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Original Research Article

Clinical Outcomes of Pars Plana Vitrectomy in Proliferative Diabetic Retinopathy Patients Without Pre-Operative Anti-VEGF Therapy

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Abstract:

Introduction: Proliferative diabetic retinopathy (PDR) is a severe complication of diabetes that can lead to significant vision loss. Pars plana vitrectomy (PPV) is a surgical treatment option, but its outcomes without pre-operative anti-VEGF therapy need further study. Aim: To investigate the anatomical and visual outcomes in patients with PDR undergoing PPV without pre-operative anti-VEGF treatment.

Material and Method: This prospective interventional study was conducted at a tertiary eye care hospital from July 2020 to July 2022, involving 52 eyes from 52 patients. Comprehensive pre-operative and post-operative evaluations were conducted, and patients were followed up at one week, one month, and three months postoperatively.

Results: The mean age of patients was 53.29 years, with a predominance of males. Most patients had type 2 diabetes for an average of 10 years. Vitrectomy with silicone oil tamponade was used in most cases, with 12% of cases also undergoing cataract surgery. The primary indications for surgery were non-resolving vitreous hemorrhage and tractional retinal detachment. Significant visual improvement (p=0.0008) was observed one-month post-surgery, which continued through the three-month follow-up (p=0.006). Visual recovery was slower in cases with tractional retinal detachment compared to other indications. Early post-operative complications included bleeding and vitreous hemorrhage. Eyes with macula-involving tractional retinal detachment had poorer visual outcomes compared to those without macula involvement. By the end of the study, one case of vitreous hemorrhage and two cases with traction were noted.

Conclusion: Pars plana vitrectomy effectively improves visual acuity in proliferative diabetic retinopathy patients without pre-operative anti-VEGF therapy. There is a risk of immediate post-operative rebleeding, and visual recovery is slower in tractional retinal detachment cases. Visual improvements are sustained short-term, though outcomes are poorer in macula-involving cases.

Keywords: Proliferative diabetic retinopathy, pars plana vitrectomy, visual outcomes, anti-VEGF, tractional retinal detachment.

Introduction

Proliferative diabetic retinopathy (PDR) is one of the most severe complications of diabetes, characterized by the growth of abnormal blood vessels on the retina, which can lead to significant vision loss.[1,2] If left untreated, PDR can result in vitreous hemorrhage and tractional retinal detachment, both of which can cause permanent blindness.[3] Pars plana vitrectomy (PPV) is a surgical procedure commonly used to manage these complications by removing the vitreous gel and any blood or scar tissue from the eye, thus stabilizing or improving vision.[4,5] Anti-vascular endothelial growth factor (anti-VEGF) therapy is often used pre-operatively to reduce the risk of intraoperative bleeding and to improve surgical outcomes.[6] However, in some clinical scenarios, pre-operative anti-VEGF treatment may not be feasible due to various reasons such as patient contraindications or urgent surgical needs.[7,8] This study aims to investigate the anatomical and visual outcomes in patients with PDR undergoing PPV without pre-operative anti-VEGF therapy, providing insights into the effectiveness and safety of this approach in real-world clinical settings.

Material and Methods

This prospective observational clinical study was conducted at a tertiary eye care hospital from July 2020 to July 2022. The study aimed to evaluate the anatomical and visual outcomes in patients with

proliferative diabetic retinopathy (PDR) undergoing pars plana vitrectomy (PPV) without pre-operative anti-VEGF therapy.

The study included 52 eyes from 52 patients. The inclusion criteria were patients with non-resolving vitreous hemorrhage, presence of tractional retinal detachment, or combined retinal detachment. Patients who had received intravitreal anti-VEGF injections within three months prior to PPV or had other causes of proliferative retinal disease, such as CRVO, BRVO, vasculitis, Eales disease, or trauma, were excluded.

Pre-operative assessments included a thorough history (both ocular and systemic), evaluation of metabolic control, measurement of visual acuity/BCVA, and B/L slit lamp examination to rule out rubeosis iridis. Intraocular pressure was assessed bilaterally, and detailed retinal evaluations were performed using indirect ophthalmoscopy and slit lamp 90 dioptre biomicroscopy. Ultrasonography was also conducted as part of the pre-operative assessment.

