) for statistical analysis. The operation details were also recorded, including operation duration, whether performing external subretinal fluid drainage and whether performing circumferential scleral buckling.

Statistical analyses were performed with IBM SPSS ver.19.0 (IBM Corp., Armonk, NY, USA); Paired samples t-tests were used to compare preoperative and postoperative data. A p-value < 0.05 was defined statistically significant.

Results

Twenty-eight consecutive patients (28 eyes) underwent scleral buckling surgery from January 2014 to December 2015 and completed follow-up of 6-36 months. Twelve women and 16 men were included in the study. The mean age was 34.0±11.4 years (range 18-58 years). The mean follow-up was 7.9 months (range 6-36 months). The mean axial length, measured with immersion A-scan ultrasound biometry, was 25.91±2.33 mm (range 21.67-29.01mm). The mean BCVA was 0.95±0.85 LogMAR ranging from 4 to 0 LogMAR. The mean intraocular pressure was 12.89±2.99 mmHg. Thirteen of the 28 patients were myopia (range -1.00 to -12.00 DS) and one has trauma history. One of the 28 eyes was pseudophakic with a contracted anterior capsule and a small anterior capsular opening of 4 mm. This pseudophakic eye had a retinal detachment of 6 clock hours with a retinal fold in the inferotemporal quadrant but without finding confirmed tears. Three eyes had lens of mild opacity(2 eyes of grade NO3NC3 and one of grade P2 according LOCS Ⅲ cataract grading).Thirty-five holes were detected in the 28 eyes preoperatively, including 26 shoe-shape tears and 9 circle holes. One single retinal break was found in 24 eyes and multiple holes in 4 eyes. Ten retinal holes are located in pre-equatorial zone, 24 in equatorial and 1 in post-equatorial zone. Degeneration areas were found in 16 eyes and in 13 fellow eyes. The mean extension of the retinal detachment was 7.5±4.7 clock hours (range 1-12 clock hours). Maculae of 18 eyes were involved (Table 1). Grade C1 PVR were found in two eyes. One eye was the pseudophakic case mentioned above. Another one was a phakic eye which had a retinal detachment of 6 clock hours (all the temporal quadrant) with a shoe-shape tear in the superior quadrant and a retinal fold nearby.

The mean operation time was 46.56±34.25 min. All operations were performed by one experienced surgeon (Wang). One circle hole was found during the operation of the pseudophakic eye mentioned above and one additional hole that had not been detected preoperatively was found in another patient. Of all 28 eyes, local depression was done in 28 eyes and additional encircling band was used in one eye; subretinal fluid drainage in 12 eyes and hyaluronate injection in 12 eyes. No complications occurred such as lens damage, vitreous or choroidal hemorrhage, endophthalmitis and retinal injury.

Retinal re-attachment was achieved in all 28 eyes at the final follow-up while two cases received further vitrectomy and silicone oil injection due to either progressive PVR or new retinal breaks. At the final follow-up the mean BCVA was 0.54±0.60 LogMAR ranging from 3 to 0 LogMAR which was significantly improved compared with preoperative BCVA ($P<0.001$). The mean intraocular pressure was 14.00±2.78 mmHg with no significant difference compared with preoperative ($P=0.149$) (Table 2).

Discussion

From our study it is found that endoillumination aided scleral buckling led to a satisfactory result of retina re-attachment. In our study there was one case of pseudophakic eye with a contracted anterior capsule and a small anterior capsular opening making it hard to find a confirmed retinal break preoperatively. A circle hole during the operation was found by the aid of endoillumination and a successful scleral buckling was completed, which relieved the economic and physical stress of vitrectomy and silicone oil injection. In another case of this report one additional hole was found which had not been detected preoperatively, which avoid a recurrent retinal detachment. Our study confirmed the advantages of the use of endoillumination and noncontact wide-angle viewing system which had been reported previously: (1)upright images of the fundus and better visualization for retinal details, (2)reducing the recurrence rate by sealing all retinal holes even those that were not identified preoperatively, (3)making scleral buckling an option for the cases with small pupils or opacity of refractive media, (4)shortened operation time, (5)enabling to obtain video record for further training and review, and finally, (6)eliminating surgeons' stress caused by bending neck and waist over and over again when using an indirect ophthalmoscope. Chandelier endoilluminators were also reported to be used combined with noncontact wide-angle viewing system [10]. But we believe that fiber illuminator might be a better choice because it could be aimed directly to the affected part to obtain a clearer sight view and Chandelier is more expensive and not so widely used as a routine surgical equipment.

