Five-year outcomes of pars plana vitrectomy for macular edema associated with branch retinal vein occlusion

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Purpose: Long-term outcomes of pars plana vitrectomy (PPV) for macular edema (ME) associated with branch retinal vein occlusion (BRVO) have been previously reported, but the studies did not report the number of additional treatments after surgery. During 5 years of follow-up, we therefore investigated the efficacy and safety of PPV for BRVO and evaluated the incidence of additional treatments.

Methods: We retrospectively reviewed the medical records of 25 eyes of 24 patients who underwent PPV for ME associated with BRVO and were followed up for at least 5 years. Best-corrected visual acuity was measured, and foveal thickness was assessed by optical coherence tomography. Additional treatments were also investigated.

Results: The logarithm of the minimal angle of resolution (logMAR) improved from 0.53±0.23 at baseline to 0.16±0.25 at 5 years (P<0.0001). The foveal thickness decreased from 535±222 µm at baseline to 205±143 µm at 5 years (P<0.0001). For the eyes with residual ME, the following additional treatments were performed within 5 years of follow-up: sub-Tenon injection of triamcinolone acetonide in two eyes, intravitreal injection of bevacizumab in three eyes, grid laser photoacoagulation in one eye, and direct photoacoagulation of macroaneurysm in one eye. Additional surgeries were performed in two eyes: for one eye, phacoemulsification extraction of the ocular lens and intraocular lens implantation were performed because of cataract progression, and for the other eye, additional PPV was done for postoperative retinal detachment.

Conclusion: PPV was effective for resolution of ME associated with BRVO and improved visual acuity with a small number of additional treatments during long-term follow-up.

Keywords: branch retinal vein occlusion, macular edema, pars plana vitrectomy, 5-year outcomes

Introduction

Macular edema (ME) is a major cause of visual impairment in patients with branch retinal vein occlusion (BRVO). Many treatments for this disorder have been reported, such as photoacoagulation,1,2 intravitreal or sub-Tenon injection of triamcinolone acetonide (STTA),13–18 intravitreal tissue plasminogen activator injection,19,20 and dexamethasone intravitreal implantation.12 It has also been reported that pars plana vitrectomy (PPV) is effective for reducing ME and improving visual acuity (VA) in patients with BRVO.2,13–18 Although the precise mechanism by which PPV reduces ME is unknown, it has been suggested that PPV may have beneficial effects on retinal ischemia by allowing oxygenated fluid to circulate in the vitreous cavity,19 releasing vitreomacular attachment in persistent ME,17,20 improving perifoveal microcirculation,21 and/or increasing the clearance of VEGF in the vitreous cavity.22 Recently, intravitreal injection...
of anti-VEGF drugs (eg, bevacizumab, ranibizumab, and aflibercept) has been widely used and reported to be effective against ME associated with BRVO. However, recurrence of ME was often observed. In these cases, patients needed repeated injections, which could lead to increased risk of surgical complications as well as economic burdens. Therefore, it would be of benefit to the patients suffering from BRVO if the resolution of ME and improvement in VA could be maintained with minimal additional treatments. In this study, we investigated 5-year results of PPV for ME associated with BRVO to evaluate the efficacy and safety of the treatment as well as the incidences of additional treatments.

Subjects and methods

All procedures conformed to the tenets of the Declaration of Helsinki, and the study design was approved by the institutional review board of the Kobe City Medical Center General Hospital. The review board waived the need for written informed consent because the study design consisted of a retrospective chart review.

We retrospectively examined consecutive nonrandomized patients who underwent PPV for BRVO from September 2003 to October 2007 and completed a 5-year follow-up. Inclusion criteria were ME associated with BRVO, and best-corrected visual acuity (BCVA) was ≤0.6 in decimal VA. Exclusion criteria were proliferative diabetic retinopathy, vitreous hemorrhage, severe cataract, and other eye diseases that could contribute to visual loss. Eyes that were treated with PPV prior to the surgical intervention for BRVO were excluded. Eyes with previous scatter photocoagulation were included, but those with previous grid pattern photocoagulation were excluded.

BCVA was measured using Landolt ring charts and converted into the logarithm of the minimal angle of resolution (logMAR). Optical coherence tomography (OCT) was performed to measure foveal thickness using an OCT 2 (Carl Zeiss, Oberkochen, Germany), 3D OCT-1000 (Topcon, Tokyo, Japan), or Spectralis OCT (Heidelberg Engineering, Dossenheim, Germany). A standard three-port PPV was performed using a 20-G system or a 23-G system. A posterior vitreous detachment was induced if the cortical vitreous adhered to the retina. If the ME showed no improvement within 3 months after surgery, additional treatments such as STTA, grid laser photocoagulation, and intravitreal injection of bevacizumab (IVB) were performed.

