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CASE SERIES

Anatomical and visual outcome of vitrectomy for giant retinal tear detachment with proliferative vitreoretinopathy: A retrospective, consecutive case series

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ABSTRACT

Aim: To report the anatomical and visual outcome of giant retinal tear (GRT) associated retinal detachment (RD) with advanced proliferative vitreoretinopathy (PVR) and determine the effect of presenting clinical and surgical variables.

Method: Retrospective, non-comparative, consecutive, interventional case series of vitreoretinal surgeries performed in a private tertiary eye unit. Patient demographics, preoperative, and intra-operative variables were assessed and analyzed.

Inclusion: Eyes which had surgery for previously unoperated GRT RD with PVR and had > 3 months of follow up.

Exclusion: Other primary and secondary forms of RD with no GRT.

Results: Thirty-six eyes of 36 patients were evaluated. Male: female ratio = 5:1. Mean age of 45.53 ± 13.2 years (range 12 - 65 years). Left eye, twenty-three eyes (63.9%). Rate of advanced PVR C and D was 83%, four quadrant (total RD) 55.6%, macula detachment 91.7%, giant tear size was 90 to 180 degree and > 180 degree in 55.6% and 33.3% respectively. Single surgery attachment rate was 41.7% and final attachment after a second surgery was 86.1%. Visual outcome was CF or better in twenty-three eyes (63.9%). Recurrent RD in 58.3% was due to postoperative PVR. Gender, age, laterality, PVR grade, giant tear size, quadrants affected by RD had no impact on anatomical outcome ($p > 0.05$). Significantly, scleral buckle (SB) use did not reduce rate of recurrent RD and had no significant effect on anatomical outcome ($p > 0.05$).

Conclusion: GRT RDs have a higher rate of PVR compared to more commonly encountered RRD. When treating GRT RD with advanced PVR, meticulous membrane removal should be accomplished using vital dyes to aid visualization. This will reduce recurrence of postoperative PVR. Pre-, intra- and post-operative factors, including use of a SB did not affect single surgery success. Visual improvement is limited by the occurrence of PVR.

Introduction

A Giant retinal tear (GRT) is a retinal break which extends circumferentially for three or more contiguous clock hours, in association with a posterior vitreous detachment (PVD).[1] GRT should be differentiated from retinal dialysis in which a PVD is not present, and in which a disinsertion of the retina from the ora serrata has occurred.[2] GRT associated retinal detachments (RD) are a less common and distinct group of complex RD that present specific challenges to manage. GRTs are at a significantly higher risk of preoperative and postoperative proliferative vitreoretinopathy (PVR) and other complications, including posterior slippage of the retina. [3-6] Furthermore, there are several variables in the surgical treatment of GRT detachments, including the intraoperative use of perfluorocarbon liquid (PFCL), the addition of a scleral buckle (SB), choice of endotamponade, and performing 360-degree endo-retinal laser photocoagulation, which makes for a nonstandard or non-uniform treatment protocol.[7] Therefore, significant controversy exists in surgical treatment of GRT RD.

Late presentation of patients, is a known challenge of patient care in low-income economies, resulting in even more complex presentation of GRT and other rhegmatogenous retinal detachments (RRD). Reported rates of PVR in RD from African countries vary widely and ranges from 16.5% to as high as 65%.[8,9] Though there are several reports on the outcome of vitrectomy for the repair of GRT detachment from other regions of the world, the outcome of vitrectomy for GRT RDs with a high rate of advanced PVR from a low-income economy has not been reported. We research the anatomical outcome of vitrectomy in our series of GRT associated RD with advanced PVR and investigate what preoperative and intraoperative factors are associated with single surgery anatomical success and improved visual outcome.

Method

We performed a retrospective interventional consecutive case series, reviewing case records of patients whose eye had vitrectomy for repair of GRT RD with PVR. This study was approved by the Eye Foundation Hospital Research Ethics Committee (EFHREC) and was performed according to the principles of the Helsinki declaration. Permission was obtained from the EFHREC for the review of patients' medical records, and retrieved information was anonymized. All patients gave written informed consent prior to surgery.