Informed written consent was obtained from all patients after explaining the procedure and its possible complications. Surgeries were performed under local anesthesia with a peribulbar block and close monitoring by an anesthetist. The eye was prepared using 5% povidone iodine, and three 23G pars plana vitrectomy ports were created. Anterior vitrectomy was performed, and posterior hyaloid separation was achieved using triamcinolone staining if necessary. Tangential traction was relieved, and haemostasis was maintained with endocautery.

Complete peripheral vitreous clearing was followed by air-fluid exchange and endolaser photocoagulation. An intraoperative tamponade (air, C3F8, or silicone oil) was used, and the sclerotomies were sutured or left unsutured as needed. Post-operatively, a subconjunctival injection of gentamicin, dexamethasone, and a mydriatic agent was given, and the eye was patched with antibiotic steroid eye ointment.

Post-operative assessments were conducted on day 1, day 7, and at 1 and 3 months. Evaluations included BCVA for distance and near vision using the Snellen chart, intraocular pressure measurement, slit lamp examination for anterior segment assessment, and 90 dioptre examination. Binocular indirect ophthalmoscopy was also performed to monitor retinal status. Patients were advised on proper positioning based on the location of retinal breaks and macular status. Follow-up treatments included a combination of antibiotic with steroid eye drops, cycloplegic, and intraocular pressure-lowering medications.

Results

The study included 52 patients with proliferative diabetic retinopathy undergoing pars plana vitrectomy, with a mean age of 53.29 years (range 21-75 years). The majority of patients (48%) were in the 51 to 60 years age group. Specifically, 12 patients (23.1%) were aged 61 to 70 years, 6 patients (11.5%) were aged 41-50 years, 3 patients (5.8%) were aged 21 to 30 years, and 3 patients (5.8%) each were in the 31 to 40 and 71 to 80 years age groups. The study noted a male predominance, with 73% (38 patients) being male and 27% (14 patients) female.

Diabetes duration varied among the patients, with 36 patients having diabetes for 1-10 years, 15 patients for 11-20 years, and 1 patient for 21-30 years. Those with diabetes for 10 years had a pre-operative visual acuity of 1.74 logMAR, which improved to 1.35 post-operatively. Patients with 11-20 years of diabetes had a pre-operative visual acuity of 1.71 logMAR, improving to 1.07 post-operatively. The single patient with diabetes for 21-30 years showed no change in visual acuity. (Figure 1).

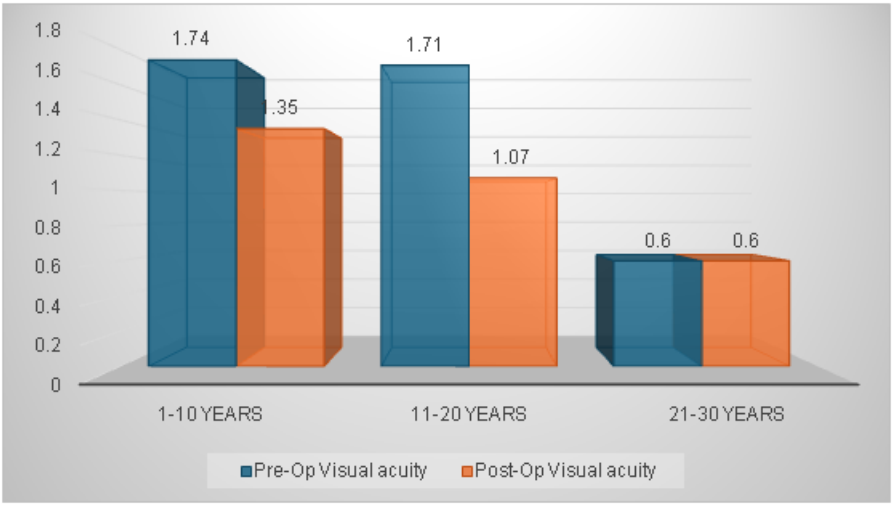

Figure 1: Visual acuity and Duration of DM

In terms of diabetes type, 41 patients (79%) had type 2 diabetes, while 11 patients (21%) had type 1 diabetes. Patients with type 1 diabetes showed a significant improvement in visual acuity from 1.65 pre-operatively to 1.14 post-operatively. Similarly, those with type 2 diabetes improved from 1.73 pre-operatively to 1.29 post-operatively, both improvements being statistically significant.

