

Original Article

Anatomical and functional outcomes of retinectomies in retinal detachments complicated by proliferative vitreoretinopathy



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Abstract

Purpose: To study anatomical and functional outcomes of retinectomies in rhegmatogenous retinal detachments complicated by proliferative vitreoretinopathy.

Methods: This is a retrospective interventional consecutive case series of eyes with rhegmatogenous retinal detachments complicated by advanced proliferative vitreoretinopathy and managed by relaxing retinectomy over a period of seventeen years. Three-port pars plana vitrectomy included core vitrectomy and removal of all epi-retinal membranes. On failure to flatten, retina was cut and excised. Basal vitrectomy and removal of anterior flap of retina then followed. Silicone oil was used as tamponade in majority of cases. The dependent variables were anatomical and functional outcomes. The statistical analysis was performed on SPSS 21.

Results: Series included 370 eyes of 337 patients. Mean follow up was 39 months. Scleral explant was used in 90(24.39%) cases. Two hundred and nine (56.49%) eyes were operated with trans conjunctival sutureless vitrectomy technique. Procedure was bilateral in 33 patients (9.79%). Retina attached in 311(84.05%) eyes after initial surgery. Final re-attachment after one or more surgeries was achieved in 344(92.97%) eyes. Two hundred and eleven (57.02%) cases achieved visual acuity of 6/60 or better.

Conclusion: Relaxing retinectomies have good and encouraging anatomical and functional outcomes. This surgery can be effectively carried out with trans conjunctival sutureless vitrectomy technique.

Keywords: Retinotomy and retinectomy, Proliferative vitreoretinopathy, Trans conjunctival sutureless vitrectomy, Silicone oil

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Introduction

Proliferative vitreoretinopathy (PVR) is a complex cellular reaction representing a vitreo-retinal wound healing response characterized by formation of periretinal non-vascular fibrocellular membranes, intraretinal fibrosis and subretinal bands, and is a major cause of surgical failure of rhegmatogenous retinal detachment (RRD) surgery.¹ Relaxing retinectomy (RR) is performed to cut or excise the stiff

retina in the process of treating RRDs complicated by advanced PVR and is an effective procedure for flattening the retina as an adjuvant to vitrectomy. It is an attempt to salvage the visually significant posterior retina by excising the fibrotic peripheral retina.^{2,3}

In current surgical practice RR involves pars plana vitrectomy (PPV) with scleral explant, as primary pars plana vitrectomy (PPPV) without scleral explant along with stiches to scleral ports and PPV with no stiches performed by trans

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conjunctival sutureless vitrectomy (TCSV) technique. The availability of better instrumentation and visualization, and use of perfluorocarbon liquids (PFCL) as surgical tool⁴ has made the retinal surgeon do a lot that could not be done in past. The use of scleral explants once common in RR is on decline in present era.⁵ The Silicone Study Group⁶ reported 19% primary >180° retinotomy, Faude et al.⁷ reported 15% primary 360° retinotomy and Tseng et al.⁸ reported 64.2% primary retinectomies in their series of 81 retinectomies. Quiram et al.⁹ advocated radical anterior vitreous base dissection and lensectomy in retinectomy with complex PVR-related retinal detachments (RD). Vitreous base shaving and excision of anterior flap of retinectomy is becoming part of RR.¹⁰ Complicated retinal surgical procedures are increasingly being reported with TCSV technique.^{11,12} As a result of all these advances reports for better anatomical re-attachments and visual outcomes about the efficacy of RR are on increase.^{10,13}

Our study presents anatomical and functional outcomes of the largest case series undergoing RR in RDs complicated by PVR over a period of 17 years (1999–2015). The study also reflects and gives insight into incorporation of above-mentioned advances into practice.

Patients and methods

This is a retrospective interventional case series of consecutive surgeries of PPV with retinectomies in 370 eyes of 337 patients from January 1999 to June 2015 in patients with RRDs complicated by advanced PVR. Series includes patients with a minimum follow up of six months. Approval by Institutional Review Board was obtained for this retrospective study. All patients signed an informed consent form before the procedure. Surgeries were performed by a single surgeon (MIA) at Civil Hospital, Dow University of Health Sciences and at Hashmani Hospital, Karachi, Pakistan. Patients with trauma, proliferative diabetic retinopathy, retinal incarceration, inflammatory eye diseases, retinopathy of prematurity, and giant retinal tears were not included in this study. Surgeries were performed using Associate (DORC), Accurus (Alcon), Pulsar 2 (Optikon) and Constellation (Alcon) vitrectomy machines.