Another innovative point of our study was the use of hyaluronate instead of air at the procedure of intravitreal injection. Hyaluronic acid has long been used in ophthalmology only as a kind of vitreous substitute at the beginning [11] but now mainly as viscoelastic solution used in cataract surgery. Intraocular use of Hyaluronate, including intravitreal use, was proved safe and nontoxic to retina [12,13]. We observed 16 cases of hyaluronate injection following subretinal fluid drainage. No complication was found. Besides, the homogeneous refractivity of hyaluronate similar as vitreous maintained the clear visualization after intravitreally injected (Fig. 4). When the air was injected on the contrary, the air bubble and even the "fish egg" like bubble could greatly block the view of the fundus [14]. As to pseudophakic eyes and those who had loose or damaged zonular suspension, the gas might come into the anterior chamber limiting the retinal visualization. A potential disadvantage of hyaluronate injecton was that the formation of commuting flow between retinal tear and external sclerotomy hole might result in vitreous and hyaluronate flowing out through the drainage hole. To avoid this situation, sclerotomy should be performed at a proper site far enough away from the retinal tear and the pinpoint of the needle should not be oriented directly to the retinal tear when hyaluronate was injected. The phenomenon did not really occur in our 16 cases with the careful operation and the special attention to this point. Another role of gas tamponade is that the surface tension and buoyance of the gas can also keep the bubble press the retinal hole. But our study found that proper drainage and buckling could guarantee complete closure of the retinal breaks at the end of the operation. Therefore, the gas pressing against the hole and the special position after gas injection may be not necessary. At last, hyaluronate injection further lowered the possibility of Cataract progression compared with air injection.

Despite of zero occurrence in our study, the complications reported in previous literatures should be alerted, such as vitreous herniation from sclerotomy sites, vitreoretinal traction [6], endophthalmitis [15], iatrogenic retinal tears or lens damage [5]. To reduce the complications some points below should be emphasized: (1) avoid inserting the illuminator probe into vitreous repeatedly, (2) avoid moving the probe rapidly and over-inserting, (3) do not stir vitreous, and (4) examine the closure of sclerotomy site in case of vitreous herniation from sclerotomy sites and secondary vitreoretinal traction.

Conclusion

The anatomical success and functional improvement achieved by scleral buckling surgeries combined with endoillumination and a contact wide-angle viewing system were satisfactory. Intravitreal injection of hyaluronate instead of gas maintained a clear visualization. The modified scleral buckling surgery could provide a clearer view of fundus, decrease the possibility of omitting small holes, reduce surgeons' discomfort and share videos with trainers and other surgeons. The efficiency and safety of the modified scleral buckling surgery need to be evaluated by further randomized controlled trials.

Abbreviations

BCVA: best corrected visual acuity

IOP: intraocular pressure

RRD: rhegmatogenous retinal detachment

LogMAR: logarithm of the minimum angle of resolution

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee at China-Japan Friendship Hospital. Written informed consents were obtained from all participants.

Consent for publication

Written informed consent was obtained from the patients for publication and any accompanying images.

Availability of data and material

The datasets produced during and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests and no financial competing interests.

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None.

Authors' contributions

T Z drafted the manuscript. Z W revised the manuscript and conducted operation. All authors have read and approved of the final manuscript.

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Tables

Table 1 The characteristics of the tears and retinal detachment.

Total	Number of retinal breaks		Macula involved	Complicated with retinal degeneration of the affected eye	Complicated with retinal degeneration of the fellow eye	Location of the retinal breaks			The mean extension of the retinal detachment (clock hours)
	Single	Multiple				Pre-equatorial	Equatorial	Post-equatorial	
28	23	4	18	16	13	10	24	1	7.5±4.7

Table 2 The change of BCVA and IOP after the operation.