Regarding prior treatment, 28 patients (54%) had a history of panretinal photocoagulation (PRPC), while 24 patients (46%) did not. The indications for vitrectomy included vitreous hemorrhage (VH) in 24 eyes (46%), tractional retinal detachment (TRD) in 13 eyes (25%), and a combination of VH and TRD in 15 eyes (29%).

The types of surgeries performed were Pars Plana Vitrectomy with Silicone Oil Injection (63%), Pars Plana Vitrectomy with C3F8 Tamponade (25%), Pars Plana Vitrectomy combined with Cataract Surgery and Silicone Oil Injection (8%), and Pars Plana Vitrectomy combined with Cataract Surgery and C3F8 Tamponade (4%). (Table 1).

Table 1: Type of Surgeries Done

Surgical Procedure	Number of Patients	Percentage (%)
Pars Plana Vitrectomy + Silicone Oil Injection (PPV + SOI)	33	63
Pars Plana Vitrectomy + C3F8 Tamponade (PPV + C3F8)	13	25
Pars Plana Vitrectomy + Cataract Surgery + Silicone Oil Injection (PPV + CAT + SOI)	4	8
Pars Plana Vitrectomy + Cataract Surgery + C3F8 Tamponade (PPV + CAT + C3F8)	2	4
Total	52	100

In the immediate post-operative period, the mean best-corrected visual acuity (BCVA) was 1.70±0.02. At one month post-operatively, the mean BCVA improved to 1.48±0.04, and at three months, it further improved to 1.25±0.09. (Table 2) For the 52 eyes that underwent vitrectomy, the mean pre-operative visual acuity (VA) was 1.71±0.05, which remained statistically unchanged immediately post-surgery at 1.70±0.02 (p=0.414). However, significant improvements were observed at one month (1.48±0.04, (P<0.05)) and three months (1.25±0.09,(P<0.05)).

Table 2: Visual Acuity and Anatomical Outcomes

Post Operative Visit	Visual Acuity Range ± SD
Immediate	1.70 ± 0.02
1 Month	1.48 ± 0.04
3 Months	1.25 ± 0.09

In the vitreous hemorrhage (VH) group, the mean pre-operative BCVA was 1.78±0.00. Immediate post-operative BCVA improved to 1.69±0.02, which was statistically significant (p=0.002). Further significant improvements were noted at one month (1.41±0.03, p<0.05) and at three months (1.11±0.08, (p<0.05)). In the tractional retinal detachment (TRD) group, the mean pre-operative BCVA was 1.64±0.06. Immediate post-operative BCVA was 1.71±0.01, which was not significant (p=0.204). At one month, BCVA was 1.50±0.05(P<0.05), and at three months, BCVA improved to 1.34±0.07, which was significant (p=0.00098). In cases with combined VH and TRD, the mean pre-operative BCVA was 1.66±0.12. Immediate post-operative BCVA was 1.71±0.02 (not significant, p=0.24). At one month, BCVA was 1.58±0.04 (not significant, p=0.21), and at three months, BCVA improved to 1.41±0.09, which was significant (p=0.002). Significant improvement in visual acuity was observed at one and three months post-operatively across all groups. Preoperative visual acuity for all eyes was 1.71±0.05, improving to 1.25±0.09 at three months (p=0.01). For vitreous hemorrhage cases, it improved from 1.78±0.00 to 1.11±0.08 (p=0.002). Tractional retinal detachment cases improved from 1.64±0.06 to 1.34±0.07 (p=0.00098). Combined cases improved from 1.66±0.12 to 1.41±0.09 (p=0.002).

