Efficacy and Safety Profile of 25-Gauge Pars Plana Vitrectomy in Rhegmatogenous Retinal Detachment in Pakistan: A Multicenter Retrospective Study

Muhammad Amer Awan 1, Syed Zohaib Maroof Hussain 2, Fiza Shaheen 1, Mian Bilal Humayun 1, Nain Tara Zeb 3, Bushra Ayub 4, M. A. Rehman Siddiqui 5

1. Ophthalmology, Shifa International Hospital, Islamabad, PAK
2. Ears, Nose, and Throat, Norfolk and Norwich University Hospital, Norwich, GBR
3. Internal Medicine, Shifa International Hospital, Islamabad, PAK
4. Centre for Clinical Best Practices, Dean’s Office, Aga Khan University Hospital, Karachi, PAK
5. Section of Ophthalmology, Aga Khan University, Karachi, PAK

Corresponding author: M. A. Rehman Siddiqui, rehman.siddiqui@gmail.com

Abstract

Introduction
This study aims to evaluate the primary anatomical success and visual outcomes of 25-gauge pars plana vitrectomy (25g PPV) in patients with rhegmatogenous retinal detachment (RRD) in Pakistan.

Design
This is a five-year retrospective, interventional cohort study conducted at tertiary care hospitals in Pakistan from October 2013 to October 2018.

Methods
This is a retrospective, interventional cohort study of 418 consecutive patients with RRD who underwent 25g PPV. All surgeries were performed by two experienced surgeons at tertiary care hospitals in Pakistan. Consecutive patients who underwent 25g PPV surgery as the treatment for RRD from October 2013 to October 2018 were included. We excluded patients who had a history of previous retinal surgery or did not complete the 4-8 weeks of primary outcome visit. We used the Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corporation, Armonk, NY, USA) for statistical analysis. A p-value of <0.05 was considered significant.

Results
We identified 452 patients through the coding system of our hospitals who underwent 25g PPV surgery for RRD during the study period. A total of 441 patient files were reviewed for the study, of which 418 patients met the criteria for final analysis. The mean age was 49 ± 15.8 years. There was a higher number of males (n = 284, 67.9%). In our study, 186 (44.4%) patients were phakic at the time of presentation. The macula was detached in 361 (86.4%) patients. At the primary outcome visit (4-8 weeks of follow-up), the primary anatomical success rate was 89.47%. The most common cause of failure was proliferative vitreoretinopathy (PVR) (n = 20), followed by missed breaks (n = 5).

Conclusions
The surgical outcomes of RRD with 25g PPV surgery in our study were similar to the outcomes reported in the developed world. We propose a prospective multicenter national study to prospectively evaluate the risk factors for RRD surgical failure in the Pakistani population.

Categories: Ophthalmology
Keywords: 25 gauge, proliferative vitreoretinopathy, surgical audit, pars plana vitrectomy (ppv), retinal detachment surgery

Introduction
Rhegmatogenous retinal detachment (RRD) is the most common type of retinal detachment, involving one in 10,000 of the population per annum [1]. RRD causes visual deterioration due to the separation of the neurosensory retina from the underlying retinal pigment epithelium. Late presentation and proliferative vitreoretinopathy (PVR) further complicate the anatomical and visual outcomes of RRD [2].

There are different surgical methods for the treatment of RRD [3]. These include scleral buckle (SB), pars
Descriptive statistics were used to summarize the data in terms of the frequency and percentages of

**Statistical analysis**

Descriptive statistics were used to summarize the data in terms of the frequency and percentages of
Qualitative variables. The Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corporation, Armonk, NY, USA) was used for data entry and statistical analysis. Quantitative variables were described as mean (± standard deviations). Visual acuity was converted from Snellen to log-MAR visual acuity. Count fingers and hand motion visual acuity were converted to log-MAR 2 and 3, respectively. The Mann-Whitney U test was applied to check the comparison between pre- and postsurgical visual acuity. The chi-square and Fisher’s exact tests were used to test for the group difference in categorical data. Visual acuity was tested before surgery and postoperatively at two and six months. A p-value of <0.05 was considered statistically significant. This is a retrospective study; therefore, a priori sample size calculation was not done.