	BCVA(logMAR)	IOP (mmHg)
preoperative	0.95±0.85	12.89±2.99
postoperative	0.54±0.60	14.00±2.78
P	<0.001	0.149

Figures

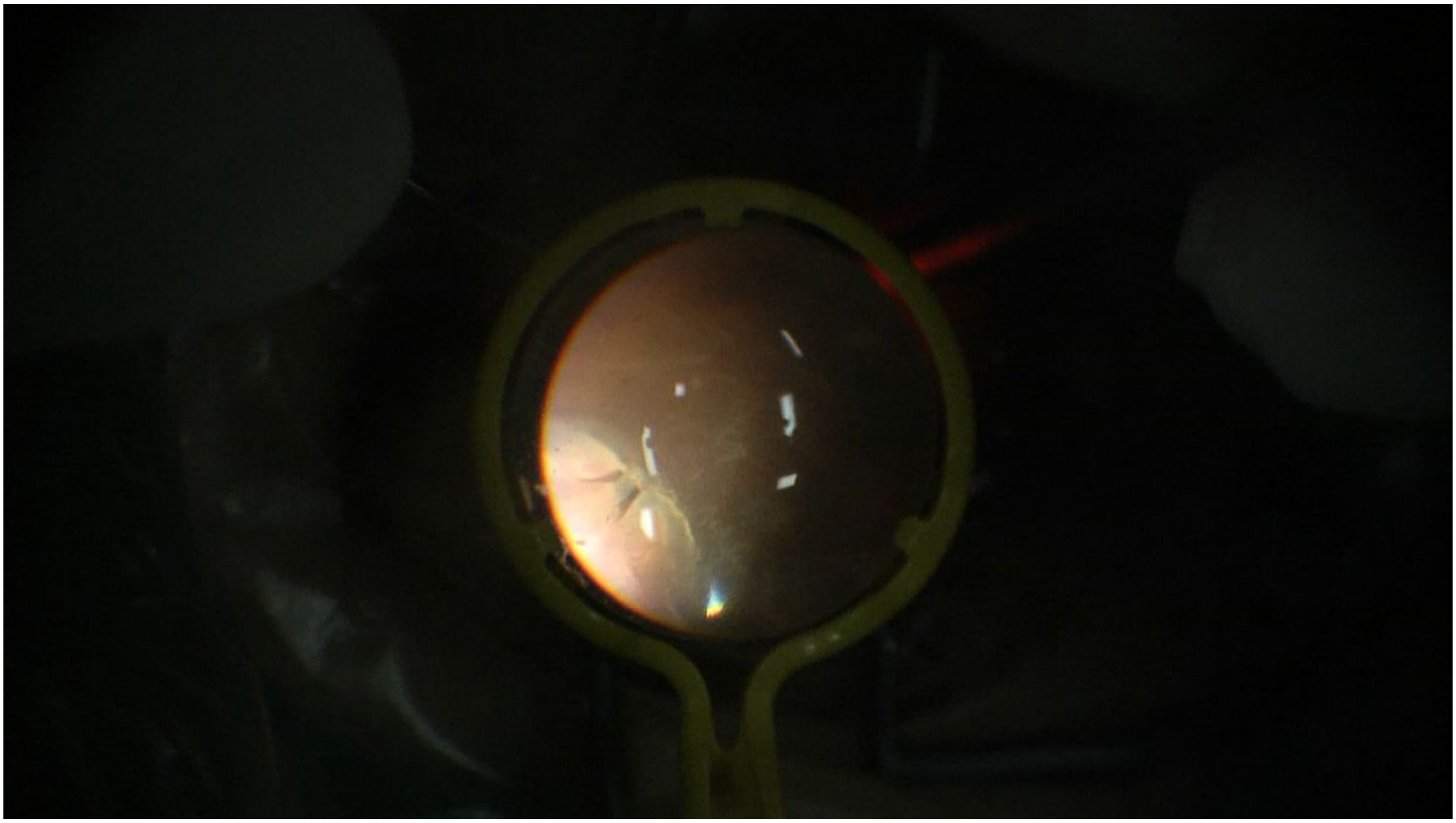

Figure 1

Fundus examination of retinal breaks through noncontact wide-angle viewing system.