Data were collected in accordance with compliance guidelines outlined by the Declaration of Helsinki. Medical records of all these patients were reviewed, and age, sex, ophthalmic

history, preoperative and postoperative visual acuity (VA) and intra ocular pressure (IOP), notes of anterior segment and fundus examinations, and intraoperative or postoperative complications were obtained. The cases included had Grade C Posterior and Anterior PVR evaluated intra-operatively by modified Retinal Society Classification.³ (Table 1) Information collected also included number of prior vitreo-retinal surgeries, type of temponade used, extent of retinectomy, removal of silicone oil (ROSO), number of surgeries and complications encountered during operative and postoperative period.

Surgeries in this series were performed under general anesthesia. Peritomy around limbus, and encirclement with solid silicone band along with buckle was performed in the initial period in 90(24.32%) cases. Three scleral ports were made 3.5 mm from the limbus for PPV in phakic eyes and at 3.00 mm from limbus in aphakic and pseudophakic eyes. Later on procedure was done as PPPV in 71(19.19%) eyes without explants. Crystalline lens was removed as part of procedure in all phakic patients. Lensectomy was performed in 16(4.32%) cases. Phacoemulsification with intraocular lens (IOL) implantation was performed in 246(66.49%) phakic eyes. This procedure was done prior to making ports for PPV. In all patients undergoing phacoemulsification with IOL, central posterior capsulotomy with vitreous cutter was performed as a routine procedure. In later part of series, from 2006 onwards, all 209(56.49%) cases were performed with 23 Gauge and 20 Gauge TCSV technique.

Surgeries were performed using binocular indirect ophthalmology microscope (BIOM) as wide-angle system. Triamcinolone acetate (TA) was used in the later part of series to identify vitreous and epi-retinal membranes (ERM). Core-vitrectomy was performed and careful identification and meticulous removal of surface retinal fibrous proliferations was carried out in all cases. The Silicone oil (SO) was removed, when present in referred cases, or as a part of repeat surgery in re-detachments, by active aspiration in the initial part of series and by passive method through non-valved cannulae in later part of the series. Corneal epithelium was removed with cotton bud whenever intra-operative corneal edema interfered in visualization mostly seen in eyes with preoperative hypotony. The decision to perform retinectomy was made only after maximal removal of surface fibrous proliferations failed to adequately release retinal traction, in presence of visible contracted retina and presence of sub-retinal fibrosis thought to be contributing

Table 1. 370 cases of retinotomies and retinectomies in PVR. (Grading of PVR According to Modified Retinal Society Classification 1991).³

PVR grading	PVR type	Eyes	Extent of retinectomy
CP 10 to CP 12 CP 12 to CP 02 CP 03 to CP 05 CP 07 to CP 09	Type 1 Focal/Type 2 Diffused, + - Type 3 Subretinal strands	126 (34.05%)	90°
CA 09 to CA 03 (Superior Retina) CA 09 to CA 03(Inferior Retina)	Type 1 Focal/Type 2 Diffused, + - Type 3 Subretinal strands	105 (28.38%)	180°
CA 01 to CA 12 360° Retina	Type 1 Focal/Type 2 Diffused, + - Type 3 Subretinal strands Type 4 Circumferential Contraction Type 5 Anterior displacement	139 (37.57%)	360°

PVR = Proliferative Vitreoretinopathy, C = Grade C PVR, which denotes full-thickness rigid retinal folds. Extent of PVR is expressed by number of clock hours of the retina involved (1–12). CP denotes PVR predominantly posterior to vitreous base and equator, CA denotes PVR anterior to equator up to ora serrata and beyond. Further description of CP PVR and CA PVR describes contraction types such as Type 1 (Focal), Type 2 (Diffused), Type 3 (Subretinal strands), Type 4 (Circumferential contraction), and Type 5 (Anterior displacement).

Machemer R, Aaberg TM, Freeman HM, Irvine AR, Lean JS, Michels RM. An updated classification of retinal detachment with proliferative vitreoretinopathy. *Am J Ophthalmol* 1991;112:159–165.

to failure in flattening the retina or after evidence of sub-retinal migration of PFCL or air.

The retinal tissue aimed for cutting, was cauterized over the visible vessels and retina was cut with curved scissors in some cases, and with vitreous cutter in vast majority of the cases. The fibrosis seen under surface of retina was removed under direct visualization. Infusion bottle was lowered to avoid rotation and mobility of free posterior flap of retina after retinectomy during sub-retinal surgery.