Information obtained from the case records included biodata, laterality, etiology of GRT, lens status, quadrants affected by RD, size of GRT, presence of rolled over retina, macula involvement by RD, grade of PVR, use of SB, tamponade used, preoperative and postoperative intraocular pressure, preoperative and postoperative visual outcome, recurrence of retinal detachment, anatomical outcome at last visit, duration of patient follow up.

All patients had a vitrectomy performed between April 2006 to June 2013. The surgeries involved the use of Alcon's 20-gauge Accurus vitrectomy system (Fort Worth, TX, USA) and the 1800 cuts per minute (cpm) Innovite vitrector. A GRT and posterior vitreous detachment (PVD) were present in all eyes. A core vitrectomy was followed by the injection of PFCL to stabilize the retina and unfold the folded retina. A peripheral vitreous base shaving and removal of the anterior retinal flap was performed. A Tano diamond-dusted scrapper and end gripping intraocular forceps were used to remove visualized epiretinal membranes and subretinal membranes. Relaxing circumferential or radial retinectomies were performed as needed in situations of a stiff retina. The PFCL was topped up to fill the vitreous cavity. Endo retinal laser was performed using an Iridex 810nm laser probe. Three or more rows of retina laser photocoagulation were applied to the retina periphery. Cryotherapy was not used in any of the eyes. A direct PFCL – silicone oil exchange was performed to prevent posterior slippage, i.e., a posterior slipping back towards the macula of the more peripheral retina. The silicone oil was removed after three to six months. In cases where there was redetachment after silicone oil removal, further surgery was warranted to reattach the retina, and a repeat silicone oil tamponade was performed. In those cases, in which a scleral buckle was used, a 360-degree sponge buckle was fixed to the sclera using 8-0 polyester sutures 15mm posterior to the limbus before the commencement of vitrectomy. PVR classification was based on the 1983 Retina Society Terminology Committee classification.[10] This classification divided PVR into four stages, A, B, C, and D, by increasing its severity from minimal to massive PVR.

Data on anatomical and visual outcomes obtained from the case record was categorized. Anatomical outcome: Anatomical reattachment was the primary outcome. Retina attachment was assessed as the retina status at the last visit and categorized as "attached" if the retina was wholly attached or "detached" if any portion of the retina was detached. In each case, redetachment after initial successful primary surgery was specifically assessed, and the outcome of re-operation was

documented. The single operation surgical attachment success rate was determined.

Visual outcome which was the secondary outcome was assessed using Snellen visual acuity. Preoperative acuity and acuity at the last visit were assessed. Visual outcome was categorized as "improved" if postoperative visual acuity was better than preoperative. It was categorized as "same" if preoperative and postoperative were same, and "worse" if the preoperative visual acuity was better than postoperative.

An analysis of the effect of preoperative and intra operative variables on anatomical and visual outcome was done. Preoperative variables were categorized as following. Etiology of GRT RD was categorized into idiopathic, trauma, and myopia. Quadrants of RD were categorized into one quadrant, two to three quadrants, and four quadrants (i.e., total retinal detachment). Giant retinal tear size was categorized into 90 degrees, 90 – 180 degrees, and > 180 degrees. Macula involvement (indicating the involvement of the macula by RD), was categorized as macula involved (Off) or macula not involved (On). Circumferential SB was categorized as "Yes" (use of SB) or "No" (SB not used). Crystalline lens status could be aphakia, cataract, phakic–clear lens, or posterior chamber intraocular lens. Lastly, rolled over retina was categorized as "Yes" (there is a rolled over retina) or "No" (retina was not rolled over).

Data Management

Data were analyzed using IBM SPSS version 22.0 (IBM Corp. Armonk, NY, USA). Data were entered into an Excel spreadsheet and transferred to SPSS for analysis. Frequencies and percentages were used to summarize categorical variables. Crosstabulations of variables against study outcomes (primary anatomic attachment and visual outcome) were done. Pearson Chi-square test and Fisher's exact were used to determine statistical significance, and a P-value <0.05 was deemed statistically significant.

Results

Thirty-six eyes of 36 patients were included in this study. There were 30 males (83.3%) and a male to female ratio of 5:1. The modal age of patients in this study was 60 years, mean of 45.53 ± 13.2 years (range 12 - 65 years). Age of participants are presented in **table 1**; 40 – 59-year age group accounted for most patients, 21 patients (58.4%).

Table 1: Age distribution of study participants.

