

# Surgical Outcomes Of Pars Plana Vitrectomy In Aded And Prognostic Factors For Poor Visual Outcomes

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## Abstract

**Objective:** To assess the visual and anatomical outcomes of pars plana vitrectomy (PPV) in patients with advanced diabetic eye disease (ADED) and to determine the prognostic factors associated with poor visual outcomes.

**Methods:** A cross-sectional study was conducted among those who underwent PPV for ADED at Al Ibrahim Eye Hospital from January 2023 to December 2023. Visual acuity before surgery, intraoperative surgical details, and complications after surgery were documented. Outcomes after surgery, including best-corrected visual acuity (BCVA) and retina status, were assessed at 3- and 6-month follow-ups. Indications for surgery included tractional retinal detachment (TRD), persistent vitreous haemorrhage (VH), and vitreomacular interface abnormalities. Bivariate and multivariate logistic regression analyses assessed factors associated with poor visual outcomes.

**Results:** Of the 50 eyes analysed, 67.5% of patients achieved mild vision impairment (6/36 or better) by the final follow-up. Mean BCVA improved significantly from 1.85 logMAR preoperatively to 1.47 logMAR at six months ( $p < 0.05$ ). Poor preoperative visual acuity, macular involvement, and iris neovascularisation were identified as significant predictors of poor visual outcomes ( $p < 0.05$ ). Final anatomical attachment was achieved in 82.5% of cases. Postoperative complications included VH (10%), retinal detachment (5%), and neovascular glaucoma (2.5%).

**Conclusions:** To improve or stabilise vision in patients with ADED, PPV proved to be effective with high rates of retinal reattachment. Prognostic factors such as preoperative VA and involvement of the macula emphasise the need for timely intervention and careful intraoperative management to optimise outcomes.

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**Keywords:** Retinal detachment, Vitrectomy, Visual acuity, Diabetic retinopathy

## Introduction

Diabetic retinopathy stands as a prominent contributor to blindness in the working population. Its occurrence becomes more prevalent with prolonged diabetes duration, almost all individuals with insulin-dependent (type 1) diabetes and in non-insulin dependent (type 2) more than 60% of individuals present with diabetic retinopathy later than 20 years.<sup>1</sup> India, second in line only to China, has approximately 77 million patients with diabetes, and is poised to encounter a rising array of microvascular complications, among which diabetic retinopathy (DR) stands most prevalent.<sup>2</sup>

A quarter of diabetes-related vision loss is caused by proliferative diabetic retinopathy (PDR), which is associated with the formation of new capillaries on the retina and optic disc as a result of hypoxia and capillary blockage.<sup>3</sup> The age at which diabetes mellitus (DM) first manifests is believed to have a significant impact on the development and progression of diabetic retinopathy (DR) and its associated consequences, such as vitreous haemorrhage (VH), tractional retinal detachment (TRD), and severe fibrovascular proliferation.<sup>4</sup>

Those with early-onset illness may experience these effects quickly. Among the sight-threatening complications of DR, TRD is particularly problematic.<sup>5</sup> It can be challenging to do vitrectomy in

### Contributions:

U.H. - Conception of study  
- Experimentation/Study Conduction  
U.H, T.M - Analysis/Interpretation/Discussion  
U.H, M.H, A.H, S.H. - Manuscript Writing  
U.H, M.H, S.H. - Critical Review

All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

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### Institutional Review Board Approval

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young patients due to extensive, significant active fibrovascular growth, vitreoretinal adhesion, and an increased risk of neovascular glaucoma (NVG), recurrent VH, and recurrent retinal detachment as surgical sequelae.<sup>6-8</sup>

Many diabetics continue to experience serious sight-threatening complications, like TRD, even after the implementation of diabetic eye screening programs, strict glycemic control and advanced treatment for proliferative DR (PDR). Round about 5% of PDR patients still need pars plana vitrectomy (PPV) for TRD, although they had been treated by panretinal photocoagulation.<sup>9</sup>

The management of advanced diabetic eye diseases typically involves a spectrum of surgical interventions, including vitrectomy, laser photocoagulation, intravitreal injections, and increasingly, the utilisation of innovative technologies such as microincisional vitreoretinal surgery and sustained-release drug delivery systems.<sup>10</sup> However, the effectiveness, safety, and long-term visual outcomes of these surgical approaches in the context of advanced diabetic eye diseases remain areas of active investigation.