PFCL was used to stabilize retina during the excision of retina and as an operative tool to flatten retina after removal of all surface retinal fibrosis and sub-retinal fibrosis. The extent of retinectomy varied from less than 90°, 180° or 360° depending upon visible contraction of the retina and behavior of retina under PFCL. The retinectomy was extended circumferentially as far as necessary to relieve all traction and contraction of retina. The migration of PFCL under the retina necessitated further excision of retinal tissue.

The bleeding encountered was controlled by raising the infusion bottle height and with the help of endo-cautery when needed. If seen folded under PFCL, the retina was rotated with the help of retinal spatula and/or Tano's brush to bring the macula in position. Both these instruments were also used to make the edges of the cut retina smooth and tension free. The anterior flap of the cut retina was removed with vitreous cutter and a basal vitrectomy with scleral indentation was carried out under direct visualization of operating microscope. Three to four rows of endo-photocoagulation were applied posterior to free edge of the cut retina. PFCL was directly exchanged with SO. SO of 1000 Centistokes (CS) or 5000 CS was used in 302(81.62%) cases as internal tamponade. Prior to injection of SO, in aphakic eyes, Ando iridectomy at 6 o'clock was performed. The PFCL air exchange followed air-gas exchange in 68(18.38%) cases. In 38(10.27%) cases 15% Perfluoropropane (C₃F₈) and in 30 (08.11%) eyes 20% Sulfur-hexafluoride (SF₆) gases were used as tamponade. The ports and conjunctiva were closed with 6/0 vicryl in 161(43.51%) eyes. In 209(56.49%) eyes operated with TCSV technique, gentle pressure and massage on the ports for 30–40 s was applied to achieve the closure of the ports. Anterior segment migration of SO bubble when seen near the end of the surgery was managed by injection of viscoelastic in the anterior chamber. In eyes which had corneal epithelium removed during the procedure, a bandage contact lens was inserted on the cornea which was retained till complete healing of the epithelial defect during postoperative period. The patients were hospitalized for one day and were seen on the 1st postoperative day, after a week, after a month for two visits and then at 3 months interval. During all visits the visual acuity, intraocular pressures, and anatomical state of the retina were recorded.

SO was removed by three-port PPV using active aspiration technique. Active aspiration replaced passive ROSO in TCSV technique from 2006 onwards. For 1000 cs SO 23 G TCSV technique, and for 5000 cs SO 20 G TCSV technique was used. All the visible pre-retinal surface retinal membranes, if present over the macula or around the retinectomy scars were removed during the process of ROSO. In all cases 2–3, and in cases of emulsified SO, 5–6 fluid-air exchanges were made as standard procedure using Charles flute needle to ensure complete ROSO, and fine droplets of SO. This was

followed by 2–3 rows of endo-photocoagulation posterior to the scar of the cut margins of retina carried out in the process of RR. Fluid – air exchange then followed. In high risk cases air was exchanged with 20–30% SF₆ or 15% C₃F₈. In cases of on-table retinal re-detachments during ROSO, re-detachments after ROSO and in re-detachments secondary to re-proliferations, identification and meticulous removal of the proliferative fibrosis on and under the surface of retina was done and PFCL was used as operating tool. Further extension of the retinectomy, if required, was carried out followed by endo-photocoagulation and 5000 cs SO injection.

The collected data was analyzed by SPSS 21 on computer and presented in form of mean ± S.D, and Tables. Preoperative and post-operative Snellen's visual acuity was transcribed into logarithm of minimal angle of resolution (Log MAR) for statistical analysis. Paired student t-test and chi-square were used where appropriate for quantitative and qualitative data. Correlation studies and regression analysis were carried out to study the relationship and predictability of some independent variables on the dependent variables (functional and anatomical outcomes). A p-value less than 0.05 were considered as statistically significant.

Results

Three hundred and seventy eyes of 337 patients were analyzed, (Table 2). Two hundred and twenty-five (66.77%) patients were males and 112(33.23%) were females. Mean age of patients was 42 ± 18.53 years (range 5–85 years). Median follow up was 39 months (Range: 6–168 months). Right eye was operated in 186(50.27%) cases and left eye was operated in 184(49.73%) cases. In 33(9.79%) patients the procedure was done in both eyes. Twenty-six patients (7.71%) were only-eyed.

One hundred and sixty-one eyes (43.51%) were operated by 20 G with-suture (WS) technique. This includes 90 (24.32%) eyes where scleral buckle and encircling band were used along with PPV. In 71(19.19%) eyes the procedure was carried out as PPPV without using any explants. Two hundred and nine (56.49%) eyes were operated with TCSV; out of which 110(29.73%) eyes were operated with 20 G TCSV and 99(26.77%) were operated with 23 G TCSV technique.