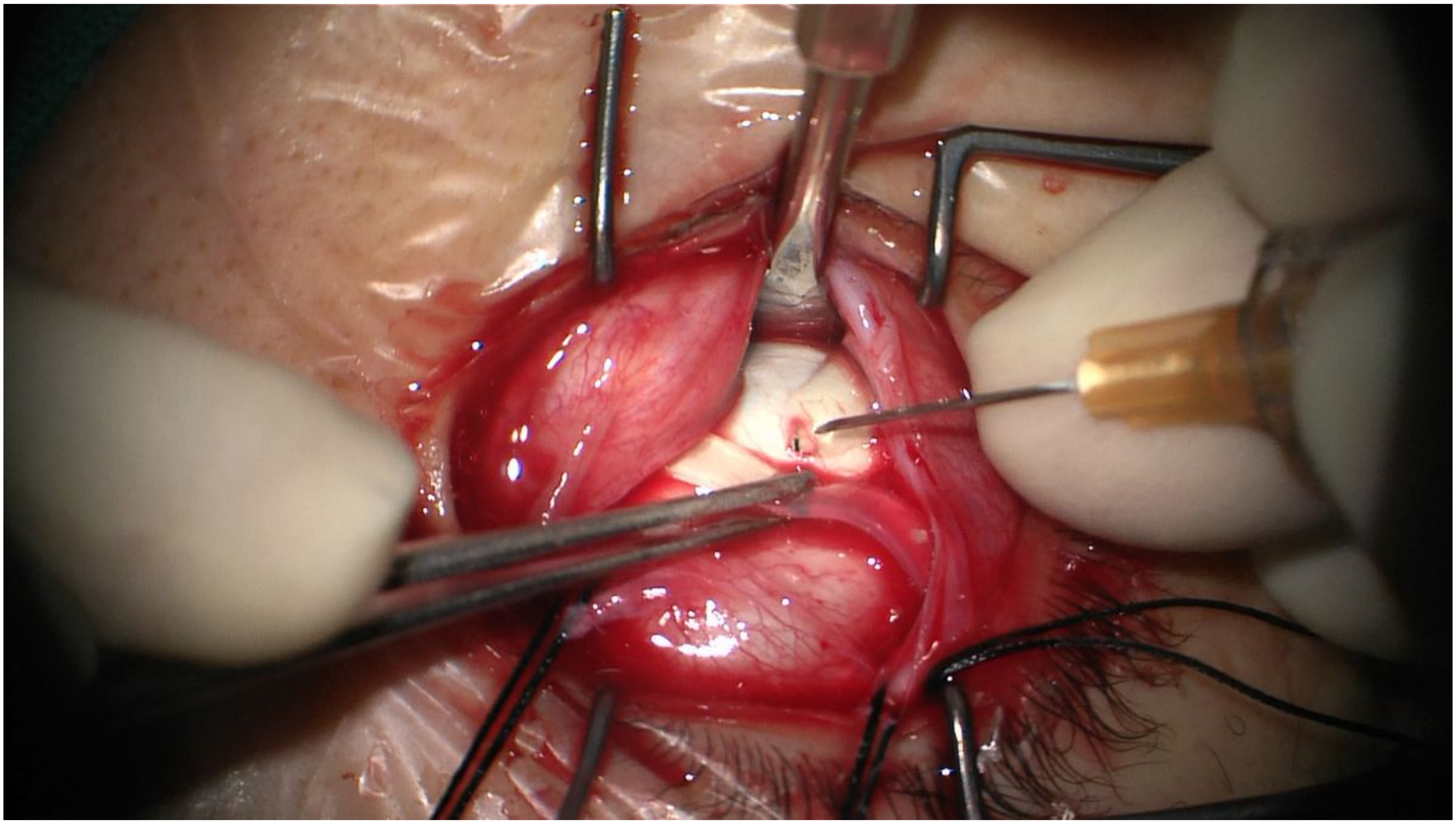

Figure 2

Subretinal fluid drainage was performed through the external sclerotomy.