All values were presented as mean ± standard deviation. Paired t-tests were used to compare preoperative and postoperative BCVAs. To compare preoperative and postoperative foveal thicknesses, Welch’s t-tests were used because of missing values. Differences were considered statistically significant when the P-values were <0.01 following the Bonferroni correction.

Results

From September 2003 to October 2007, 61 eyes of 59 patients underwent PPV for ME associated with BRVO. Among these cases, 35 patients (36 eyes) withdrew before the 5-year follow-up visit. The change in BCVA of the dropped out patients is shown in Figure S1. As a result, 25 eyes of 24 patients with ME associated with BRVO were included in this study. All cases except one eye that had received STTA were treatment-naïve. The baseline characteristics of the study patients are summarized in Table 1. The mean age of the patients at surgery was 66.7±8.8 years (range, 51–87 years) and included 14 male (one case who underwent PPV in both eyes was counted as two) and 11 female eyes. The major branch of the retinal vein was occluded in 13 eyes, and the macular branch was occluded in 12 eyes. Fluorescein angiography revealed that 6 eyes were ischemic (≥5 disk areas of capillary nonperfusion) and 19 were nonischemic. The mean estimated elapsed time from the onset of the disease to surgery was 6.2±9.2 months (range: 0.5–36 months). The lens status before surgery was phakic in 23 eyes and pseudophakic in 2 eyes. For 22 of 23 phakic eyes, phacoemulsification of the ocular lens and intraocular lens (IOL) implantation were performed together with PPV to avoid postoperative nuclear sclerosis (Table 2). Intravitreal injection of triamcinolone acetonide (TA), arteriovenous sheathotomy, and internal limiting membrane peeling were combined with PPV in eight, four, and four eyes, respectively (Table 2). Endophotocoagulation was performed in five cases: four for intraoperative iatrogenic retinal tears and one for capillary nonperfusion (Tables 2 and 3). Temporary elevation of intraocular pressure (>21 mmHg) was observed in four eyes, which was controlled with temporary topical antiglaucoma medication in all cases.
Discussion

This study provided long-term results of PPV for ME associated with BRVO. Tachi et al\(^7\) reported that significant visual improvement was observed after PPV for BRVO in a follow-up period ranging from 12 to 32 months. Long-term

![Figure 1](https://www.dovepress.com/)

Figure 1 Changes in pre- and postoperative logMAR.

Notes: Error bars indicate standard deviations. *\(P<0.01\) versus baseline. **\(P<0.0001\) versus baseline.

Abbreviation: logMAR, logarithm of the minimal angle of resolution.

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**Table 2** Combined procedures with PPV

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEA + IOL</td>
<td>22</td>
</tr>
<tr>
<td>Intravitreal TA injection</td>
<td>8</td>
</tr>
<tr>
<td>Arteriovenous sheathotomy</td>
<td>4</td>
</tr>
<tr>
<td>ILM peeling</td>
<td>4</td>
</tr>
<tr>
<td>Photocoagulation</td>
<td>5</td>
</tr>
</tbody>
</table>

**Abbreviations:** PPV, pars plana vitrectomy; PEA + IOL, phacoemulsification and intraocular lens implantation; TA, triamcinolone acetonide; ILM, internal limiting membrane.

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**Table 3** Intra- and postoperative complications

<table>
<thead>
<tr>
<th>Complications</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative complications</td>
<td></td>
</tr>
<tr>
<td>Iatrogenic retinal tear</td>
<td>4</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td></td>
</tr>
<tr>
<td>Rhegmatogenous retinal detachment</td>
<td>1</td>
</tr>
<tr>
<td>Elevation of intraocular pressure</td>
<td>4</td>
</tr>
</tbody>
</table>

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**Table 4** Characteristics of the eyes that required additional treatments