Fifteen (4.05%) eyes were aphakic, 93(25.14%) eyes were pseudophakic and 262(70.81%) eyes were phakic. In phakic group 16(4.32%) eyes had lensectomy, and in 246(66.49%) eyes, phacoemulsification with intraocular lens (IOL) implantation was carried out as part of the procedure. Forty-seven (12.70%) eyes had previous vitreo-retinal surgeries. SO (1000 cs and 5000 cs) was used as tamponade in 302 (81.62%) eyes. Longstanding gases (20% SF₆ or 15% C₃F₈) were used in 68(18.38%) eyes.

The extent of retinectomies varied from up to 90° in 126 (34.05%) cases, 180° in 105(28.38%) and 360° in 139 (37.57%) cases. Fifty-two (14.05%) eyes had re-detachments secondary to re-proliferations. Another group of retinal re-detachments were seen after ROSO.

Seventy-one (19.19%) eyes had ROSO in this series. The indications for ROSO in 71 eyes were emulsification of silicone oil (EOSO) in 39(54.9%) eyes, glaucoma in 21(29.0%) eyes and EOSO with glaucoma in 11(15.%) eyes.

The operative findings in these 71 eyes with undergoing ROSO included 37 (53.62%) with no evidence of

Table 2. 370 cases of retinotomies and retinectomies in PVR.

Age	Mean (Range) 2 ± 18.53 (5–85 years)	
<i>Baseline data</i>		
<i>Follow up</i>	Median/Range 39 Months (6–168 Months)	
<i>Sex</i>		
Male	225(66.77%)	
Female	112(33.23%)	
Total	337(100%)	
<i>Pre-op visual acuity</i>		
Up to 6/18	06	01.62%
6/24–6/60	65	17.57%
F C to HM to PL	299	80.81%
Total	370	100%
<i>Lens status</i>		
Phakic	262	70.81%
Pseudophakic	93	25.14%
Aphakic	15	04.05%
Total	370	100%
<i>Previous V/R Surgery</i>	47	12.70%
<i>Temponade used</i>		
Silicone Oil	302	81.62%
SF6/C3F8	68	18.38%
Total	370	100.00%
<i>Extent of retinectomy</i>		
Up to 90°	126	34.05%
180°	105	28.38%
360°	139	37.57%
Total	370	100.00%
<i>Type of Surgery</i>		
PPV With Sutures	Buckle/Band & PPV 90	24.32%
	Primary PPV 71	19.19%
Sub-total with-sutures	161	43.51%
TCSV	TCSV 20 G 110	29.73%
	TCSV 23 G 99	26.77%
Sub-total TCSV	209	56.49%
Total	370	100%

re-proliferation, 14 (20.29%) had focal re-proliferation, 2 (2.89%) showed both diffused and focal fibrosis which were peeled off during the surgery. Five (7.25%) eyes developed re-proliferation around the sites of retinectomies and needed extension of retinectomies.

Out of these 71 eyes undergoing ROSO, 20 (28.17%) had retinal re-detachments. Three eyes (4.23%) detached on table, 2(2.82%) eyes re-detached within 2–3 weeks, 9 (12.68%) eyes re-detached within 2–3 months, 3 (4.23%) eyes re-detached within 4–6 months and 3 (4.23%) eyes re-detached after more than 1 year out of which one only-eyed patient presented with re-detachment 5 years after ROSO.

Three eyes with re-detachment on table had to undergo further surgical procedure and reinjection of SO. Two patients refused further surgical intervention and went lost on follow up. Remaining 15 patients with re-detachments were re-operated which involved removal of proliferative tissue and extension of retinectomies along with reinjection of SO. Retina remained flat in 66 eyes (92.96%) and none of these patients developed hypotony. In 3 (4.23%) eyes retina could not be re-attached and in these eyes mean IOP was 02.

Out of the total of these 72(19.46%) retinal re-detachments in this series of 370 eyes, which includes 20

re-detachments following ROSO, in 43(11.62%) eyes retina flattened after repeat surgery. Twelve patients (3.24%) refused further surgery and in 17(4.59%) eyes retina could not be flattened even after repeat surgery. Average number of surgeries performed on one patient was 1.36. ROSO was not considered as repeat surgery. When prior surgeries are included, the average number of surgeries rises to 1.71.

Anatomical and functional outcomes and influence of independent variables on these dependent variables are summarized in Tables 3–6.