Advanced diabetic eye disease (ADED) results in tractional retinal detachment (TRD) and dense vitreous haemorrhage (VH). VH arises when blood seeps into the vitreous from injured arteries. Diabetes-related vascular disease causes retinal ischaemia, which is followed by the release of vascular endothelial growth factor (VEGF). The main cause of neo-vessels is Vascular endothelial growth factor (VEGF).<sup>11</sup> PPV plays an important role in the management of complex ADED. Since Robert Machemer's initial successful treatment in 1970 in the diabetic patient with dense organised VH, this approach has seen a significant technological advancement in recent decades. Surgical equipment has become extremely small in size in recent years.

The idea of microincision vitreoretinal surgery (MIVS) has gained huge popularity after the introduction of trocars that are 23-, 25-, and 27-gauge, which enables minimally invasive surgery.

Modern vitrectomy equipment is very advanced with enhanced cut rates, better fluidics, and optimized intraoperative intraocular pressure control makes the procedure safer and more effective than earlier.

Recent advancements enable surgeons to undertake extensive vitreous shave. Proper treatment of the whole retina is also made possible by the latest wide-angle viewing systems, contemporary auxiliary endoillumination devices (chandeliers), and cutting-edge curved or steerable endolaser probes. Alongside this technological progress, the criteria for diabetic vitrectomy have evolved, shifting from more traditional conditions like TRD and VHs to more intricate conditions including macular oedema, neovascular glaucoma, vitreomacular tractions, and epiretinal membranes.

Clearing media opacities, release of vitreoretinal tractions, epiretinal membrane peeling, endolaser photocoagulation, tamponade use for retinal tears are the objectives of PPV in DR. Furthermore, because there is no scaffold for proliferation, the vitreous cutting proved to be successful in raising the oxygen concentration in the retina and inhibiting the development of fibrovascular membrane.<sup>12</sup> The rationale is to find out the surgical outcomes of advanced diabetic eye disease and poor prognostic factors.

## Materials And Methods

A cross-sectional study was done in the retina department of Al Ibrahim Eye Hospital from January 2023 to December 2023 with a 6-month follow-up. Prior ethical approval was sought from the ethical committee of the hospital. A sample was calculated through OpenEpi by the proportion method. After depicted population size is 1000 (expected cases of PPV per year), and the proportion of improved vision in vitrectomy is 85%.<sup>13</sup> Keeping a 95% confidence interval, 10% and a margin of error. A sample size was found to be 47. Patients were prepared for surgery by two experienced retinal consultants. Preoperative visual acuity was recorded using Snellen charts. Routine preoperative tests like RBS, BP, Hepatitis Profile, Urea, and Creatinine were done. Each consultant documented Intraoperative details. Early (within 1 month) and late complications after surgery were documented. Postoperative visual acuity was assessed at 3 and 6 months, and anatomical outcomes are considered successful when the retina was found to be completely attached with no features of proliferation at 6 months.

Records were kept of demographic information, ophthalmologic findings, surgical techniques, and anatomical and visual results. Four groups of surgical indications were identified: persistent or recurrent VH; abnormalities of the vitreomacular interface (VMI), such as severe macular traction; combined TRD and RRD; or macula-threatening or macula-involved TRD. Early onset was defined as postoperative VH that occurred within four weeks of primary vitrectomy, and late onset as VH that occurred after that time. Patients who were monitored for a maximum of six months had their final visual and anatomical results examined. A visual acuity of 3/60 or lower was considered a poor visual outcome.