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (years)</th>
<th>Sex</th>
<th>LogMAR at baseline</th>
<th>LogMAR at 5 years</th>
<th>Additional treatment</th>
<th>Months after PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72</td>
<td>M</td>
<td>0.52</td>
<td>-0.08</td>
<td>Nd:YAG</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>66</td>
<td>M</td>
<td>0.52</td>
<td>0.30</td>
<td>PPV</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>74</td>
<td>F</td>
<td>0.30</td>
<td>0.22</td>
<td>STTA</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>66</td>
<td>F</td>
<td>0.40</td>
<td>0.40</td>
<td>Grid PC</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>58</td>
<td>M</td>
<td>0.40</td>
<td>0.30</td>
<td>STTA</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>M</td>
<td>0.70</td>
<td>0.70</td>
<td>Nd:YAG</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>51</td>
<td>F</td>
<td>0.52</td>
<td>-0.08</td>
<td>STTA</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>73</td>
<td>F</td>
<td>0.52</td>
<td>0.00</td>
<td>Nd:YAG</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>M</td>
<td>0.40</td>
<td>0.30</td>
<td>Nd:YAG</td>
<td>41</td>
</tr>
<tr>
<td>10</td>
<td>60</td>
<td>M</td>
<td>0.22</td>
<td>0.30</td>
<td>IVB</td>
<td>16</td>
</tr>
</tbody>
</table>

**Note:** Nd:YAG, Nd:YAG posterior laser capsulotomy.

**Abbreviations:** logMAR, logarithm of the minimal angle of resolution; PPV, pars plana vitrectomy; M, male; F, female; IVB, intravitreal injection of bevacizumab; PC, photocoagulation; STTA, sub-Tenon injection of triamcinolone acetonide; PEA + IOL, phacoemulsification and intraocular lens implantation.
against BRVO and indicated that 50% of the patients had associated with BRVO. 

Vitreous cavity have become a first-line treatment for ME 
cizumab, ranibizumab, pegaptanib, and aflibercept into the VA without additional treatments for an extended period PPV could maintain resolution of ME and improvement in Table 4), indicating that the majority of the eyes treated with direct photocoagulation of macroaneurysms, was five (20%; ME, such as STTA, IVB, grid laser photocoagulation, and 
of eyes that received additional treatments against residual 
ction and IOL implantation were performed simultaneously opacification in 5 out of 23 eyes in which phacoemulsifica 
was Nd:YAG laser capsulotomy for posterior capsule additional treatment performed during the 5-year follow-up 
fleatraction and foveal thickness (Figure 3). The most frequent 
showed improvement in VA from the baseline 31–48 months 
artovenous sheathotomy, and internal limiting membrane 
have an advantage in cases that require repeated injections 
the incidences of postoperative endophthalmitis were 0.020% (4 of 19,865 eyes), 0.028% (3 of 10,845 eyes), and 
0.021% (1 of 4,717 eyes) for 20-G, 23-G, and 25-G systems, respectively. 37

Summarizing these reports, the risk of postoperative RD in PPV was 10- to 100-fold higher than that in intravitreal injection. Indeed, postoperative RD occurred in one case in the present study (Tables 3 and 4). In contrast, the incidences of postoperative endophthalmitis were not so much different between PPV and intravitreal injections. It is possible that multiple injections increased the risk of endophthalmitis, potentially more than that of a single PPV. Therefore, although the application of PPV should be restricted, it may have an advantage in cases that require repeated injections of anti-VEGF drugs for maintaining resolution of ME.

Limitations of this study involve the retrospective data collection and the relatively small number of cases. More than half of the patients did not complete 5-year follow-up. It is possible that the patients with poor VA stopped to come to hospital before 5-year follow-up. To minimize the bias, we analyzed the patients who had completed 5-year follow-up; however, we cannot eliminate the possibility described earlier. Nonuniformity of surgical procedure among cases, such as intravitreal injection of TA, arteriovenous sheathotomy, and internal limiting membrane peeling, is another drawback of this study. However, we believe that our study provides valuable insight into the long-term outcomes of PPV for BRVO.

Conclusion
PPV was effective for improvement in VA and resolution of ME associated with BRVO. The effects lasted at least 5 years with minimal additional treatments. Although the incidences of postoperative RD were higher than that in intravitreal injections, PPV may have an advantage in cases
that require repeated injections of anti-VEGF drugs, because a smaller number of additional treatments can avoid the risks associated with repeated injections. Further investigation is required to clarify whether PPV is also effective for anti-VEGF-treated eyes.

Acknowledgment
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Disclosure
The authors report no conflicts of interest in this work.

References
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**Supplementary material**

![Graph showing changes in pre- and postoperative logMAR of patients who withdrew before the 5-year follow-up visit.](image)

**Figure S1** Changes in pre- and postoperative logMAR of the patients who withdrew before the 5-year follow-up visit.

**Abbreviation:** logMAR, logarithm of the minimal angle of resolution.