Anatomical Outcome: The retina went flat after first surgery in 311(84.05%) eyes. After one or more repeat surgeries retina flattened in 344(92.97%) eyes. Binary regression analysis for predictability on anatomical outcome of retina showed statistically significant results for preoperative visual acuity (p 0.003, OR 2.5, CI 1.36–4.64). The technique of surgery, type of temponade and size of retinectomy did not show statistically significant predictability value on anatomical outcome.

Visual Acuity: Mean pre-operative Log MAR improved from 2.33 ± 0.83 to mean postoperative Log MAR 1.48 ± 0.92 ($p = 0.000$). The number of cases with visual acuity of 6/60 or better increased from preoperative 71(19.19%)–211(57.02%). Linear regression analysis for predictability for preoperative visual acuity showed statistically significant positive but very low predictive values on visual outcome (p 0.007, R 0.16, CI 0.044–0.273). The technique of surgery and type of temponade did not show any predictability on visual outcome. Although visual field defects are inherent to the procedure, the assessment of this visual function was not carried out in present series.

IOP: Mean preoperative intraocular pressure (IOP) $11.90 \text{ mmHg} \pm 5.18$ rose to mean postoperative IOP $13.80 \text{ mmHg} \pm 8.04$ (p 0.000) (Table 7). Hypotony defined as IOP of 5 mmHg or less was noted in 24(6.49%) eyes. Fifty-seven (15.40%) eyes developed IOP of more than 25 mmHg and were defined as eyes with secondary glaucoma. Pre-operative IOP had statistically significant predictive value on anatomical outcome (p 0.012, OR 0.883, CI 0.801–0.973) and post-operative IOP showed statistically significant but low predictive value on functional outcome (p 0.35, R 0.13, CI 0.001–0.24). The type of temponade had no statistically significant relationship with postoperative IOP. None of the patients with flat retina after ROSO developed hypotony.

Complications: The complications encountered in operative and postoperative period are presented in Table 8. The commonest operative complication was intraoperative bleeding and was encountered in 80 (21.62%) cases. The most common postoperative complication seen was fibrin formation in the pupillary area seen in 85 (22.97%) eyes. Re-proliferation leading to retinal re-detachments and post ROSO re-detachments were seen in 72 (19.46%) eyes.

Discussion

Advances in surgical management and techniques have significantly improved outcomes of complicated RD surgery.² Although visual acuity of eyes with complicated RDs with advanced PVR may be limited, the rationale for performing retinectomy surgery is well-established.¹⁴

Retinotomy is part of the procedure in macular rotation nowadays in which healthy peripheral retina is cut all around

Table 3. 370 cases of retinotomies and retinectomies in PVR. Comprehensive table of outcome variables. Functional outcome and anatomical outcome.

		Cases n(%)	Visual acuity (log MAR)		Anatomical outcome	
			Pre-Op Mean ± S.D	Post-Op Mean ± S.D	Flat after 1st surgery n (%)	Flat after 2nd or more surgeries n (%)
PPV WS	SBP& PPV	90(24.32)	3.34 ± 2.30	2.06 ± 2.53	73(81.11)	80 (88.89)
	PPPV	71(19.19)	2.31 ± 0.93	1.50 ± 0.94	59(83.10)	66 (92.96)
	Subtotal	161(43.51)	2.85 ± 1.13	1.78 ± 1.59	132(81.98)	146 (90.68)
TCSV	20 G	110(29.73)	1.89 ± 0.95	1.76 ± 1.05	95 (86.36)	106 (96.36)
	23 G	99(26.77)	2.06 ± 0.98	1.57 ± 0.96	84(84.85)	92 (92.93)
	Subtotal	209(56.49)	1.97 ± 0.97	1.68 ± 1.01	179(85.65)	198 (94.74)
Total		370(100)	2.33 ± 0.83	1.48 ± 0.92	311(84.05%)	344(92.97)

WS = With-Sutures, TCSV = Trans Conjunctival Sutureless Vitrectomy, PPV = Pars plana Vitrectomy, SBP = Scleral Buckling Procedure, PPPV = Primary Pars Plana Vitrectomy.

Table 4. 370 cases of retinotomies and retinectomies in PVR. Correlation studies. Influence of independent variables on dependent variables.

