ORIGINAL ARTICLE

Outcome of Bimanual 23G, 5-Ports Versus 3-Ports Pars Plana Vitrectomy for Advanced Diabetic Eye Disease

Rana Naveed Iqbal[1], Asad Aslam Khan[2], Khalid Waheed[3] Haroon Tayyab[4], Mohsin Ihsan[5] Intzar Hussain[6]

[1'3'5'6]Services Institute of Medical Sciences, [2]King Edward Medical University, Mayo Hospital Lahore
[4]Agha Khan University, Karachi

ABSTRACT

Purpose: Evaluation of efficacy and safety of 23 – guage five ports vitrectomy versus 23 – guage three ports pars plana vitrectomy (PPV) in diabetic tractional retinal detachment.

Study Design: Prospective Interventional case series.

Place and Duration of Study: Mayo hospital and Services hospital, Lahore, from February 2018 to December 2018.

Material and Methods: Forty eyes of forty patients were equally divided into two groups. One group which underwent five ports PPV and the other group had three ports PPV. Patients with tractional retinal detachment (TRD) with fibrovascular membranes were included and patients who had undergone previous ocular surgery (except cataract surgery) or having TRD due to other ocular diseases were excluded. Preoperative work-up included visual acuity, intra ocular pressure measurement and slit lamp examination of anterior and posterior segment. Gender, age, pre-operative and post-operative BCVA and intraocular pressure presented by calculating frequency and percentages.

Results: Pre-operative BCVA improved from 1.11 ± 0.5 to 0.66 ± 0.5 in 3-port groups and from 1.7 ± 0.9 to 0.87 ± 0.8 in 5-port groups. Duration of surgery was 74.40 ± 5.4 and 53.40 ± 2.5 minutes in 3 ports and 5-ports group respectively. Iatrogenic retinal tear developed in two patients in each group. Per-operative vitreous hemorrhage developed in three patients in 3-ports group and in two patients in 5-ports group. Two patients in each group developed post vitrectomy cavity hemorrhage.

Conclusion: Bimanual 5- ports 23-guage vitrectomy is a faster procedure than three ports 23 – guage vitrectomy in diabetic tractional retinal detachment but with similar intraoperative and postoperative complications.

Key Words: Pars plana vitrectomy, Tractional retinal detachment, Vitreous haemorrhage.

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INTRODUCTION

About half a billion of world population is expected to suffer from diabetes mellitus by 2030. Diabetic retinopathy causes blindness in 4.8% people globally and is one of the most common diabetic complications.[1] Various anti vascular endothelial growth factors have been used intravitreally in patients with vitreous hemorrhage caused by proliferative diabetic retinopathy but still pars plana vitrectomy is required for one third of these eyes.[2]

Correspondence to: Rana Naveed Iqbal
Services Institute of Medical Sciences, Lahore
Email: rananaveediqbal14@yahoo.com

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We have seen a revolution in the treatment of diabetic retinopathy with the introduction of various anti VEGF agents and advancements in laser treatment for Diabetic Retinopathy (DR) but surgical treatment in the form pars plana vitrectomy is still required in non-clearing vitreous hemorrhage (NCVH) with and without TRD.

TRD is an advanced and devastating complication of PDR which can cause irreversible damage to retinal architecture. The most important part of vitrectomy for diabetic TRD is careful segmentation and removal of fibrovascular tissue that can cause severe complications.[3] There are different surgical techniques for delamination of taut and tough fibrovascular membrane using bimanual delamination technique like En-Bloc perfluoro-dissection in vitreoretinal surgery and the 'suck-and-cut' bimanual technique for delamination of fibrovascular membranes in proliferative diabetic retinopathy.[4,5] More expertise can be achieved for bimanual vitrectomy for more extensive and threatening TRD especially those with more adherent and widely spread fibrovascular tissue which can cause per-operative complications that may become very difficult to manage.[6] Various studies have been conducted in the past which involved bimanual dissection of proliferative retinal membranes and for this purpose specially designed sophisticated instruments were used in these studies.[7,8,9]