Age Range	**Frequency (%)**
10 - 19	2 (5.5%)
20 - 29	3 (8.3%)
30 - 39	4 (11.1%)
40 - 49	11 (30.6%)
50 - 59	10 (27.8%)
60 - 69	6 (16.7%)
Total	**36 (100%)**

There were twenty-three (63.9%) left eyes. Etiology was mostly Idiopathic (22 eyes, 61.1%), trauma related in eight eyes (22.2%) and six myopic eyes (16.7%). One eye was aphakic (2.8%), 20 eyes (55.6%) had a cataract, and 12 (33.3%) phakic eyes with a clear lens. Three eyes (8.3%) were pseudophakic.

Preoperative characteristics of the GRT RD are as follows. A rolled-over retina in 22eyes (61.1%). GRT size: twenty eyes (55.6%) had a tear 90° - 180°, 12 eyes (33.3%) had tears >180°, and four eyes (11.1%) were 90° in size. Most of the RDs were macula involving (off) (33 eyes, 91.7%). Four quadrants (total) RD was present in 20 eyes (55.6%), 13 eyes (36.1%) had a single quadrant involvement, while three eyes (8.3%) had 2-3 quadrants involved. There was advanced PVR in 29 eyes (C + D = 83%). Intraoperative variables include encircling SB use in 9 eyes (25%), perfluorocarbon liquid and 1000CS silicon oil tamponade use in all 36eyes. **Table 2** summarizes the independent variables and characteristics of GRT RD.

Fifteen eyes (41.7%) out of the 36 eyes had a single surgery anatomic success, while 21 eyes (58.3%) re detached after initial attachment due to re proliferation of PVR. Sixteen eyes (44.4%) had a re-operation for recurrent RD. Final anatomic attachment after repeat vitrectomy was thirty-one eyes (86.1%), while 5 eyes (13.9%) remained detached.

Thirty-two eyes (88.9%) had preoperative vision less than 3/60, 2 eyes (5.5%) had vision of 6/18 and better, and two eyes (5.5%) 6/60 to 6/24, **table 3**. Post operative vision was counting fingers or better in twenty-three eyes (63.9%).

There were nineteen eyes with postoperative vision better than preoperative vision. Five of these eyes had retina attachment after a single surgery, while 14 (73.7%) were eyes that suffered a re-detachment and improved after a second surgery. Therefore 14 of 21 eyes that had a re detachment had a better post operative visual outcome and this was statistically significant, p=0.048. There was statistically significant association between surgical intervention, anatomic success, and eyes with a better postoperative visual outcome (p=0.045) and eyes with the same vision as preoperative (p=0.008). Details of the preoperative and postoperative vision is represented in **table 3**.

An analysis of independent preoperative retina variables on improved visual outcome revealed that eyes with macula "on" had a better visual outcome. Eyes with greater than 90 degrees of retina tear tended to have a poorer visual outcome. Eyes with PVR C had a decreased likelihood of improved vision than PVR B. Trauma cases were less likely to have improved vision. Lastly, eyes with 2 – 3 quadrant RD had a higher chance of improved vision than eyes with a total (4 quadrants) RD. However, none of these factors reached statistically significant, as the P was >0.05 in all cases, **table 4**.

Twenty-seven eyes (75%) had surgery without using a scleral buckle, while in 9 eyes (25%), a scleral buckle was used. In the scleral buckle group, six eyes (66.7%) developed a redetachment compared to 15 eyes (55.6%) in the non-scleral buckle group (p=0.343). The retinal redetachment rate was higher in the scleral buckle group.

Table 2: Patient demographics and pre operative characteristics of giant retinal tear.

Variable		**Number (N)**	**Percentage (%)**
1. Gender	Male	30	83.3
	Female	6	16.7
2. Laterality	Right eye	13	36.1
	Left eye	23	63.9
3. Lens status	Cataract	20	55.6
	Phakic	12	33.3
	Pseudopahakia	3	8.3
	Aphakia	1	2.8
4. Rolled over retina	Yes	22	61.1
	No	14	38.9
5. Quadratic affectation	1 quadrant	13	36.1
	2 to 3 quadrants	3	8.3
	4 quadrants (total detachment)	20	55.6
6. Size of retinal tear	90 degrees	4	11.1
	90 to 180 degrees	20	55.6
	>180 degrees.	12	33.3
7. Macular status	On	3	8.3
	Off	33	91.7
8. Scleral Buckle	Yes	9	25
	No	27	75

Table 3: Pre and postoperative visual acuity of the 36 eyes.