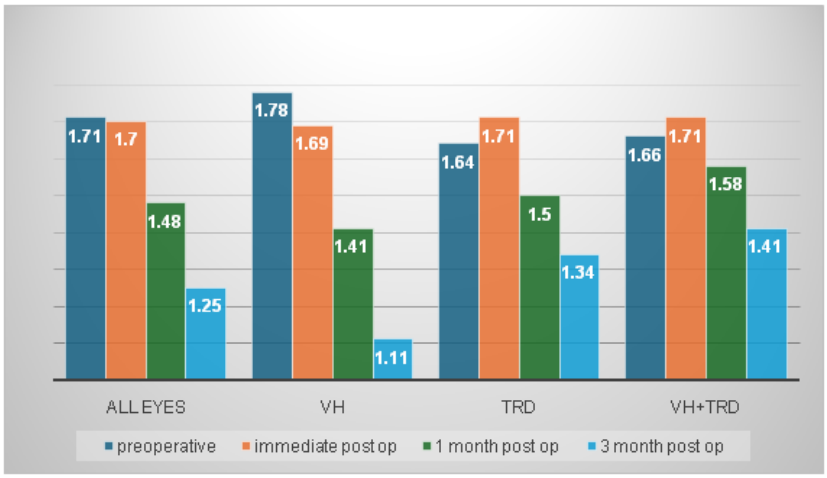

Figure 2: Pre and Post Operative Visual Acuity

Among cases with TRD involving the macula, the mean pre-operative BCVA was 1.72±0.05, and immediate post-operative BCVA was 1.80±0.00 (not significant, p=0.15). At one and three months, the p-values remained insignificant. For TRD not involving the macula, the mean pre-operative BCVA was 1.60±0.11, immediate post-operative BCVA was 1.65±0.03 (P>0.05). While significant improvements were noted at one month (p=0.02) and three months (p=0.007).

In this study, 24 eyes with VH and 13 eyes with TRD underwent PPV. In the VH group, 11 eyes showed immediate improvement post-operatively, while 5 eyes in the TRD group improved (p=0.00015). At one month, all 24 VH eyes showed improvement, while 8 TRD eyes showed improvement (P>0.05). At three months, one VH case deteriorated due to recurrence of VH, and 9 TRD eyes improved (P>0.05).

Immediate post-operative improvement was seen in 13 eyes with a history of PRPC and 9 eyes without PRPC (P<0.05). At one month, 22 eyes in the laser group and 19 in the non-laser group showed significant improvement. At three months, improvement was noted in both groups but was not significant

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Table 3: Comparison of Improvement in Visual Acuity in Eyes With and Without Vitreous Haemorrhage (VH)

Post Operative Visit	VH Improved	VH Not Improved	Without VH Improved	Without VH Not Improved	Statistical Analysis (Chi-Square Test)
Immediate	17	22	5	8	0.000385
1 Month	33	6	8	5	0.399503
3 Months	35	4	9	4	0.08564

In this study, in immediate post operative period, mean BCVA was 1.70±0.02, at 1 month it was 1.48±0.04, at 3 months post operatively it was 1.25±0.09.Of the 52 eyes which underwent vitrectomy the mean preoperative VA was 1.71±0.05 whereas immediately post-surgery the mean VA was 1.70±0.02 which was not statistically significant(P>0.05). At the end of 1 month, it was 1.48±0.04 which was statistically significant(P<0.05). At 3 months post operatively mean VA was 1.25±0.09 which was also significant with p value of <0.05.

Table 4: Comparison of Improvement in Visual Acuity in Eyes with and Without Tractional Retinal Detachment (TRD)

Post Operative Visit	TRD Improved	TRD Not Improved	Without TRD Improved	Without TRD Not Improved	Statistical Analysis (Chi-Square Test)
Immediate	11	17	11	13	0.05
1 Month	17	11	24	0	0.118
3 Months	21	7	23	1	0.079

In eyes with VH the mean BCVA was 1.78±0.00 preoperatively, immediate postoperatively it was 1.69±0.02 which was statistically significant(p>0.05) while 1 month post operatively the mean BCVA was 1.41±0.03 which was significant (p<0.05), 3 months post operatively

mean BCVA was 1.11±0.08 which also was significant ($p<0.05$).

Table 5: Comparison of Postoperative Visual Acuity in Patients with Tractional Retinal Detachment (TRD) Involving Macula and Not Involving Macula

Post Operative Visit	TRD Involving Macula (n=11) BCVA ± SD	P-Value	TRD Not Involving Macula (n=17) BCVA ± SD	P-Value
Preoperative	1.72 ± 0.05		1.60 ± 0.11	
Immediate	1.80 ± 0.00	0.15	1.65 ± 0.03	0.25
1 Month Postoperative	1.75 ± 0.00	0.348	1.41 ± 0.02	0.02
3 Months Postoperative	1.65 ± 0.03	0.177	1.20 ± 0.04	0.03

In TRD group, preoperative BCVA was 1.64±0.06 while immediately post operatively it was 1.71±0.01 which was not significant with p value=0.204. BCVA 1 month post operatively was 1.50±0.05 which was near to significance with p=0.06, while 3 months postoperatively BCVA was 1.34±0.07 which was significant with p=0.00098.