Data was analysed by using SPSS V.23.0, after checking normality of data by the Shapiro-Wilk test. Data found to be normally distributed. Mean±S.D was used for continuous variables. All categorical variables were presented in terms of frequencies and percentages. The chi-square test was used to compare vision in the Snellen chart. To see the association of factors with poor visual outcomes, bivariate logistic regression was used. For p value < 0.2, the variables were entered into a multiple logistic regression model.<sup>14</sup> A p-value <0.05 was considered statistically significant.

## Results

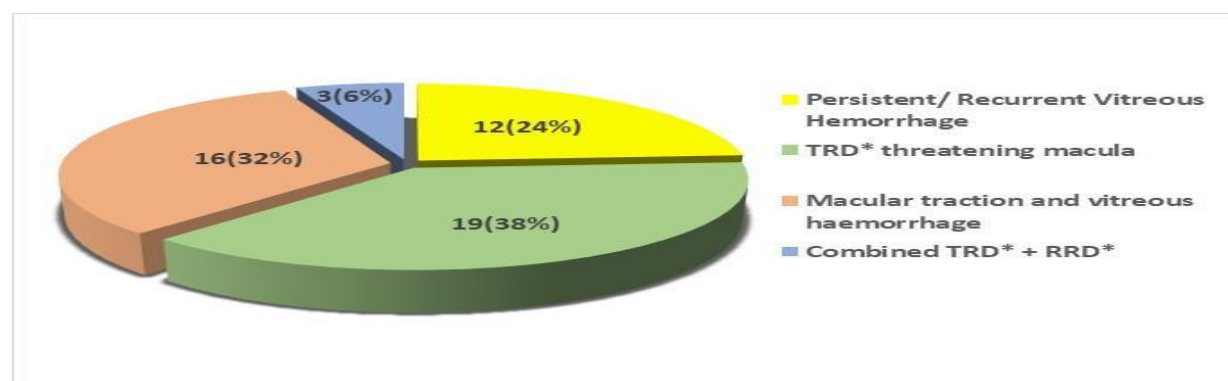
A total of 50 eyes of 50 patients, comprising 70%(n=35) males and 30%(n=15) females included in the study. The mean age was  $49.3 \pm 9.5$  years. The majority of the patients, 66%(n=33), had a duration of diabetes of more than 10 years. The demographic and pre-operative characteristics of the patients are summarised in **Table 1**.

**Table 1: Demographic and pre-operative characteristics of the vitrectomy patients**

| Descriptive Statistics            |                |                    |
|-----------------------------------|----------------|--------------------|
| <b>Age (years)</b>                |                |                    |
|                                   | Mean $\pm$ S.D | 49.3 $\pm$ 9.5     |
|                                   | Range          | 23-72              |
| <b>Gender, n(%)</b>               |                |                    |
|                                   | Male           | 35 (70)            |
|                                   | Female         | 15 (30)            |
| <b>Weight (kg)</b>                |                |                    |
|                                   | Mean $\pm$ S.D | 68.3 $\pm$ 13.9    |
|                                   | Range          | 40-110             |
| <b>Random Blood Sugar (mg/dL)</b> |                |                    |
|                                   | Mean $\pm$ S.D | 276.38 $\pm$ 111.9 |
|                                   | Range          | 82-552             |
| <b>Duration of Diabetes, n(%)</b> |                |                    |
|                                   | 1-5 years      | 5 (10)             |
|                                   | 6-10 years     | 12 (24)            |
|                                   | > 10 years     | 33 (66)            |
| <b>Diabetes management, n(%)</b>  |                |                    |
|                                   | Oral           | 25 (50)            |
|                                   | Insulin        | 18 (36)            |
|                                   | Combined       | 7 (14)             |
| <b>HbA1c status, n(%)</b>         |                |                    |
|                                   | Good (<6.5)    | 19 (38)            |
|                                   | Poor (>6.5)    | 31 (62)            |