23–gauge vitrectomy has been used by many surgeons worldwide and over the years it is found to be a safe and swift technique with less ocular surgical trauma, shorter duration, less inflammation in postoperative period and most importantly better and quick recovery in patients with retinal surgery including those with advanced diabetic eye disease.[9] Previous studies have been conducted to observe the safety and efficacy of four ports pars plana bimanual vitrectomy, which has been found to be an excellent surgical procedure that helps in safe and adequate removal of proliferative fibrovascular tissue in advanced PDR.[10] The structural and functional results of bimanual 23 – gauge vitrectomy were reported with illumination source, which did not require manual fixation by the assistant during surgery for complicated vitreoretinal cases.[11] A variety of chandelier lighting systems have been developed to provide stationary, wide-angle and uniform endo-illumination for obtaining adequate visualization of retina during surgery.[12] Chandelier endo-illumination with two optic fibers described by Eckardt as the twin light chandelier, is more useful than a single fiber system for obtaining homogeneous and more widespread illumination. The 2-fiber system eliminates the need to reposition the fiber and minimizes the shadow seen with single-fiber chandelier endo-illumination because the illumination comes from 2 different directions.[6,13,14] Mercury vapor and xenon have been used in chandelier lights of smaller size for improved illumination with wide angle view of retina.[15,16,17,18]

In our five ports bimanual vitrectomy, the fourth and fifth port were made at 5 and 7 o'clock position. Main outcome measures in this study include preoperative and postoperative best corrected visual acuity along with intraocular pressure, intraoperative and postoperative complications and duration of surgical procedure. The purpose of our study was to observe the outcome of 23-guage, 5-ports versus 23-guage, 3-ports pars plana vitrectomy in advanced diabetic eye disease.

MATERIAL AND METHODS

Total eyes of 40 patients were divided into two groups with one group undergoing 23 – guage three ports PPV and the other group undergoing five ports PPV. There were 20 eyes in each group. Patients with TRD and fibrovascular membranes extending over an area of greater than two quadrants of retina and also having an impending or actual macular detachment irrespective of the presence or absence of vitreous hemorrhage were included in the study. Those patients who had undergone previous ocular surgery (excluding cataract surgery) or having TRD due to other ocular diseases were not included in our study.

Every patient was examined for pre-operative best-corrected visual acuity, intra ocular pressure measurement and slit lamp examination of anterior and posterior segment especially for Tractional Retinal Detachment. Patients fulfilling the inclusion criteria were selected for 23 guage five ports bimanual pars plana vitrectomy or three ports conventional vitrectomy and the duration of surgery along with per-operative and postoperative complications, post-operative best corrected visual acuity and intra ocular pressure were noted.

In all patients, a 23 – gauge trocar cannula was inserted at 15° to 30° angle through pars plana at 3.5–4.0 mm from the limbus. The cannula for infusion was inserted inferotemporally. The remaining two ports

were for fibreoptic light and vitrectomy cutter. BIOM was used to get the wide angle view of the retina during vitrectomy. The surgery started with core vitrectomy along with clearance of vitreous haemorrhage (if present) and then the removal of posterior hyaloid was performed. Peripheral vitrectomy along with vitreous base shave was done to get rid of anteroposterior tractions. In the five ports group, bimanual surgery helped in easy and more appropriate removal of fibro vascular tissue. The fourth and fifth ports were placed at 5 and 7 o' clock position. As the illumination source was self-retained, so bimanual technique was used for peeling, segmentation and delamination of fibrovascular tissue. All the instruments used were of 23 – gauge including vitreous cutter, endo-illumination light, micro-scissors, forceps, laser probe, intraocular diathermy probe and flute needle. Tractional tissue was removed with vitrectomy cutter or micro-scissors and the proliferative membranes were elevated with end-gripping forceps or with cutter through aspiration. Intraocular diathermy was used to control the bleeding. Pan-retinal photocoagulation was performed up to the peripheral retina. Endolaser was applied around iatrogenic breaks. After the fluid was exchanged with air, silicone oil was injected only in those patients who developed iatrogenic break. At the end, micro-cannulas were removed with firm pressure applied on to the sclerotomy sites with a cotton-tip applicator to enhance the sealing of the sclerotomies. A nylon 10/0 suture was applied if there was any leakage through the sclerotomy site. Finally, injection of dexamethasone and antibiotic was given sub-conjunctivally. Topical antibiotics and steroids were advised post operatively. Patients with silicone oil tamponade were advised to maintain face down position for initial 5 to 7 days.