Independent variable	Anatomical outcome	Visual outcome
Age	r 0.083, p 0.112	r 0.072, p 0.164
Sex	r 0.083, p 0.112	r 0.034, p 0.511
PPV with-sutures or TCSV	r 0.036, p 0.495	r 0.054, p 0.302
Pre-operative visual acuity	r 0.261, p 0.000	r 0.240, p 0.000
Extent of retinectomy	r 0.017, p 0.747	r 0.156, p 0.003
Pre-operative IOP	r 0.074, p 0.156	r 0.025, p 0.635
State of eye: phakic, pseudophakic, aphakic	r 0.017, p 0.750	r 0.002, p 0.976
Lens surgery	r 0.066, p 0.202	r 0.031, p 0.558
Type of temponade used: Gas or SO	r 0.034, p 0.511	r 0.100, p 0.055

Table 5. 370 Cases of Retinotomies and Retinectomies in PVR. Binary regression. Dependent variable. Anatomical outcome—retina attached/detached.

Independent variables	ODD's Ratio	P Value	95% C I lower bound	95% C I upper bound
VAs Pre-operative	2.506	0.003	1.355	4.636
Pre-Op IOP	0.883	0.012	0.801	0.973
Post Op IOP	0.989	0.711	0.933	1.048
Extent of retinectomy	1.142	0.676	0.613	2.129
Gas or silicone oil temponade	0.855	0.785	0.278	2.635
Technique of surgery	0.655	0.100	0.396	1.084

Table 6. 370 Cases of retinotomies and retinectomies in PVR. Linear regression. Dependent variable – visual outcome – Log MAR VA's.

Independent variables	R	P Value	95% C I lower bound	95% C I upper bound
VAs pre-operative	0.159	0.007	0.044	0.273
Pre-Op IOP	-0.004	0.646	-0.022	0.014
Post Op IOP	0.013	0.034	0.001	0.024
Extent of retinectomy	0.155	0.005	0.046	0.265
Gas or silicone oil temponade	0.105	0.253	-0.076	0.286
Technique of surgery	-0.037	0.402	-0.124	0.050

Table 7. 370 Cases of retinotomies and retinectomies in PVR. IOP in different techniques. Pre-op IOP and Post-op IOP, (p 0.0000).

PPV technique	PPV n (%)	Pre-Op IOP mmHg Mean ± S.D	Post-Op IOP mmHg Mean ± S.D
PPV WS	SBP & PPV	90(24.32)	10.36 ± 4.1
	PPPV	71(19.19)	12.56 ± 4.87
	Overall	161(43.51)	11.92 ± 5.17
PPV TCSV	TCSV 20 G	110(29.73)	12.01 ± 5.34
	TCSV 23 G	99 (26.77)	12.44 ± 5.38
	Overall	209 (56.49)	12.67 ± 5.29
Grand Total	370 (100)	11.90 ± 5.18	13.80 ± 8.04

WS = With-Sutures, TCSV = Trans Conjunctival Sutureless Vitrectomy, PPV = Pars plana Vitrectomy, SBP = Scleral Buckling Procedure, PPPV = Primary Pars Plana Vitrectomy.

360°. ¹⁵ While dealing with retina affected by PVR, the three main indications for RR include contraction of the edges of a large retinal tear, taut sub-retinal strands, and retinal incar-

ceration in a wound. ⁸ Procedure was described with the use of scleral explants along with encirclement to produce deep scleral indents to relieve the circumferential traction forces

Table 8. 370 Cases of retinotomies and retinectomies in PVR. Complications. Intraoperative and post-operative.

370 Retinotomies and retinectomies	Frequency/percentage
Intraoperative bleeding	80(21.62%)
Iatrogenic retinal breaks	48(12.97%)
Subretinal PFCL	14(03.78%)
Subchoroidal SO migration	08(02.16%)
SO in anterior chamber	32(08.65%)
Retinal re-detachment	72(19.46%)
Post operative bleeding	33(08.92%)
Fibrin in pupillary area	60(16.22%)
Hypotony (<5 mmhg)	24(06.49%)
Macular Pucker	35(09.46%)
Optic atrophy	16(04.32%)
Unexplained loss of vision	03(00.81%)
Persistent corneal epithelial defects	10(02.70%)
Band Keratopathy	25(06.77%)
Corneal decompensation	10(02.70%)
Corneal perforation and egression of SO	01(00.27%)
Secondary Glaucoma	57(15.41%)
PFCL bubbles in anterior chamber	17(04.59%)
Rubeosis Iridis	07(01.89%)
Phthisis Bulbi	05(01.35%)
Subconjunctival Hemorrhage	65(17.57%)
Subconjunctival SO	14(03.78%)
Dislodged cannulas	24(06.49%)
Choroidal Effusion	09(02.43%)
Subconjunctival SO bubbles	09(02.43%)
Subconjunctival bubbles of gases	12(03.24%)

and removal of all visible surface and sub-retinal fibrosis to relieve the anterior-posterior and tangential traction forces responsible for these complicated situations.^{16,17}