**Results**

We identified 452 patients from the hospital coding system who underwent 25g PPV for RRD during the study period, of which 11 patients were considered as ineligible either because of non-RRD cases or repeat retinal surgery. A total of 441 patient files were reviewed, of which 418 met the inclusion criteria and were included in the final analysis (Figure 1). Most surgeries were performed under local anesthesia (n = 347, 83.01%).
The proportion of males was higher (67.9%). The mean age of the patients was 49 ± 15.8 years. In our study, 186 (44.4%) patients were phakic at the time of presentation. The macula was detached in 361 (86.4%) patients. PVD was clinically present in 324 (77.5%) patients. Table 1 shows the baseline characteristics of all enrolled patients.
| Characteristics (n = 418)       | Frequency | Percentage (%) |
|-------------------------------|-----------|----------------|
| Gender                        |           |                |
| Male                          | 284       | 68             |
| Female                        | 134       | 32             |
| Age (years) (median, IQR = 38, 60) |           |                |
| 5-15                          | 17        | 4.1            |
| 16-25                         | 13        | 3.1            |
| 26-50                         | 167       | 40             |
| 51-65                         | 165       | 39.6           |
| 66-80                         | 55        | 13.2           |
| Status of lens                |           |                |
| Phakia                        | 186       | 44.4           |
| Pseudophakia + aphakia        | 232       | 55.5           |
| Status of the macula          |           |                |
| Off                           | 361       | 86.4           |
| On                            | 57        | 13.6           |
| PVD                           |           |                |
| Present                       | 324       | 77.5           |
| Absent                        | 94        | 22.4           |
| PVR                           |           |                |
| <PVR grade C                  | 323       | 77.3           |
| PVR grade C                   | 95        | 22.7           |

**TABLE 1: Baseline characteristics of the enrolled patients.**

PVD: posterior vitreous detachment, PVR: proliferative vitreoretinopathy

Different types of breaks were observed; the mixed type was predominant 157 (37.5%). In terms of the number of breaks, 2-5 breaks were identified in the majority of the patients (n = 221, 52.8%). Table 2 shows the intraoperative parameters of all enrolled patients. The perioperative tamponade agent used during the procedure is shown in Figure 2.
In our study, there was a significant improvement in the mean postoperative BCVA at six-month follow-up compared with the mean preoperative BCVA (Table 3).
| Time (N)       | Macula-on RD* | Macula-off RD* | P-value |
|---------------|---------------|----------------|---------|
| Preoperative  | 0.6 (0.2-2)   | 2 (2-3)        | <0.0001 |
| Two months    | 1 (0.6-2)     | 1 (0.7-2)      | 0.579   |
| Six months    | 0.35 (0.1-0.8)| 0.70 (0.3-2)   | 0.002   |

**TABLE 3: Comparison of pre- and postoperative visual acuity.**

*Median (IQR) VA in log-MAR
RD: retinal detachment, N: number of patients

At the primary outcome visit, the anatomical success rate was 89.47% (n = 374/418). The most common cause of failure was PVR (n = 20), followed by missed breaks (n = 5). No definitive reason for failure was identified in the remaining cases. The most common complication after vitrectomy was cataract formation/progression in 16.2% of participants, followed by a raised IOP in 12%, and ERM formation in 8% of the patients. No patient developed infectious endophthalmitis in our cohort.

When comparing the primary reattachment rate between patients with less than PVR grade C and PVR grade C, it was noted that 31/290 (10%) patients did not reattach in less than PVR grade C group (lost to follow-up = 4). While in the PVR grade C group, 13/81 (16%) failed at primary surgery (lost to follow-up = 2) (p = 0.425). It was also noted that silicone oil was used more frequently in patients with PVR grade C (p < 0.001) (Table 4). Interestingly, there was no difference between the tamponade agent used and the primary retinal reattachment rate (p = 0.306).

**TABLE 4: Frequency of tamponade agent used.**

PVR: proliferative vitreoretinopathy, SF6: sulfur hexafluoride, C2F6: hexafluoroethane, C3F8: octafluoropropane, SO: silicon oil

**Discussion**

Our results indicate that 25g PPV is an effective surgical procedure for RRD, with or without PVR, in our study population. The primary anatomical reattachment rate of the retina in our study was 89.47%, which is consistent with an attachment rate of 80.8% (95% CI: 78.1%-83.3%) in other international studies, after one surgical procedure [4,10,13].

Following initial reservations due to instrument bending during peripheral vitreous shave, small-gauge vitrectomy is now becoming a popular method for primary RRD repair. Kunikata et al. reported a primary anatomical success rate of 95%. However, their sample size was only 84, and the PVR status was not mentioned in their study [14]. Likewise, Iwahashi et al. determined the anatomical success rate in 27 patients with RRD complicated by PVR [11]. In their study, the reattachment rate was 78% after the initial procedure and 95% after the final procedure.