Table 6: Comparison of Improvement in Visual Acuity in Eyes with Laser vs. Without Laser

Post Operative Visit	Laser Improved	Laser Not Improved	No Laser Improved	No Laser Not Improved	Statistical Analysis (Chi-Square Test)
Immediate	13	15	9	15	0.000403
1 Month	22	6	19	5	0.048202
3 Months	23	5	21	3	0.01378

In cases with VH+TRD, preoperative BCVA was 1.66±0.12, immediate postoperative BCVA was 1.71±0.02 i.e., not significant with p=0.24, whereas BCVA 1 month postoperatively was 1.58±0.04 also not significant with p=0.21. 3 months postoperatively mean BCVA was 1.41±0.09 with p=0.002 i.e., significant.

At the end of three months, among the 52 patients, epiretinal membrane (ERM) was noted in 11 patients, recurrence of VH in 1 case, persisting traction in 2 cases, fibroglial proliferations in 16 cases, pre-retinal hemorrhage due to recurrence in 3 cases, and disc pallor in 8 patients.

Table 7: Post Operative Fundus Findings at 3 Months

Post Operative Findings at 3 Months	Number of Eyes	Percentage (%)
Epiretinal Membrane (ERM)	11	21%
Vitreous Hemorrhage (VH)	1	2%
Traction	2	4%
Fibroglial Proliferations (FGP)	16	31%
Preretinal Hemorrhage (PRH)	3	6%
Disc Pallor	8	15%

Discussion

As the prevalence of diabetes mellitus (DM) continues to rise, the management of diabetic retinopathy, particularly proliferative diabetic retinopathy (PDR), becomes increasingly important. The primary modalities for managing PDR include retinal photocoagulation, intravitreal anti-VEGF therapy, and in severe cases, vitreoretinal surgery. Pars plana vitrectomy (PPV) is particularly effective in PDR cases for clearing media opacities and relieving traction caused by fibrovascular tissue on the retina. The success of PPV in terms of visual and anatomical outcomes is influenced by various factors. In a study conducted by Adelman et al.[9], involving 84 eyes, the mean age of patients was 58 years, and 61 patients had type 2 diabetes. In comparison, our study included 52 patients with PDR who underwent PPV, with a mean age of 53.29 years. Among our patients, 73% were male, 69% had DM for 1-10 years, and 79% had type 2 diabetes. Additionally, 58% of our patients had other associated comorbidities.

A study by Thompson et al.[10] reported that in their study, 35% of PPV cases had vitreous hemorrhage (VH), 36% had tractional retinal detachment (TRD), 17% had combined tractional and rhegmatogenous retinal detachment, and 12% had fibrovascular proliferation. In our study, the most common indications for PPV were VH in 46% of cases, TRD in 25% of cases, and a combination of VH and TRD in 29% of cases.Dorota Borowicz et al.[11] found that postoperative visual acuity improved in 60% of cases and was worse or unchanged in 40% of cases, with greater improvements noted in the VH group. Our study similarly observed significant visual improvements, but with varying timelines for different conditions. In all patients who underwent vitrectomy, immediate postoperative visual improvement was not significant but became significant at three months postoperatively. Specifically, in eyes with VH, visual improvement

was significant immediately postoperatively, indicating early and substantial recovery in this group. In contrast, the TRD group showed significant visual improvement only at three months, suggesting that visual recovery in TRD cases takes longer. Similarly, in cases with both VH and TRD, significant visual improvement was observed at three months, indicating a delayed recovery in such cases.

These findings underscore the importance of tailoring management strategies for PDR based on individual patient characteristics and the specific indications for surgery. Early intervention in cases of VH can lead to quicker visual recovery, while TRD cases may require a longer postoperative period for significant improvements. Understanding these dynamics can help optimize treatment plans and improve outcomes for patients with PDR.