Snellen Visual Acuity	Pre operative (n)	Post operative (n)
6/6	1	
6/9		
6/12		1
6/18	1	
6/24	1	
6/36		4
6/60	1	5
CF	15	13
HM	15	10
PL	2	3
Total	**36**	**36**

CF: Counting Fingers, HM: Hand Motion, PL: Perception of Light.

Table 4: Association between variables, single surgery retinal attachment, and improved visual outcome.

Variable		Single surgery success (retinal attachment) N=15(%)	P value	Better post operative visual outcome N=19(%)	P value
1. Gender	Male	14 (93.3%)	0.200*	14 (73.7%)	0.408*
	Female	1 (6.7%)		5 (26.3%)	
2. Laterality	Right eye	5 (33.3%)	0.769	5 (26.3%)	0.196*
	Left eye	10 (66.7%)		14 (73.7%)	
3. Lens status	Phakic	13 (86.7%)	0.472	19 (100%)	0.081
	Pseudophakia	2 (13.3%)		-	
	Aphakia	-		-	
4. Rolled over retina	Yes	3 (20%)	0.083*	10 (52.6%)	0.097*
	No	12 (80%)		9 (47.4%)	
5. Quadratic affectation	1 quadrant	6 (40%)	0.89	7 (36.8%)	0.204
	2 to 3 quadrants	1 (6.7%)		3 (15.8%)	
	4 quadrants (total detachment)	8 (53.3%)		9 (47.4%)	
6. Size of retinal tear	90 to 180 degrees	9 (60%)	0.473	15 (78.9%)	0.158*
	>180 degrees.	6 (40%)		4 (21.1%)	
7. Macular status	On	-	0.250	2 (10.5%)	
	Off	15 (100%)		17 (89.5%)	
8. Scleral Buckle used	Yes	3 (20%)	0.705*	6 (31.6%)	0.451*
	No	12 (80%)		13 (68.4%)	
9. PVR	B	4 (26.7%)	0.369	5 (26.3%)	0.469
	C	9 (60%)		13 (68.4%)	
	D	2 (13.3%)		1 (5.3%)	
10.Aetiology	Idiopathic	11 (73.3%)	0.328	12(63.2%)	0.538
	Myopia	1 (6.7%)		4 (21.1%)	
	Trauma	3 (20%)		3 (15.8%)	

* p value- Fishers exact

Assessing the effect of PVR grades on anatomical outcome, seven eyes (19.4%) had PVR grade B, 26 eyes (72.2%) had grade C, and three eyes (8.3%) grade D. Of the seven PVR B, 4 (57.1%) achieved primary anatomic attachment while of 9 (34.6%) of the 26 PVR C had primary anatomic attachment. Two (66.7%) of three PVR D eyes had primary anatomic attachment, **table 5**. The primary reattachment rate was highest in PVR D (66.7%), followed by PVR B (57.1%), and least in PVR C (34.6%). However, the difference was not statistically significant, **Table 4** (P = 0.369)

Table 5: Analysis of PVR grades on single surgery reattachment rates.

			Primary Attachment Achieved		Total
			NO	YES	
PVR Grade	PVR B	Number of eyes	3	4	7
		% within PVR B	42.9%	57.1%	100.0%
	PVR C	Number of eyes	17	9	26
		% within PVR C	65.4%	34.6%	100.0%
	PVR D	Number of eyes	1	2	3
		% within PVR D	33.3%	66.7%	100.0%
Total		Total number of eyes	21	15	36

NO = Primary retina attachment not achieved. YES = Primary retina attachment was achieved.