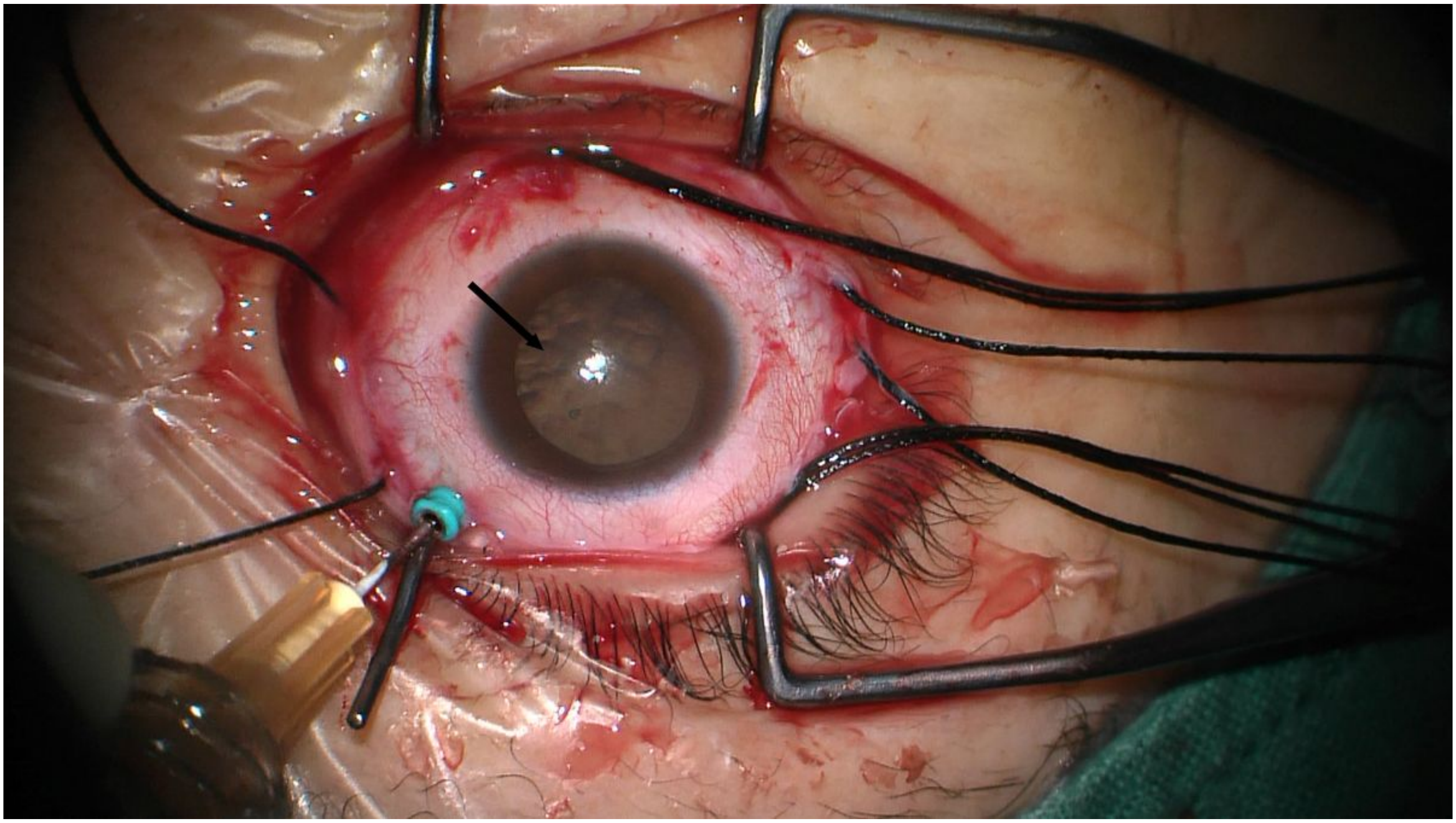

Figure 3

Hyaluronate was injected into the vitreous cavity through the trocar. Arrow showed gelatinous hyaluronate.