In a study by Ibrahim Taskintuna et al.[12], complete or partial vitreous hemorrhage (VH) clearance was achieved in 100% of eyes in the preoperative intravitreal bevacizumab-before-PPV group and 94.1% of eyes in the PPV-only group. The purpose of preoperative bevacizumab is to reduce intraoperative bleeding, induce regression of neovascularization, and facilitate fibrovascular membrane dissection. In our study, immediate postoperative VH was present in 13 cases.

A study by Priya Gupta et al.[13] found significant improvement in visual acuity (VA) at all time points ($p<0.0001$) for cases with preoperative VA of 20/80 or worse and preoperative VH. However, for those with preoperative VA of 20/70 or better, or without VH, no statistically significant improvement in VA was noted. In our study, comparison of visual outcome improvement in groups with and without VH showed no significant difference immediately postoperatively. However, at one and three months postoperatively, the group with VH showed significant improvement.

Similar findings were observed in comparing TRD and non-TRD groups. The differences were attributed to more fibrovascular proliferation and higher bleeding rates in the early postoperative period. A study by La Heij EC et al.[14] on 44 eyes undergoing vitrectomy for TRD involving the macula showed mean VA improvement from 20/800 to 20/160 after 10 months, with most eyes having a fully attached macula at the final examination. In our study, cases with TRD involving the macula showed insignificant visual outcome even at three months, suggesting that outcomes depend on the duration of detachment, macular ischemia, and photoreceptor disruption.

Dorota Borowicz et al.[11] found that preoperative logMAR BCVA improved from 1.39 ± 0.66 to 1.26 ± 0.56 in TRD patients and from 1.90 ± 0.07 to 1.65 ± 0.12 in VH patients postoperatively. This study demonstrated that PPV significantly improves vision in both VH and TRD groups, with more evident improvement in the VH group. Our study showed that visual recovery was achieved in both VH and TRD groups, but cases with VH experienced earlier visual recovery compared to the TRD group.

Damian I et al.[15] found that previous treatment with panretinal photocoagulation (PRPC) resulted in better visual acuity, although not significantly ($p>0.05$). In our study, pre-treatment with PRPC showed significant visual recovery immediately postoperatively ($p=0.0004$) and at one month ($p=0.04$). However, at three months, both PRPC and non-PRPC groups showed improvement, making the difference insignificant ($p=0.01$).

In a study by Yorston D et al.[16], postoperative VH was noted in 37 (22%) eyes, retinal detachment in 5 (3%) eyes, and rubeotic glaucoma in 5 (3%) eyes. In our study, traction post-vitrectomy was noted in 2 patients, and 1 patient had postoperative VH. Additionally, epiretinal membrane was observed in 11 cases, fibroglial proliferation in 16 cases, pre-retinal hemorrhage due to rebleeding in 3 cases, and disc pallor in 8 cases.

These findings highlight the complexity of managing PDR with PPV and the importance of considering various factors that influence visual and anatomical outcomes. Tailoring treatment plans based on individual patient characteristics and surgical indications can help optimize results and improve the quality of life for patients with PDR. Our study had several limitations. The small sample size was due to the limited time duration of the study. Additionally, the follow-up period was only three months, which is shorter than that reported in other studies. Furthermore, the study did not include a comparison group of patients undergoing PPV with preoperative anti-VEGF treatment. These factors may affect the generalizability and comprehensiveness of our findings.

Conclusion

Vitreous hemorrhage and tractional retinal detachment are the most common indications for pars plana vitrectomy in diabetic retinopathy. Patients with vitreous hemorrhage tend to present with significant worsening of visual acuity compared to other complications of proliferative diabetic retinopathy. Pars plana vitrectomy results in significant improvement of visual acuity in these patients. However, intraoperative challenges such as excessive bleeding that obscures the visual field and difficulty in cauterization and membrane separation are encountered. Visual recovery is gradual, and there is a risk of rebleeding in the immediate postoperative period. Nonetheless,

visual acuity improvement is sustained over a short-term follow-up. Eyes with tractional retinal detachment tend to show more gradual visual improvement compared to eyes with vitreous hemorrhage, and eyes with macula-involving tractional retinal detachment tend to have poorer visual outcomes.

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