Snellen visual acuity was converted into logarithms of the minimum angle of resolution for statistical analysis. Counting fingers vision was defined as 0.01 (2.0 log MAR), and hand movements were defined as 0.001 (3.0 log MAR). Statistical analyses were performed using SPSS version 20.0. Age, pre-operative BCVA and post-operative BCVA of patients, pre-operative and post-operative intraocular pressures were presented by calculating mean and standard deviation. Mean improvement in BCVA was obtained by subtracting mean post-operative BCVA at 4 weeks from mean pre-operative BCVA. Improvement or deterioration of the postoperative visual acuity was defined as a decrease or increase of log MAR units by 0.3 or more. A p-value of less than 0.05 was defined as statistically significant. Gender and all the variables including age, pre-operative BCVA, post-operative BCVA, pre-operative and post operative intraocular pressure, duration of the surgery and increase in visual acuity were presented by calculating frequency and percentages.

RESULTS

Mean age in 3 port group was 54.50 ± 7.7 years and in 5 port group 57.60 ± 9.8 years with *p-value of 0.273* (Table 1). Gender distribution showed that there were

Table 1: *Age Distribution.*

Age (Years)	3 – Port, n (%)	5 – Port, n (%)
Total	20 (100.0)	20 (100.0)
Mean ± SD	54.50 ± 7.7	57.60 ± 9.8
Minimum	45	40
Maximum	71	73
p-value	0.273	

8 females (40%) and 12 males (60%) in 3-port pars plana vitrectomy group while in 5 – port pars plana vitrectomy group this distribution was 5 females (25%) and 15 males (75%). Overall collectively both the groups consisted of 13 females (32.5%) and 27 males (67.5%) with p value of 0.501 (Table 2).

Table 2: *Gender Distribution.*

Gender	3 Port n (%)	5 Port n (%)	Total n (%)
Female	8 (40.0)	5 (25.0)	13 (32.5)
Male	12 (60.0)	15 (75.0)	27 (67.5)
Total	20 (100.0)	20 (100.0)	40 (100.0)
P Value		0.501	

Safety of the surgical procedure was considered in terms of intraoperative and postoperative complications. Two (10%) patients in each group developed iatrogenic retinal tears with a p-value of 1.00. Iatrogenic per-operative vitreous hemorrhage developed in three patients (15%) in 3-ports group and two patients (10%) developed this complication in 5-ports group (Table 3). Two (10%) patients in each group developed post vitrectomy vitreous cavity

Table 3: *Intraoperative Complications.*

Complications		3 – Port n (%)	5 – Port n (%)	P Value
Iatrogenic Retinal Tears	No	18 (90.0)	18 (90.0)	1.000
	Yes	2 (10.0)	2 (10.0)	
Iatrogenic Vitreous Hemorrhage	No	17 (85.0)	18 (90.0)	1.000
	Yes	3 (15.0)	2 (10.0)	

hemorrhage which did not require any intervention and resolved by itself 4 weeks post operatively. None of the patients developed any rhegmatogenous retinal detachment because in those patients who developed iatrogenic retinal breaks the complication was promptly managed with the use of endo-laser application around the break. There was no iatrogenic cataract formation in each group (Table 4).

Table 4: *Postoperative Complication.*

Complications		3 – Port n (%)	5 – Port n (%)	P Value
Post vitrectomy vitreous cavity hemorrhage	No	18 (90.0)	18 (90.0)	1.000
	Yes	2 (10.0)	2 (10.0)	
Rhegmatogenous retinal detachment	No	20 (100.0)	20	-
	Yes	0 (0.0)	0 (0.0)	
Cataract	No	20 (100.0)	20	-
	Yes	0 (0.0)	0 (0.0)	

Pre-op intraocular pressure in 3 ports group was noted to be 17.70 ± 1.6 mmHg and postoperative intraocular pressure was 16.35 ± 1.9 mmHg with a net change of about 1.35 ± 2.2 mmHg. In 5 ports pars plana vitrectomy group, pre-op IOP was 15.55 ± 1.6 mmHg and post operatively it changed to 14.35 ± 2.3 mmHg. The change in intraocular pressure between the two groups was insignificant as the p value was 0.837. Duration of surgery in 3 ports group was 74.40 ± 5.4 minutes and in 5 ports group was 53.40 ± 2.50 minutes with a difference of about 21.00 minutes. It was statistically significant with a p-value of 0.001. In 3 ports group pre-operative BCVA (Log MAR) was 1.11 ± 0.5 which changed to 0.66 ± 0.5 and in 5 ports group pre-operative BCVA was 1.71 ± 0.9 and this improved to 0.87 ± 0.8 (Table 5).