Pars plana vitrectomy was done in 70%(n=35) eyes. Post-operative complications included vitreous hemorrhage 10%(n=4), postoperative retinal detachment 5%(n=2) and neovascular glaucoma 2.5%(n=1). Final anatomical attachment was achieved in 82.5% (n=33)

The commonest reasons for surgery were Tractional Retinal Detachment, 38%(n=19), followed by macular traction and vitreous haemorrhage, 32%(n=16), **Figure 1**



**Figure 1: Indications of Surgery**

Post-vitrectomy in the first week, 22%(n=11) patients achieved mild vision impairment (6/36 or better) as compared to pre-operative vision, 10%(n=5) with mean BCVA significantly improved from 0.72 to 0.45 logMar ( $p < 0.05$ ). Similarly, 8%(n=4) patients presented with moderate vision (<6/36 to 6/60) preoperatively which was improved to 28%(n=14) at first week and 41.6%(n=20) at first month ( $p < 0.05$ ). Furthermore, 82%(n=41) of patients had severe visual impairment (<6/60) preoperatively,

and this frequency was reduced to 50%(n=25) at the first week and 25% (n=10) at the last follow-up. At final follow-up, 67.5%(n=27) of patients achieved mild vision impairment (6/36 or better). **Table 2.** Mean BCVA significantly improved from 1.85 logMar preoperatively to 1.47 logMar at last month ( $p<0.05$ ).

**Table 2: Visual Outcomes of the patients who underwent vitrectomy**

| VA category    | Visits to patients |                         |                          |                          |                          | p-value |
|----------------|--------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------|
|                | Pre BCVA<br>n(%)   | First week<br>BCVA n(%) | First month<br>BCVA n(%) | Third month<br>BCVA n(%) | Sixth month<br>BCVA n(%) |         |
| 6/18 to 6/36   | 5 (10)             | 11 (22)                 | 12 (25)                  | 20 (44.4)                | 27 (67.5)                | 0.015   |
| < 6/36 to 6/60 | 4 (8)              | 14 (28)                 | 20 (41.6)                | 13 (28.8)                | 3 (7.5)                  |         |
| < 6/60         | 41 (82)            | 25 (50)                 | 16 (33.3)                | 12 (26.6)                | 10 (25)                  |         |

### Risk factors associated with poor visual outcome

Patient's age, gender, and duration of diabetes were not found to be independently associated with poor visual outcomes. Multivariate analysis showed that poor pre-operative VA, involvement of macula, like macular detachment and iris neovascularisation, were significantly associated with poor visual outcomes. **Table 3**

**Table 3: Factors associated with poor visual outcomes**

| Factors                 | cOR(95% C.I)        | p-value | aOR(95% C.I)       | p-value |
|-------------------------|---------------------|---------|--------------------|---------|
| Age (years)             |                     |         |                    |         |
| 23 - 35                 | Ref                 | 0.456   |                    |         |
| 36 - 50                 | 1.542(0.937-3.122)  |         |                    |         |
| > 50                    | 1.713(1.122-2.865)  |         |                    |         |
| Gender                  |                     |         |                    |         |
| Male                    | 1.120(0.763-3.345)  | 0.513   |                    |         |
| Female                  | Ref                 |         |                    |         |
| Duration of diabetes    |                     |         |                    |         |
| 1-5                     | Ref                 | 0.339   |                    |         |
| 6-10                    | 1.853(1.351-4.879)  |         |                    |         |
| > 10                    | 2.995(1.539-5.827)  |         |                    |         |
| Poor pre-operative VA   |                     |         |                    |         |
| Yes                     | 2.148(1.619-6.883)  | 0.021   | 2.056(1.569-6.559) | 0.026   |
| No                      | Ref                 |         | Ref                |         |
| Macular detachment      |                     |         |                    |         |
| Yes                     | 1.219(0.576-2.579)  | 0.011   | 1.112(0.456-2.391) | 0.019   |
| No                      | Ref                 |         | Ref                |         |
| Iris neovascularization |                     |         |                    |         |
| Yes                     | 1.673(0.185-2.457)  | 0.045   | 1.256(0.171-3.131) | 0.039   |
| No                      | Ref                 |         | Ref                |         |
| Rubeosis                |                     |         |                    |         |
| Yes                     | 2.612(0.319-21.423) | 0.371   |                    |         |
| No                      | Ref                 |         |                    |         |