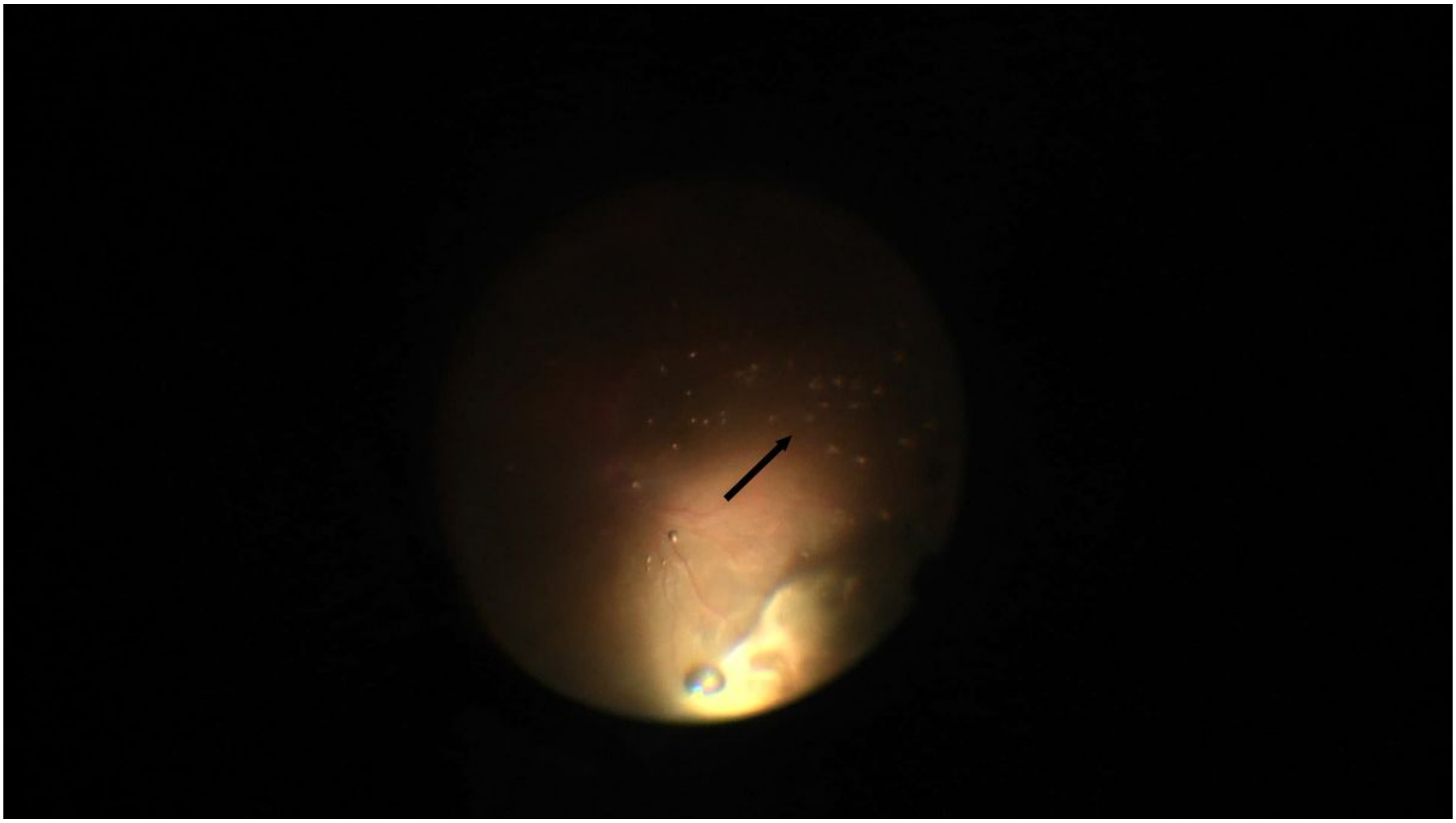

Figure 4

Clear fundus view after hyaluronate was injected. Arrow showed hyaluronate in the vitreous cavity.