The present series includes 90(24.32%) cases of retinectomy dealt by using broad buckle with encirclement along with PPV. The use of scleral explants by retinal surgeons is on decline.⁴ Because of the fact that primary PPV is reported to produce encouraging results, there has been increasing trend towards primary retinectomy over a period of time. Tseng et al.⁸ reported 64.2% primary retinectomy in their series of 81 retinectomies. The scleral buckle and explants once thought to be essential components of RR were not used in 280(75.68%) eyes in our series. In our part of the world the cases present fairly late and at advanced stages and this necessitated the retinectomy as primary procedure in 323 (87.30%) in present series.

The extent of retinectomy in present study varied from up to 90°, 180°–360°. In fact this is the largest series of 139 (37.57%) eyes reported in literature for 360° RR. The extent of RR has been reported to influence the anatomical outcomes.^{6,8,17} Similar to other reports^{9,18} we did not find a significant association between anatomic success and extent of retinectomy.

Re-proliferations and recurrent PVR remain the main cause for anatomic and functional failure after RR.^{9,10,13} The reported rate of recurrent retinal detachments after 180° and 360° retinectomies ranges from 17% to 48%.^{9,13,19} Retinal re-detachments were seen in 72(19.46%) cases in this series. Re-proliferation is not limited to peripheral retina, but also affects the posterior pole resulting in macular pucker reported in 22–43% cases.¹⁶ In present series macular pucker was seen in 35(09.46%) cases.

Machemer et al.²⁰ suggested the hemorrhage at the site of retinectomy contributing to re-proliferation of fibrous tissue and recurrent RD. Federman and Eagle²² reported intraoperative and postoperative hemorrhages from retinal

vessels in 78% and 17% of eyes undergoing retinotomy respectively, and intraoperative hemorrhage from choroidal vessels in 22% of eyes. Kolomeyer et al.²³ reported intraoperative bleeding from retinal vessels in 32% eyes and postoperative pre-retinal and retinal hemorrhage in 29% eyes undergoing 360° retinectomy. Although we used endocautery prior to cutting the retina in all cases in this study, the most common intraoperative complication associated with retinectomy was intraocular hemorrhage, which was seen in 80(21.62%) eyes. The intra-operative bleeding originated from the cut margins of the retina except in two eyes where choroidal bleeding occurred as a result of tip of the cutter inadvertently hitting the choroid. Postoperative hemorrhage was noted in 33(08.92%) eyes.

During repair of complicated retinal detachments with PVR, SO or intraocular gas temponade is commonly used. Several reports cite no significant difference in reattachment rates for SO and intraocular gas temponade.^{9,23} In our series also the type of temponade did not show influence or predictability on anatomical, and visual outcome. Considering the advanced nature of pathology on presentation our country that warrants prolonged temponade, we used SO in majority of cases. Like Kolomeyer et al.²³ we also believe the potential benefits of SO when used as temponade outweigh its recognized disadvantages like, secondary glaucoma, and corneal decompensation.

Patients in our practice are advised for ROSO at three months, but in majority of the patients in this series of RR, SO was not removed until uncontrolled glaucoma and EOSO necessitated its removal. A serious complication associated with ROSO is the recurrence of retinal detachment, which has been variably reported in literature from 3.46% to 40% cases in different series.²⁴ Re-detachment is most common in first 10 days after ROSO and is uncommon after 3 months.²⁴ In present series retinal re-detachment after ROSO was seen in 20(28.17%) eyes. Our series reports rather high incidence of re-detachments in eyes that underwent RR followed by ROSO in the course of follow up. Re-detachments after ROSO in eyes that had undergone RR with a follow-up of 6 months, and with a mean follow up of 23.2 months have been reported to be 9.4%²⁶ and 23%¹⁸ respectively. Our follow up has been longer and in fact one of our patient presented with re-detachment 5 years after ROSO.

