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Vitrectomy without encircling band for rhegmatogenous retinal detachment with inferior break utilizing 3D heads up viewing system

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Purpose: This study aimed to determine the anatomical and functional outcomes of pars plana vitrectomy without encircling band for primary rhegmatogenous retinal detachments with inferior breaks utilizing 3D heads up viewing system. **Method:** This prospective, single-center study included 22 consecutive eyes with primary rhegmatogenous retinal detachments with only inferior breaks with proliferative vitreoretinopathy (PVR) CP2 or less, who underwent pars plana vitrectomy without encircling band, with silicon oil as tamponade. All surgeries were performed by a single surgeon. The single operation success rate was recorded after silicon oil removal. **Results:** The patient population consisted of 08 women (36%) and 14 men (64%) with a mean age of 56.6 +/− 14.7 years. The mean follow-up period was 8 months. A single break was present in 13 cases (59%), and 2–4 breaks were present in 9 cases (40.9%). The mean time for the surgical procedure was 35 min (range: 25–50). The macula was found to be detached in 19 cases (86.36%) and attached in 3 cases (13.6%). Single operation success rate (SOSR) of vitrectomy, after silicon oil removal without encircling band, for primary rhegmatogenous retinal detachment (RRD) with inferior breaks was 95.4%. One case redetached due to PVR changes and underwent re-surgery. Final reattachment was achieved in all 22 cases (100%). Mean best-corrected visual acuity (BCVA) significantly improved from 1.43 ± 0.59 logarithm of the minimum angle of resolution (logMAR) to postoperative BCVA was 0.48 ± 0.34 logMAR ($P = 0.001$). **Conclusion:** Pars plana vitrectomy without encircling band, utilizing 3D heads up the system in RRDs with inferior breaks in eyes with PVR grade C2 or less, provides good outcome.

Key words: 3D heads up viewing system, digitally assisted vitreoretinal surgery, encircling band, inferior retinal breaks, rhegmatogenous retinal detachment, silicone oil injection

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Inferior breaks in rhegmatogenous retinal detachments (RRD) are considered to be one of the risk factors for failure after pars plana vitrectomy (PPV).[1-3] Conventionally, inferior retinal detachments are treated with PPV with encircling bands to provide support to the residual vitreous base.[4] However, the need for an encircling band is contentious, with the current stance that close vitreous base shaving is more relevant. The theoretical advantages of encircling bands are often outweighed by its complications. Encircling band may lead to complications such as extrusion, infection, band migration, diplopia, postoperative glaucoma, limbal stem cell deficiency, and very rarely, anterior segment ischemia. Other than these serious complications, a band placement prolongs the surgery, and postoperatively, leads to conjunctival scarring and constant discomfort to the patient. Additional maneuvers have been used for PPV in inferior RRD such as peripheral vitrectomy under perfluorocarbon liquid with scleral depression for adequate peripheral vitreous removal,[5] use of heavy silicon oil for tamponade,[6,7] etc., to improve the success rate of PPV. However, the management of inferior retinal detachment is still uncertain owing to few studies showing good results without an encircling band.[3,5,8]

This study aimed to determine the anatomical and functional outcomes of PPV without encircling band for primary RRDs with inferior breaks.

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Methods

This prospective, single-center study included 22 consecutive eyes with primary RRDs with only inferior breaks. The study was approved by the institute ethics committee. Written informed consent was taken from all patients. Inclusion criteria were primary RRD with breaks lying between 4 and 8 clock h and PVR grade CP2 or less. Breaks with a size of more than 1 clock h were considered large breaks, more than half clock hour medium size breaks, and less than half clock hours were noted to be small breaks. Patients with a history of previous retinal detachment surgery, RRD with giant retinal tears, dialysis were excluded. Young phakic patients with anterior breaks or dialysis were excluded from the study and underwent scleral buckling. All surgeries were performed by a single surgeon.

A single operation success rate (SOSR) was recorded. Single operation success was defined as a retinal attachment for 6 months of primary vitrectomy and silicone oil removal.