Discussion

This study represents a single unit's real-world outcome of the repair of a challenging series of GRT associated RDs complicated with advanced PVR. We sought to determine which factors influenced or contributed to the single surgery anatomical success and improved vision. Single surgery reattachment rate was 41.7% and a final attachment rate of 86% after a second surgery. The single surgery success we report is less than previous published reports, but the final reattachment rate is like other reports.[11 -13] Also, recurrent RD rate was higher in our series than in other reports, ie 16% and 22% compared to our report of 58.3%.[7,13] This can be explained by the much higher rate of preoperative PVR, 83% in our patients. Recurrent RD in our series was due to reproliferating membranes from the preoperative PVR process in all cases. Other reports also noted PVR to be responsible for high number of recurrent detachments, 70% and 50%.[12,13] Ghasemi et al agree with our observation as they reported a high rate of repeat vitrectomy in GRT eyes with preoperative PVR in their series consisting of 62 eyes with PVR in 22.6%.[14] PVR is the commonest cause of failure of a primary retinal reattachment surgery.[9,12,15] Therefore, a high rate of preoperative PVR in our series suggests higher postoperative PVR and a poorer anatomical outcome. PVR also has a damaging effect on vision.[9,16,17]

Treatment of PVR is surgical. Formation and contraction of the pre and subretinal membranes from PVR result in new retinal breaks with a tractional component.[15] Surgical techniques utilized in the management of advanced PVR include highlighting and removal of epiretinal membranes. The use of vital dyes to stain epiretinal tissue and internal limiting membrane, making them more visible and facilitating their manipulation during vitreous surgery has been termed chromovitrectomy.[18] Highlighting epiretinal membranes facilitates its removal with the use of various pics and membrane forceps. In some cases, internal limiting membrane peeling is performed to guarantee the removal of tractional elements from the retina and reduce the postoperative risk of reproliferating membranes. Retinotomy and retinectomy have also been used in the surgical management of PVR.[9,19 -22] At the time of surgeries in the series reported, chromovitrectomy was not in common use in the department, and meticulous or extensive epiretinal membrane and ILM peeling was not performed. The high rate of reproliferating membranes in our study and redetachment confirms the usefulness of meticulous membrane peeling and possibly ILM removal in such PVR cases.[23,24] The availability and use of these techniques would have improved the odds against reproliferation and recurrent RD.

Absence of post operative PVR has been associated with better outcome.[25] PVR is a significant association of GRT.[26,27] Our study reports the highest rate of PVR published in GRT eyes of studies reviewed. In this study, 60% (9 of 15 eyes) that achieved primary anatomic attachment and better visual outcome (68.4%) were PVR C eyes, table 4. The study sample had more PVR C eyes (26 / 36, 72.2%), skewing the findings in favor of PVR C. However, the observation that only 9 / 26 eyes (36.4%), of all PVR C eyes were primarily attached, suggests a lower rate compared to the other PVR grades, table 5. We did not find any significant association between PVR grade and

single surgery anatomic attachment (p=0.369) or better visual outcome (p=0.469). PVR D GRT have been successfully attached by Glaser et al who reported successful attachment in 9 of 10 PVR D eyes, with improved vision in 8.[26] We also observed similar findings, reattaching 2 of 3 PVR D eyes.

Males achieved a higher primary anatomic attachment (93.3%) and better visual outcome (73.7%). Our study had more males than females. We did not find a significant association between gender and rate of primary anatomic attachment or better visual outcome (p=0.200 and 0.408, respectively). Male gender has been associated with a higher risk of pseudophakic, rhegmatogenous RD and macula "off" RRD, according to findings reported by Qureshi et al, McCullagh et al and Xu et al. [27-29] Non-white, fovea involvement and male gender were additional risk factors for reoperation and poor outcome according to Xu.[29] Contrary to reports of right eye dominance of RRD,[30] we found a much higher rate of GRT in the left eye. Other studies have reported an almost equal prevalence of GRT between the right and left eyes.[11,7] We did not find any association between GRT laterality and single surgery success or improved visual outcome (p=0.769 and 0.196, respectively).

A large sample sized study on GRT by Al-Khairi et al. reported that the presence of a phakic clear lens at presentation was associated with improved visual outcome.[25] Our study agrees with Al-Khairi reporting 86.7% of eyes that achieved single surgery anatomic attachment were phakic, and all eyes with better visual outcomes being also phakic.