Table 5: *Preoperative and post-operative intraocular pressure, duration of surgical procedure and BCVA.*

Parameters	3 – Port Mean ± SD	5 – Port Mean ± SD	P Value
Preoperative Intraocular Pressure	17.70 ± 1.6	15.55 ± 1.6	0.001
Postoperative Intraocular Pressure	16.35 ± 1.9	14.35 ± 2.3	0.001
Change in Intraocular Pressure	1.35 ± 2.2	1.20 ± 2.4	0.837
Duration of surgical procedure	74.40 ± 5.4	53.40 ± 2.5	0.001
Preoperative BCVA (Log MAR)	1.11 ± 0.5	1.71 ± 0.9	0.022
Postoperative BCVA (Log MAR)	0.66 ± 0.5	0.87 ± 0.8	0.345

DISCUSSION

With the development of advanced and smaller gauge instruments, the safety and efficacy has improved due to which pars plana vitrectomy is now performed more frequently in proliferative diabetic retinopathy and even at an earlier stage, especially in cases with diabetic vitreous hemorrhage.[19,20]

In our study intra operative complications included iatrogenic retinal tear formation in two (10%) patients in each group while in a previous study, 4 ports pars plana vitrectomy group had lower number of iatrogenically induced retinal tears (22.2%) than in 3 ports vitrectomy group (43.3%) and this difference was statistically insignificant (p = 0.067)[10]. This difference in the formation of retinal break is due to the fact that bimanual surgery allows more and safer dissection and peeling of proliferative tissue because of both hands being used. Improved illumination of vitreous cavity also plays a pivotal role in this whole mission. A study from Thailand evaluated the results of three ports 23-guage pars plana vitrectomy for tractional retinal detachment and they found that iatrogenic retinal tear formation leading to retinal detachment occurred in 20/434 (4.6%) eyes of the 23G pars plana vitrectomy group.[11]

Per-operative iatrogenic hemorrhage during membrane peeling occurred in three (15%) patients in 3 ports group and in two (10%) patients in 5 ports group and this is in comparison to previous study where it was similar in both groups.[10]

Post-operative vitreous cavity hemorrhage developed in 2 patients in each group of our study. This has also been reported in another study conducted by José Alberto Lemos and his companions that post vitrectomy cavity hemorrhage occurred in 19 eyes (17.6%) which was quite high as compared to both groups in our study.[12] There was no rhegmatogenous retinal detachment and surgically induced cataract formation in our study.

Duration of surgery was shorter in 5 ports group, where it was 53.40 ± 2.5 minutes than in 3 ports group in which it was 74.40 ± 5.4 minutes. This can be attributed to significantly better illumination due to the use of chandelier light which led to better visualization with wider view. Due to this bimanual surgical intervention was quick and swift with safe handling of tissues.

There was no significant change in the intraocular pressure between the two groups under study which shows that increasing the number of ports does not affect intraocular pressure provided the cannulas used are valved and also the use of chandelier light in additional ports does not allow leakage of intraocular fluid. BCVA was noted pre operatively and post operatively in both groups and was found to improve post operatively in both groups but the improvement was more prominent in bimanual 5 ports pars plana vitrectomy group than 3 ports pars plana vitrectomy group. In a previous study, the vision improved significantly in patients who underwent bimanual vitrectomy for diabetic tractional retinal detachment.[13]

Limitation of this study is that our sample size was small and the study was conducted in only two hospitals of Lahore. However, this study will help in further research in other centers to validate the findings.

CONCLUSION

Five ports bimanual pars plana vitrectomy is better in treating extensive diabetic tractional retinal detachment as compared to conventional three port pars plana vitrectomy in terms of shorter duration of surgical procedure. Intraoperative and postoperative complications were quite similar in both groups.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board.

Conflict of Interest

Authors declared no conflict of interest.