To the best of our knowledge, our study is the first study from a South Asian country to report the outcomes of RRD with 25g PPV. In previously reported studies, sample sizes were small, vitrectomy was combined with scleral explants, or complicated cases with PVR C were excluded. Only one study specifically included grade C PVR RRD. That study too had a smaller sample size of 27 patients and reported a lower primary anatomical attachment rate of 78% [11].

In terms of the primary failure, the risk factors reported include more extensive detachment and preoperative PVR [15]. Multivariate regression analysis showed that preoperative PVR increased the risk of early surgical failure more than twofold. Each additional clock hour of detachment significantly increased the risk of surgical failure by approximately 12%. Delayed presentation may result in the detachment of the macula. Macula-off retinal detachment has a poorer visual outcome. It is known that patients with RRD in...
developing countries present late [12,16,17]. A study from Pakistan reported that 95.5% presented with macula-off RRD [16]. In addition, the nature of detachments in developing countries is complex [12].

In our study, 44 eyes had failed surgery at the primary outcome follow-up visit. One of the significant identifiable causes was PVR (n = 20). Missed or new breaks in the absence of PVR were the second most common cause (n = 5), emphasizing that a careful and thorough retinal examination with scleral indentation is mandatory at the end of any vitrectomy procedure. Over 9,000 Medicare beneficiaries in the USA were analyzed retrospectively for retinal repair at one year. It was reported that approximately 20% who underwent scleral buckle or PPV required reattachment surgery [18].

The rate of perioperative complications was significantly less in our study (<0.5%). Only a single case of an iatrogenic break was reported, further establishing the safety profile of smaller-gauge surgeries. Other studies have also reported lower iatrogenic breaks with small-gauge PPV, probably because cannula use prevents vitreous incarceration in the wound [19,20]. The use of small-gauge cannulas limits fluid currents and undesired movements of the retina, preventing inadvertent retinal incarceration in the cutter.

Raised IOP is a known complication of PPV, and the frequency is higher when SO tamponade is used [21]. In our study, increased IOP was reported in one-third of the eyes. However, it was transient and was well controlled with topical antiglaucoma drops. The second postoperative complication was a cataract that later required cataract surgery. We did not have cases of postoperative wound leak or hypotony. This has been attributed to a smaller gauge and oblique wound construction. However, in our study, we preferred suturing with a 6-0 Vicryl suture in case of persistent wound leak after a gentle massage in children <15 years of age due to the risk of involuntary rubbing and in those with silicone oil tamponade to further ensure the approximation of wound and prevention of wound leak. We found it very useful in achieving a good tamponade postoperatively.

None of our patients developed postoperative endophthalmitis, which has been documented around 0.2% previously [3]. In our view, it is directly related to wound architecture along with a meticulous draping technique and subconjunctival antibiotic at the end of surgery.

Visual outcomes depend on the status of macula preoperatively [22]. Early detection and intervention are crucial for better visual results. Williamson et al. evaluated 325 patients with macula-off RRD and found that the median final BCVA was 6/9 independently of symptom duration (recorded from day 1 to >21 days). Notably, they showed that surgery at any time between days 1 and 3 after symptom onset produced equivalent visual outcomes; nevertheless, surgery on days 4-6 conferred worse vision [23]. In our study, there was a significant improvement in the mean postoperative BCVA at six-month follow-up compared with the mean preoperative BCVA. BCVA at the six-month follow-up period was found to be better in the macula-on group compared with those in the macula-off group, thus reinforcing that timely RRD surgery is critical to achieving a better success rate and good vision. Our study has the highest rate of macula-off retinal detachment among the published studies of 25g PPV surgical outcome for RRD (Table 5).
TABLE 5: Studies reporting RRD outcomes with 25g vitrectomy.