A significant finding of this study concerns the utility and effectiveness of the combined use of SB in surgery for GRT. 80% of eyes with primary anatomic attachment did not have SB used, and likewise, 68.4% of eyes with better postoperative visual outcome did not have SB use either. Using a SB was not associated with primary anatomic success (p=0.705) or better visual outcome (0.451), implying that use of a SB did not improve anatomical or visual outcomes compared to non-use. This finding collaborates findings of other studies. Two recent studies reported that the addition of a SB did not improve the outcome of surgery,[12,7] supporting our observation. Benefit of additional SB in children < 18years was established in one study.[12] Several other studies have equally reported non superiority of SB use over nonuse.[1,13,17,30] In one study SB use was associated with a higher rate of reoperation.[14] Yet Al-Khairi et al noted a beneficial effect of SB use, and observed that placement of an encircling SB and use of silicone oil tamponade were associated with anatomic reattachment with primary procedure.[25] A significant challenge in answering the question of benefit of SB for GRT is the absence of large prospective studies due to the low rate of GRT occurrence and the multiplicity of presentation and heterogenous nature of the disease. Therefore, comparison between studies is hampered. Requirements of a randomized clinical trial of GRT to answer the question have been summarized by Gutierrez et al.[31]

Quadratic involvement of RD did not affect the single surgery anatomic success (p=0.898) or improved visual outcome (p=0.204) since more than half of 15 eyes that achieved primary anatomic success had four quadrants of the retina involved. Furthermore, almost half of the eyes with four quadrants involvement, had better visual outcomes. However, previous reports on RRD suggest that four quadrant involvement by the RD is a poor prognostic feature. In a retrospective comparative study Sung et al showed that patients with total RRD had higher recurrence rate and poorer visual outcome after surgery than patients with focal RRD.[32] Considering the entire study cohort, we also observed that, eyes with 2 – 3 quadrant retinal detachment had a higher chance of improved vision than eyes with a total (4 quadrants) retinal detachment.

Interestingly the size of the retina tear was not significantly associated with primary anatomic success. Only 13.3% of eyes that achieved primary anatomic attachment had 90 degrees of retina tear size. The GRT size did not influence the visual outcome since the p value was slightly above the cut off (p=0.066). This could be explained by the fact that a multiplicity of other factors including PVR, duration of retinal detachment also had an influence on the outcome and could alter the effect of the tear size. However, smaller size GRT have been associated with better visual outcome according to one report.[11] While larger size breaks have been associated with poor visual outcome.[17]

Almost all the eyes in our study had a macula involving RD. In the analysis, eyes that achieved primary anatomic attachment had macula-off, and the majority (89.5%) of the eyes with better visual outcomes had macula-off preoperatively. Our finding suggests that eyes presenting with macula off could still have significant improvement in vision. However, Ting et al report macula detachment to be associated with poorer vision.[17] Other studies on RRD have reported on the negative effect on visual outcome of macula detachment and duration of the detached macula.[33-35]

The etiology of GRT was not significantly associated with primary anatomic attachment and visual outcome (p=0.328 and 0.538, respectively). However, there was a tendency for trauma related

GRT eyes to have a poor visual outcome, possibly related to the other visual damaging effect of the trauma on the eye. We report idiopathic GRT as the most common cause of GRT, which agrees with other reports.[1,13] Lattice degeneration and myopia were more significant etiology in the report by Gonzalez et al.[11]

Study limitations

The retrospective nature of the study prevents the ability to eliminate bias. There are many more male eyes, PVR C, total RD and macula "Off," which affects balanced comparison between the groupings. The older version of the PVR classification does not consider anterior PVR. The use of 20 gauge, which is no longer the standard practice, also prevents a proper comparison with other studies in which MIV was used. However, this study presents a real-life reporting of outcomes of a rare form of RD with high level of complexity offered by high rate of PVR (indeed the highest rate of PVR reported in any series on GRT based on search performed using PubMed) in a low-resource setting. It is useful when comparing other reports from a similar setting and reporting outcomes in eyes with high rates of significant PVR.

Conclusion

The single surgery anatomic success of a series of vitrectomized eyes for GRT with advanced PVR trails behind the outcome in series with lower PVR rates. This report suggests that meticulous peeling of ERM and ILM is beneficial in the setting of PVR GRT RDs. This can be enhanced through adequate visualization using vital dyes. Surgical success in this category of complex RDs may require more than one attempt, and visual improvement is limited by the effect of PVR. An additional SB does not appear to improve anatomic outcomes in GRT with advanced PVR since reproliferating membranes are the major problem inducing a tractional effect and redetaching the retina from the indentation induced by the SB.

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