Authors' Designation and Contribution

Rana Naveed Iqbal; Senior Registrar: *Research design, data analysis, manuscript writing, literature review.*

Asad Aslam Khan; Professor: *Research design, final review.*

Khalid Waheed; Professor: *Research design, final review.*

Haroon Tayyab; Assistant Professor: *data collection, data analysis, final review.*

Mohsin Ihsan; Associate Professor: *Research design, final review.*

Intzar Hussain; Associate Professor: *Research design, final review.*

REFERENCES

1. **Yau GL, Silva PS, Arrigg PG, Sun JK.** Postoperative Complications of Pars Plana Vitrectomy for Diabetic Retinal Disease. Semin Ophthalmol. 2018; **33 (1):** 126-133.
2. **Bhavsar AR, Torres K, Glassman AR, Jampol LM, Kinyoun JL.** Evaluation of results 1 year following short-term use of ranibizumab for vitreous hemorrhage due to proliferative diabetic retinopathy. JAMA Ophthalmology, 2014; **132 (7):** 889-90.
3. **Newman DK.** Surgical management of the late complications of proliferative diabetic retinopathy. Eye, 2010; **24 (3):** 441.
4. **Cheema RA, Sengupta R.** The 'suck-and-cut' bimanual technique for delamination of fibrovascular membranes in proliferative diabetic retinopathy. Acta Ophthalmol Scand. 2007; **85 (2):** 225.
5. **Arevalo JF.** En bloc perfluoro dissection in vitreoretinal surgery: a new surgical technique. Retina, 2008; **28 (4):** 653-6.
6. **Eckardt C.** Twin lights: a new chandelier illumination for bimanual surgery. Retina, 2003; **23 (6):** 893-4.
7. **Gonvers M.** New instrumentation and technique for epiretinal surgery. Arch Ophthalmol. 1987; **105 (9):** 1292-3.
8. **Steinmetz RL, Grizzard WS, Hammer ME.** Vitrectomy for diabetic traction retinal detachment using the multiport illumination system. Ophthalmology, 2002; **109 (12):** 2303-7.
9. **Kadonosono K, Yabuki K, Nishide T, Nomura E, Uchio E, Yamakawa T.** Multicoated contact lens for bimanual vitreous surgery without endoillumination. Arch Ophthalmol. 2004; **122 (3):** 367-8.
10. **Wang ZY, Zhang Q, Zhao DS, Zhao PQ.** Four-port bimanual vitrectomy in fibrovascular membrane removal. Retina, 2011; **31 (4):** 798-800.
11. **Choovuthayakorn J, Khunsongkiet P, Patikulsila D, Watanachai N, Kunavisarut P, Chaikitmongkol V, et al.** Characteristics and Outcomes of Pars Plana Vitrectomy for Proliferative Diabetic Retinopathy

Patients in a Limited Resource Tertiary Center over an Eight-Year Period. J Ophthalmol. 2019; 2019.
12. **Lemos JA, Carvalho R, Teixeira C, Martins JN, Menezes C, Coelho P, et al.** Pars Plana Vitrectomy in Proliferative Diabetic Retinopathy–Retrospective Analysis of Results and Complications. Oftalmologia. 2017; **40:** 279-87.
13. **Park KH, Woo SJ, Hwang JM, Kim JH, Yu YS, Chung H.** Short-term outcome of bimanual 23-gauge transconjunctival sutureless vitrectomy for patients with complicated vitreoretinopathies. Ophthalmic Surg Lasers Imaging 2010; **41 (2):** 207-14.
14. **Oshima Y, Awh CC, Tano Y.** Self-retaining 27 – gauge transconjunctival chandelier endoillumination for panoramic viewing during vitreous surgery. Am J Ophthalmol. 2007; **143 (1):** 166-7.
15. **Sakaguchi H, Oshima Y, Nishida K, Awh CC.** A 29/30 – gauge dual-chandelier illumination system for panoramic viewing during micro-incision vitrectomy surgery. Retina, 2011; 31 (6): 1231-3.
16. **Oshima Y, Chow DR, Awh CC, Sakaguchi H, Tano Y.** Novel mercury vapor illuminator combined with a 27/29 – gauge chandelier light fiber for vitreous surgery. Retina, 2008; **28 (1):** 171-3.
17. **Williams GA.** 27 – gauge Twin light chandelier illumination system for bimanual transconjunctival vitrectomy. Retina, 2008; **28 (3):** 518-9.
18. **Chow D.** Tips on improving your use of endoillumination. Retin Physician, 2011; **8 (4):** 43-6.
19. **Baig MS, Rehman A, Burney JA.** Intravitreal Bevacizumab (Avastin) for proliferative diabetic retinopathy. Pak J Surg. 2009; **25 (2):** 110-4.
20. **Yorston D, Wickham L, Benson S, Bunce C, Sheard R, Charteris D.** Predictive clinical features and outcomes of vitrectomy for proliferative diabetic retinopathy. Br J Ophthalmol. 2008; **92 (3):** 365-8.