## Discussion

In patients with advanced diabetic eye illness, this study provides a thorough assessment of the surgical results after vitrectomy, emphasising both visual and anatomical improvements after surgery.

Macular traction with vitreous haemorrhage (32%), recurring or persistent vitreous haemorrhage (24%), and TRD endangering the macula (38%) were the main reasons for vitrectomy.

These results are consistent with previous research showing that dense vitreous haemorrhage and TRD continue to be the most frequent causes of vitrectomy in individuals with proliferative diabetic retinopathy (PDR).<sup>15</sup>

A small percentage (6%) of patients required surgery due to combined Rhegmatogenous and tractional retinal detachment (TRD + RRD), which is a complex and severe complication that poses significant surgical challenges.<sup>16</sup>

### Visual Outcomes

Post-operative visual outcomes showed a marked improvement in best-corrected visual acuity (BCVA). Pre-operatively, 82% of patients had low vision, which reduced to 50% and 33.3% at the first week and first month, respectively. Similar findings were reported by Yorston et al,<sup>17</sup> who documented similar improvements in vision post-vitrectomy for advanced diabetic eye disease. At six months, 67.5% of patients with mild visual impairment (logMAR 0.8-1.0) showed substantial visual recovery. These

findings are comparable to previous studies that have demonstrated the efficacy of vitrectomy in improving visual outcomes, especially in cases of diabetic macular oedema and tractional maculopathy.<sup>18</sup>

The statistically significant improvement in mean BCVA from 0.72 logMAR pre-operatively to 0.45 logMAR at the first week ( $p < 0.05$ ) and from 1.85 logMAR to 1.47 logMAR at one month ( $p < 0.05$ ) further supports the role of early surgical intervention in preventing irreversible vision loss.<sup>19</sup> Such results highlight the importance of timely referral and management of PDR patients with severe complications, which is critical in preventing blindness.<sup>20</sup>

Lastly, final anatomical success in our study, with 82.5% of cases achieving retinal attachment, is on par with findings from another Pakistani study, where the majority of patients achieved anatomical success, reflecting the efficacy of modern vitrectomy techniques in managing complex diabetic eye disease also align closely with findings from large cohorts, such as those reported by Khaled G. et al., where success rates for anatomical attachment post-vitrectomy ranged from 85% to 95%.<sup>21,22</sup>

Post-operative complications were relatively low, with vitreous haemorrhage (10%), retinal detachment (5%), and neovascular glaucoma (1%) being the most common and in line with international studies.<sup>22</sup> The rate of retinal detachment and vitreous haemorrhage in this study is consistent with prior studies that reported rates between 5% to 15% for post-vitrectomy complications.<sup>23</sup> Importantly, 82.5% of patients achieved final anatomical attachment, indicating the success of PPV in managing diabetic complications.<sup>24</sup> As the sample size is limited, it may restrict the generalizability of findings along with, a long period of follow-up can provide us with more details of outcomes and recurrence rates of post-operative complications. Future studies should also explore the impact of adjunctive treatments, such as anti-VEGF therapy, in conjunction with vitrectomy for improving both anatomical and functional outcomes.<sup>25</sup>

## Conclusions

This study demonstrates how effective PPV is in treating diabetic complications, with notable visual acuity improvement and a decreased incidence of post-operative complications. Early surgical intervention, combined with appropriate management of systemic factors such as glycemic control, can lead to favourable functional and anatomical outcomes in patients suffering from proliferative diabetic retinopathy.

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