| Author               | Year | Country     | Study design | Sample size | Macula-off (%) | PVR C included | Silicon oil (%) | Time at PO assessment (in weeks) | Success rate (%) |
|----------------------|------|-------------|--------------|-------------|----------------|----------------|----------------|----------------------------------|------------------|
| Mura et al. [9]      | 2009 | Netherlands | Retrospective | 131         | 59.5           | No             | 3.1            | 12                               | 92.4             |
| Kunikata et al. [14] | 2010 | Japan       | Retrospective | 84          | 53.6           | No             | 0              | 12                               | 95.2             |
| Iwahashi et al. [11] | 2013 | Japan       | Retrospective | 27          | NR             | Yes            | 11.1           | <52                              | 77.8             |
| Dell’Omo et al. [24] | 2013 | Netherlands | Retrospective | 41          | 58.5           | No             | NR             | 24                               | 92.6             |
| Susskind et al. [18] | 2016 | Germany     | Prospective   | 25          | 72             | No             | NR             | 24                               | 65               |
| Rizzo et al. [4]     | 2017 | Italy       | Prospective   | 20          | 85             | No             | 30             | 24                               | 85               |
| Romano et al. [8]    | 2017 | Italy       | Prospective   | 15          | 60             | Yes            | NR             | 24                               | 93               |
| Sborgia et al. [25]  | 2019 | Italy       | Prospective   | 46          | 52.1           | No             | NR             | 52                               | 95.7             |
| Present study        | 2020 | Pakistan    | Retrospective | 418         | 86.4           | Yes            | 44             | 8                                | 89.4             |

SB: scleral buckling, NR: not reported, PO: primary outcome

The strengths of our study include multiple centers across Pakistan, large sample size, consecutive cases, the inclusion of complex cases with PVR grade C, vitrectomy surgery that was not associated with scleral explants, and sufficient follow-up of six months. The limitations of our study include its retrospective study design, loss to follow-up, and absence of a control group.