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Surgical procedure

All surgeries were performed by a single senior retina specialist using the Constellation (Alcon Laboratories, Inc, Fort Worth, TX) micro-incisional 23-gauge valved vitrectomy system combined with the "heads-up" three-dimensional (3D) visualization system (Alcon Laboratories, NGENUITY, Inc, Fort Worth, TX) and a contact wide-angle viewing system (MiniQuadpla® XL, Volk). NGENUITY television camera was placed at 1.2 m away from the surgeon during the procedure.

Three standard 23-gauge PPV ports were created and the infusion was checked to be inside the vitreous cavity. Following core vitrectomy, the posterior vitreous detachment (PVD) status was confirmed using triamcinolone acetonide (Kenalog-40). In the absence of pre-existing PVD, PVD was induced. Peripheral vitrectomy was done and the residual anterior flap of the break was trimmed. Fluid air exchange was performed and subretinal fluid was drained through the preexisting break. If there was remaining SRF present at the posterior pole especially in eyes with posterior staphyloma, a posterior drainage retinotomy was made. To completely drain the subretinal fluid under the retinal breaks, a direct aspiration with the vitreous probe or soft tip was performed once all the vitreous fluid had been removed. Interface vitrectomy was performed under Ngenuity magnification set at "magnification 20×" with a mini-quad XL contact lens under full vitreous cavity air fill. The vitrectomy cutter was placed within the vitreous base with the port directed away from the retina, for closely shaving the vitreous base till 1–2 mm into the pars plana. No scleral depression was required. PVR membranes when present were released using Tano scrapper and ILM forceps. Endolaser was used for retinopexy under air and at least 2–3 rows of the laser were applied 360 degrees circumferentially in eyes with multiple lattices or atrophic holes in different quadrants. Intravitreal triamcinolone acetonide 2 mg was injected inferiorly into the air-filled vitreous cavity to reduce the chances of proliferative vitreoretinopathy (PVR). Silicone oil (1000 centistokes) was injected after assessing a number of factors such as the number of breaks, size of breaks, and PVR status. Only two eyes were appropriate for gas tamponade (14% C_3F_8) in our study. Postoperatively prone positioning was advised for 7 days, based on the consideration that inferior breaks require positioning for maintaining contact with the tamponading agent. A short course of systemic corticosteroids was given for 7 days as 1 mg/kg after ruling out systemic contraindication. Silicon oil removal was done using the standard technique 3 months following the successful reattachment of the retina.

Statistical analysis

A descriptive analysis has been carried out. Frequencies and percentages for qualitative variables and means and standard deviations for quantitative variables have been calculated. A P value of less than 0.05 was considered to be significant. The analysis was performed using SPSS 20.0 software.

Results

A total of 22 patients meeting the inclusion criteria were included in this prospective study. The patient population consisted of 08 women (36%) and 14 men (64%) with a mean age of 56.6 +/- 14.7 years. Six patients (27%) presented high myopia. A total of 14 patients (63.6%) had a posterior chamber intraocular lens. The posterior capsule was intact in 5 patients (35.7%). Yttrium aluminum garnet capsulotomy was present in four patients (28.5%), and a sulcus lens with a broken posterior capsule was present in five patients (35.7%). The mean follow-up period was 8 months. The baseline clinical characteristics of patients are shown in Table 1. A single break was present in 13 cases (59%), and 2–4 breaks were present in 9 cases (40.9%). The total number of retinal breaks treated was 37; 28 (75.6%) were horseshoe tears, and 9 (24.3%) were atrophic holes. Of these, 26 (70.2%) were located between 5 and 7 clock h. Table 2 summarizes the characteristics of the retinal breaks. The macula was found to be detached in 19 cases (86.36%) and attached in three cases (13.6%). The mean duration of macular detachment was 14 days (range, 2–28 days). One case (4.5%) had iatrogenic retinal tear during surgery. The surgical procedure was recorded in all 22 cases. The mean time for the surgical procedure was 35 min (range, 25–50).