Hypotony has been reported as complication in 11–39% cases of retinectomies, and to that effect, has been advocated in the treatment of intractable glaucoma.²⁵ In present series hypotony defined as IOP < 5 mmHg was noted in only 24(6.49%) eyes. The figure for hypotony in our series is on lower side and we believe this is due to extensive surgical procedure performed in our series that involved complete excision of the entire anterior proliferative complex, including vitreous base dissection and removal of anterior flap of the retina eliminating factors that cause surface contraction and traction on ciliary epithelium. Another important factor for lower figures of hypotony in our series could be use of SO in 302(81.62%) eyes. SO provides prolonged temponade and reduces incidence of hypotony and phthisis.^{6,19}

The reported anatomical outcomes after retinectomy for complicated RDs varies from 52% to 98.8%.^{8,9,13,16} The published studies on RR cannot be easily compared because of differences in etiology, severity of pathology, location, and

extent of retinotomy, different inclusion and exclusion criteria and at times different surgical approaches and different surgeons performing the surgery in the same reported series. This series, for instance, only includes the cases of PVR in RRD surgeries and does not include the traumatic cases. In most reported case series, retinectomy was performed when eyes had undergone at least one unsuccessful vitrectomy. In present series 47(12.70%) eyes had previous vitreo-retinal procedure already performed and retinectomy as primary procedure was performed in 323(87.30%) cases.

In our series the retina went flat after first surgery in 311 (84.05%) eyes. After one or more repeat surgeries retina flattened in 344(92.97%) eyes (Table 3). This figure is on the higher side of the reported cases and we believe this is due to our radical approach of doing extensive surgery to deal with anterior PVR. Eyes with anterior PVR have worse prognosis than those with posterior PVR.^{8,9,13,23} Addressing the anterior component of PVR and radical vitreous base dissection directly relieves traction and reduces the scaffold for potential proliferative tissue that can cause recurrent retinal detachment.⁹ There are several factors that account for better results in these complicated procedure in present series. The improvements in surgical techniques and instrumentation over a period of time, the use of wide-angle systems, the vitreous base dissection with scleral indentation along with removal of anterior flap of retinectomy,^{8-10,13,17} use of PFCL as operative tool,^{8,10,17} and availability of advanced vitrectomy machines could be the reasons of better anatomical outcomes.

Like anatomical outcomes, the effective comparison of functional results among existing published series in the literature is complicated by variability in the methodology used to report visual acuity outcomes. In available literature, reported visual results vary markedly with VAs improving in 20%–89%, remaining stable in 7%–22% and deteriorating in 13%–41% of patients.^{18,23} VA of 5/200 or better has been reported in 7–85% of eyes and 20/200 or better in 10–51% of cases in previous reports.^{9,10,13,17} Another aspect that needs consideration is fact that most of the reported series have small number of cases and comparatively shorter range of follow up except a large series of 304 eyes reported by Grigoropoulos et al.¹³ in which multiple surgeons performed the surgeries unlike present series in which all the surgeries were performed by a single surgeon (MIA).

In our series the mean pre-operative VA Log MAR improved from 2.33 ± 0.83 to mean postoperative Log MAR 1.48 ± 0.92 ($p = 0.000$). The number of cases with VA of 6/60 or better increased from preoperative 71(19.19%) to 211(57.03%). The visual outcome showed statistically significant relationship with preoperative VA. Several studies have found an association between large retinectomy and a worse functional outcome.^{6,14} In present series the predictive value of size of retinectomy for functional outcome is very low (R 0.16 CI 0.047–0.27). As reported in previous studies,^{6,18} we also did not find statistically significant relationship between the functional outcome and the type of temponade used.

Our visual and anatomical results are comparable to the studies reported by Quiram et al.⁹ and we agree with their hypothesis that radical anterior base dissection combined with lens removal eliminates the anterior PVR that can cause recurrent retinal detachment, and like them we attribute our 93% anatomic success rate to this technique.

The current study is limited by its retrospective nature and that the study does not have any control group. However, the study has several strengths such as largest series of retinectomies reported in literature, long follow-up period, homogeneous subset of complicated retinal detachments, uniformity and consistency of the procedure in different techniques as all surgeries have been performed by a single surgeon. The series is also unique in documenting the retinectomy procedure performed using buckle with PPV, no buckle with PPPV, and with 23 G and 20 G TCSV. This study is also the largest series reported for RR of surgeries performed by TCSV technique.

Conclusion

The anatomical and functional results of retinectomies are very encouraging and rewarding both for the patients and surgeons. This has become possible because of the advances seen in modern ophthalmic surgical practice. This series is characterized by incorporation of changing techniques of vitreo-retinal surgeries over a period of time. Starting with the retinectomies with scleral buckle, the technique changed to PPPV without any scleral buckle. Later on, with the advent of TCSV, the technique for retinectomies in this series changed on to both 23 G and 20 G TCSV. The suture-less technique have additional advantage of being even less traumatic and that of being quick in rehabilitation in these kind of complex procedures.

Conflict of interest

The authors declared that there is no conflict of interest.

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