Conclusions

The surgical outcomes of RRD with 25g PPV surgery in our study were similar to the outcomes reported in the developed world. These findings are interesting because the prevalence of PVR grade C was higher in our population. The findings from our study suggest that complicated retinal detachment can be successfully treated with small-gauge vitrectomy. We propose a prospective multicenter national study to prospectively evaluate the risk factors for the surgical failure of RRD in the Pakistani population.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. The institutional review boards of Shifa International Hospital, Shahzad Eye Hospital, and The Eye Centre, South City Hospital (SCH), issued approval 1009-284-2018. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Mitry D, Charteris DG, Yorston D, et al.: The epidemiology and socioeconomic associations of retinal detachment in Scotland: a two-year prospective population-based study. Invest Ophthalmol Vis Sci. 2010, 51:4963-8. 10.1167/iovs.10-4100
2. Regler R, Sachs HG, Hillenkamp J, Helbig H, Framme C: Long-term evaluation of anatomic and functional results after complicated retinal detachment treated with pars plana vitrectomy and heavy silicone oil tamponade. Klin Monbl Augenheilkd. 2009, 226:707-12. 10.1055/s-0028-1109685
3. Kunimoto DY, Kaiser RS: Incidence of endophthalmitis after 20- and 25-gauge vitrectomy. Ophthalmology.
2007, 114:2153-7. 10.1016/j.opththa.2007.08.009
4. Rizzo S, Polizzi S, Barca F, Caporossi T, Virgili G: Comparative study of 27-gauge versus 25-gauge vitrectomy for the treatment of primary rhegmatogenous retinal detachment. J Ophthalmol. 2017, 2017:6384985. 10.1155/2017/6384985
5. Fujii GY, De Juan E Jr, Humayun MS, et al.: A new 25-gauge instrument system for transconjunctival sutureless vitrectomy surgery. Ophthalmology. 2002, 109:1807-12. 10.1016/s0161-6420(02)01179-x
6. Ahmadieh H, Moradian S, Faghihi H, et al.: Anatomic and visual outcomes of scleral buckling versus primary vitrectomy in pseudophakic and aphakic retinal detachment: six-month follow-up results of a single operation—report no. 1. Ophthalmology. 2005, 112:1421-9. 10.1016/j.ophtha.2005.02.018
7. Mitsuji K, Kogo I, Takeda H, et al.: Comparative study of 27-gauge vs 25-gauge vitrectomy for epiretinal membrane. Eye (Lond). 2016, 30:538-44. 10.1038/eye.2015.275
8. Romano MR, Cennamo G, Ferrara M, Cennamo M, Cennamo G: Twenty-seven-gauge versus 25-gauge vitrectomy for primary rhegmatogenous retinal detachment. Retina. 2017, 37:637-42. 10.1097/IAE.0000000000001215
9. Mura M, Tan SH, De Smet MD: Use of 25-gauge vitrectomy in the management of primary rhegmatogenous retinal detachment. Retina. 2009, 29:1299-304. 10.1097/IAE.0b013e3181aa0f5f
10. Johnson Z, Ramsay A, Cottrell D, Mitchell K, Stannard K: Triple cycle audit of primary retinal detachment surgery. Eye (Lond). 2002, 16:513-8. 10.1038/sj.eye.6700145
11. Iwahashi-Shima C, Sato T, Bando H, Ikeda T, Emi K: Anatomic and functional outcomes of 25-gauge vitrectomy for repair of eyes with rhegmatogenous retinal detachment complicated by proliferative vitreoretinopathy. Clin Ophthalmol. 2015, 7:2045-9. 10.2147/OPHTH.S52260
12. Yorston D, Jalali S: Retinal detachment in developing countries. Eye (Lond). 2002, 16:555-8. 10.1038/sj.eye.6700188
13. Mitry D, Awan MA, Borooah S, et al.: Surgical outcome and risk stratification for primary retinal detachment repair: results from the Scottish Retinal Detachment study. Br J Ophthalmol. 2012, 96:750-4. 10.1136/bjo-2011-300581
14. Kunikata H, Nishida K: Visual outcome and complications of 25-gauge vitrectomy for rhegmatogenous retinal detachment; 84 consecutive cases. Eye (Lond). 2010, 24:1071-7. 10.1038/eye.2010.41
15. Poulsen CD, Green A, Grauslund J, Peto T: Visual outcome and complications of 25-gauge vitrectomy for primary rhegmatogenous retinal detachment. Ophthalmic Res. 2020, 65:25-33. 10.1159/000499130
16. Jamil MH, Farooq N, Khan MT, et al.: Characteristics and pattern of rhegmatogenous retinal detachment in Pakistan. J Coll Physicians Surg Pak. 2012, 22:501-4.
17. Takkar B, Azad SV, Bhatia I, Azad RV: Late presentation of retinal detachment in India: a comparison between developing nations. Natl Med J India. 2017, 30:116.
18. Day S, Grossman DS, Mruthyunjaya P, Sloan FA, Lee PP: One-year outcomes after retinal detachment surgery among medicare beneficiaries. Am J Ophthalmol. 2010, 150:338-45. 10.1016/j.ajo.2010.04.009
19. Scartozzi R, Bessa AS, Gupta OP, Regillo CD: Intraoperative sclerotomy-related retinal breaks for macular surgery, 20- vs 25-gauge vitrectomy systems. Am J Ophthalmol. 2007, 143:155-6. 10.1016/j.ajo.2006.07.038
20. Faia LJ, McCannel CA, Pulido JS, Hatfield RM, Hatfield ME, McNulty VE: Outcomes following 25-gauge vitrectomies. Eye (Lond). 2008, 22:1024-8. 10.1038/eye.2008.153
21. Süsskind D, Neuhann I, Hilgers RD, Hagemann U, Szurman P, Bartz-Schmidt KU, Aisenbrey S: Primary vitrectomy for rhegmatogenous retinal detachment in pseudophakic eyes: 20-gauge versus 25-gauge vitrectomy. Acta Ophthalmol. 2016, 94:824-8. 10.1111/aos.13133
22. Banker TP, Reilly GS, Jalal S, Weichel ED: Epiretinal membrane and cystoid macular edema after retinal detachment repair with small-gauge pars plana vitrectomy. Eur J Ophthalmol. 2015, 25:365-70. 10.5301/ejo.000609
23. Williamson TH, Shrumugam M, Rodrigues I, Dogramaci M, Lee E: Characteristics of rhegmatogenous retinal detachment and their relationship to visual outcome. Eye (Lond). 2015, 29:1063-9. 10.1038/eye.2015.136
24. Dell’Omo R, Barca F, Tan HS, Bijl HM, Oberstein SY, Mura M: Pars plana vitrectomy for the repair of primary, inferior rhegmatogenous retinal detachment associated to inferior breaks. A comparison of a 25-gauge versus a 20-gauge system. Graefes Arch Clin Exp Ophthalmol. 2013, 251:485-90. 10.1007/s00417-012-2059-8
25. Shorgia G, Niro A, Shorgia L, et al.: One-year outcomes of 27-gauge versus 25-gauge pars plana vitrectomy for uncomplicated rhegmatogenous retinal detachment repair. Int J Retina Vitreous. 2019, 5:13. 10.1186/s40942-019-0164-0