Initial reattachment after 2–3 months of silicon oil removal was achieved in 21 patients (95.4%). One case redetached due to proliferative vitreoretinopathy (PVR) changes and underwent re-surgery. Final reattachment was achieved in all 22 cases (100%).

SOSR of vitrectomy, after silicon oil removal without encircling band, for primary RRD with inferior breaks was 95.4%.

Mean best-corrected visual acuity (BCVA) significantly improved from 1.43 ± 0.59 logarithm of the minimum angle of resolution (logMAR) to postoperative BCVA was 0.48 ± 0.34 logMAR (P = 0.001). Of the three eyes with macula-attached RRDs, mean preoperative BCVA was 0.4 ± 0.1 logMAR, and mean postoperative BCVA was 0.23 ± 0.12 logMAR. Of the 19 eyes with macula-detached retinal detachments, mean preoperative BCVA was 1.5 ± 0.51 logMAR, and mean postoperative BCVA was 0.43 ± 0.42 logMAR.

Discussion

This prospective study evaluated the results of 22 consecutive eyes with primary RRD with inferior breaks that underwent PPV without encircling band, with silicone oil. The results of our study demonstrated the role of meticulous vitreous base shaving utilizing 3D heads up visualization system. SOSR in our study was 95.4%.

Inferior breaks are considered to be a risk factor for failure of vitrectomy.[1-3] However, controversy still exists about the management of inferior retinal breaks.[3,5,8] The increase in the risk of detachment may be due to the development of PVR due

Table 1: Baseline characteristics of 22 eyes

Clinical variables	Number
Male/female	14/08
Average age	56.6±14.7 years
Eye (R/L)	12/10
Follow-up (average)	8 months
High myopia	6 patients (27%)
Pseudophakia	14 patients (63.6%)
PC defect	9 patients (40.9%)
Aphakia	2 patients (9%)
Phakic	6 patients (27%)

Table 2: Characteristics of retinal detachment in 22 eyes

Characteristic	Clinical variable	Clinical variables
No. of quadrants involved	One	None
	Two	3
	Three	11
	Four	8
Single/multiple breaks (cases)	13/09	
Horseshoe tears/atrophic holes	28/09	
Retinal breaks, size	Small breaks	16
	Medium breaks	17
	Large breaks	04
Retinal breaks, position	Anterior	18
	Equatorial	14
	Posterior	05
Retinal breaks, position	5-7 clock h	26
	4-5 or 7-8 clock h	11
Macula on/off	3/19	
Proliferative vitreoretinopathy (PVR) grade	PVR-A	02
	PVR-B	11
	PVR-C1, C2	09
Eyes with lesions in other quadrants	Lattices with atrophic holes	8
	Horse-shoe tears	6
	Atrophic holes	1

to inadequate vitreous removal. Also, the tamponading effect of silicon oil often lacks inferiorly. These are the commonly speculated reasons for re-detachment in inferior retinal detachment, however, there can be many other causes.

Different approaches have been tried to improvise, such as supporting vitreous base with encircling band,[4-7] peripheral vitrectomy under perfluorocarbon liquid,[8] using heavy silicon oil for tamponade.[9,10] However, these additional maneuvers are not without disadvantages. The most challenging part of the management of inferior retinal breaks is the complete removal of peripheral vitreous.[11] Meticulous shaving of the vitreous base requires visualization of vitreous, which is often difficult with the conventional approach.[12]

In this study, a 3D visualization system has been utilized, with supplementary use of interface vitrectomy for close shaving of the vitreous base. However, phakic eyes required additional scleral indentation for peripheral vitrectomy. A silicon oil tamponade was preferred, as an encirclage was not placed. The results of our study demonstrated the role of near-complete vitreous removal for successful reattachment of the retina.

Conventional Pars plana vitrectomy versus 3D heads up visualization system for vitreous base shaving

Digitally assisted vitreoretinal surgery (DAVS) is one of the most intriguing advancements in the field of vitreoretinal surgeries. It allows for better depth of field and stereopsis, yet simultaneously providing high magnification. NGENUITY

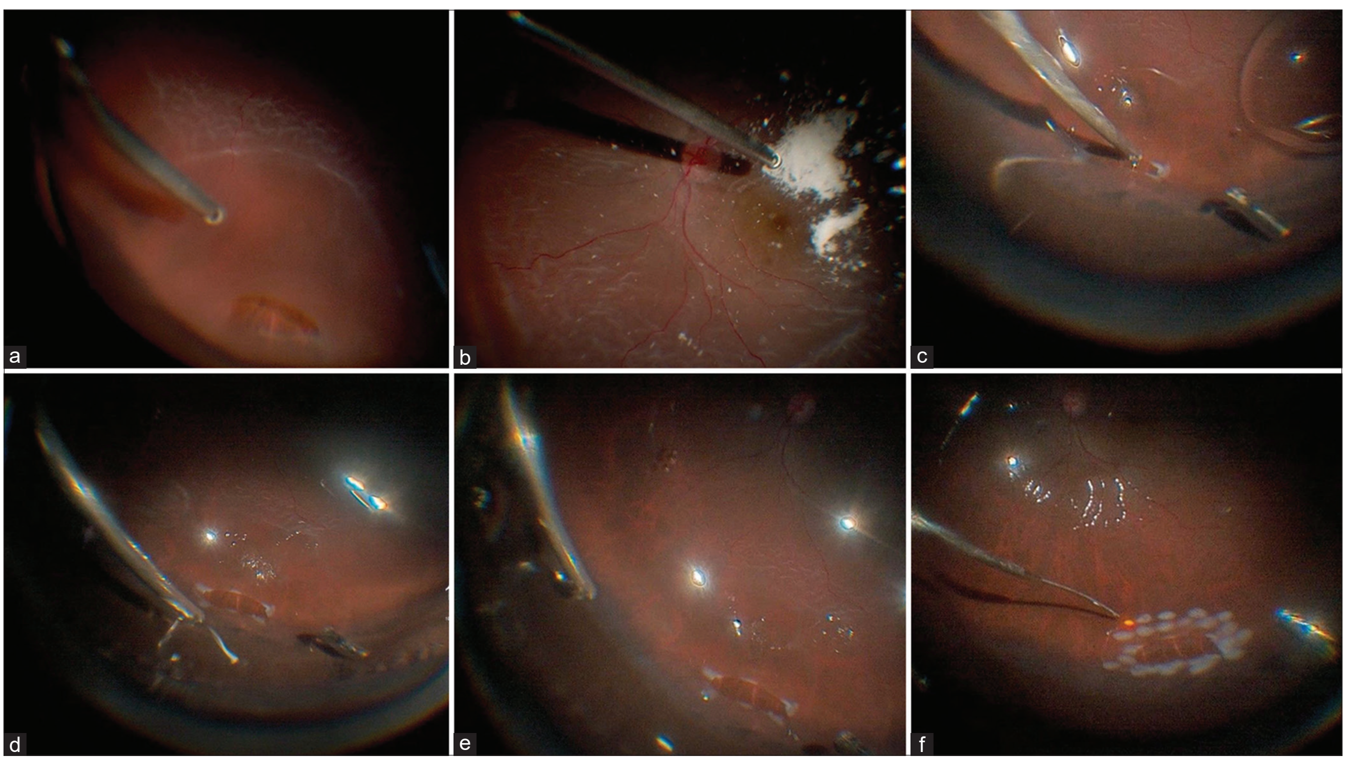

Figure 1: Surgeon's view through a 3D screen. (a) A single medium-size break visible at 6 o'clock position. (b) Triamcinolone assisted posterior vitreous detachment induction and vitrectomy. (c) After air-fluid exchange and aspiration of subretinal fluid (SRF) through retinotomy, residual SRF directly aspirated through the break. (d) Interface vitrectomy under full air fill for removal of peripheral vitreous, anterior to break. (e) Vitreous base shaving being performed anterior to ora serrata, up to 1–2 mm of pars plana. (f) 3 rows of endolaser done around the break

allows 48% higher magnification than a standard conventional microscope, up to 5 times better depth of field to maintain focus across an expanded surgical space, and up to 42% increase in depth resolution to resolve fine details.[13-15]

Although in this study, a direct comparison of the conventional microscope and 3D visualization system was not done.[16] The visualization of vitreous is of utmost importance and requires good stereopsis and depth resolution. The widened field of view helps to avoid additional maneuvers such as scleral indentation during peripheral vitrectomy. Also, identification and dissection of the vitreous around the anterior flap play a key role because of a lack of adequate tamponade inferiorly.

The technique of shaving vitreous base till 1–2 mm of pars plana must be emphasized. It is based on the knowledge that the vitreous base extends 1–2 mm anterior to the ora serrata into the pars plana [Fig. 1].[17] Often, PVR results from membranes developing from the peripheral retina into the pars plana and leads to a redetachment after oil removal.[18,19] Hence, close shaving of vitreous into 1–2 mm of pars plana must be advocated.

Interface vitrectomy under full air fill for peripheral vitreous removal

Combining 3D heads up the system with interface vitrectomy under full air fill can further allay the difficulties with vitreous removal. Interface vitrectomy is a technique described to operate at the interface between vitreoretinal tissue and substances immiscible in aqueous media such as air.[20,21] Performing peripheral vitrectomy under air has manifold advantages. As the bubble of air displaces vitreous fluid, the field of view is increased, eliminating the need for scleral depression. The air-vitreous interface allows clear visualization of the vitreous base due to differences in refractive indices. Furthermore, the air dampens the retinal motions against the aspiration forces of the vitrectomy cutter, thereby reducing the possibility of iatrogenic retinal breaks. Also, providing instantaneous surface tension over retinal breaks.[18] We have observed that working under air has been easier with 3D heads up system, probably because it reduces glare by utilizing reduced illumination.[15,16] We speculate that interface vitrectomy is comparable to the use of perfluorocarbon liquid (PFCL) to stabilize the retina, for peripheral vitrectomy.[22,23] However, a surgical technique varies in effectiveness based on the surgeon's expertise and experience. Some surgeons in fact feel that there may be increased chances of iatrogenicity as air pressure presses vitreous against the retina. Also, a pseudophakic eye with Posterior Capsule (PC) defect can cause difficulty due to the fogging of the lens under air, which needs to be swept off with a soft tip or may require an injection of viscoelastic over the posterior surface of IOL. Another consideration is that peripheral vitrectomy is easier in pseudophakics than in phakic eyes. In our study, the majority of eyes were pseudophakics, which may have contributed to the good success rate. Additionally, we had to supplement vitreous base shaving with a scleral indentation in phakic eyes to achieve a close vitreous base shave. With expertise, it is possible to closely shave the vitreous base to avoid anterior PVR in the long-term. Striving for a close vitreous shave in the first surgery can avoid substantially more difficult repeat surgery.

Few studies in the literature have shown results of PPV without encircling band.[4-7] Though, the surgical technique of the studies may differ in a few steps. These studies have recorded an SOSR comparable to our results.[24-27] However, our study had a small sample size with no randomization. Also, eyes with retinal detachment with PVR more than CP2 were not included. A head-on comparison with a group undergoing vitrectomy with encircling band could not be done. We emphasize that role of encircling band cannot be undermined in eyes with significant PVR, phakic eyes where it is felt that a thorough vitreous base shaving is not possible or where gas tamponade is chosen. Another drawback of vitrectomy with silicon oil injection in phakic eyes is the development or progression of cataract. In our study, all six phakic patients developed varying grades of cataract.

Conclusion

PPV without encircling band utilizing 3D heads up the system, in RRDs with inferior breaks in eyes with PVR grade C2 or less, provides good outcome. Utilization of 3D heads up visualization system allows better visualization of the peripheral retina and vitreous.

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Conflicts of interest

There are no conflicts of interest.

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