Trabeculectomy for Open-angle Glaucoma in Phakic Eyes vs in Pseudophakic Eyes After Phacoemulsification
A Prospective Clinical Cohort Study

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IMPORTANCE Whether pseudophakic eyes are resistant to trabeculectomy remains unknown.

OBJECTIVE To determine the effect of previous phacoemulsification on surgical success of trabeculectomy with mitomycin C for open-angle glaucoma.

DESIGN, SETTING, AND PARTICIPANTS Prospective clinical cohort study at Kumamoto University Hospital, Kumamoto, Japan, among patients 55 years or older having open-angle glaucoma with intraocular pressure (IOP) of 22 mm Hg or higher, including 39 phakic eyes (phakic group) and 25 pseudophakic eyes after phacoemulsification (pseudophakic group).

INTERVENTION Trabeculectomy with mitomycin C was performed.

MAIN OUTCOMES AND MEASURES The primary outcome measure was the probability of success at 1 year after trabeculectomy. Surgical failure was defined as the following 3 IOP levels: 21 mm Hg or higher (criterion A), 18 mm Hg or higher (criterion B), and 15 mm Hg or higher (criterion C). Secondary outcome measures included IOP, the number of postoperative antiglaucoma medications, and the number of laser suture lysis procedures, as well as postoperative complications.

RESULTS The probabilities of success at 1 year in the phakic vs pseudophakic groups were 95% vs 74% for criterion A (P = .02), 84% vs 62% for criterion B (P = .04), and 67% vs 53% for criterion C (P = .10). Only pseudophakia was significantly associated with outcome in the multivariable analysis for criterion A (relative risk, 9.37) and for criterion B (relative risk, 5.52) (P = .01 for both). Postoperative IOP in the pseudophakic group was significantly higher than that in the phakic group at 6 months (P = .03) and 9 months (P = .047) after trabeculectomy. No significant difference between groups was noted in postoperative complications or in the number of postoperative antiglaucoma medications or the number of laser suture lysis procedures.

CONCLUSIONS AND RELEVANCE Among patients with open-angle glaucoma, trabeculectomy with mitomycin C in pseudophakic eyes after phacoemulsification for target IOP of less than 21 mm Hg or less than 18 mm Hg is less successful compared with that in phakic eyes. No significant difference between phakic and pseudophakic eyes was observed for secondary outcome measures other than IOP.

TRIAL REGISTRATION clinicaltrials.gov Identifier: University Hospital Medical Information Network Clinical Trials Registry of Japan UMIN000001196.

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Trabeculectomy is the most common filtering surgical intervention for control of intraocular pressure (IOP) in patients with open-angle glaucoma (OAG). Reduction of IOP depends on aqueous humor filtration through a surgically created scleral flap and subsequent bleb formation in the conjunctiva. Fibroblast activation in the subconjunctiva and ocular inflammation may cause bleb scarring; younger patients and patients with uveitic glaucoma have higher risk for failure of trabeculectomy. Some studies report the attenuation of bleb scarring with intraoperative use of mitomycin C and postoperative topical corticosteroid eyedrops, which enhance IOP reduction after trabeculectomy.

In a previous retrospective study,7 higher risk for failure of trabeculectomy with mitomycin C among patients with OAG was demonstrated for pseudophakic eyes after phacoemulsification compared with phakic eyes. In OAG, the inflammatory cytokine concentration in the aqueous humor in pseudophakic eyes after phacoemulsification was higher than that in phakic eyes. However, no prospective studies to date have compared the outcome of trabeculectomy between phakic eyes and pseudophakic eyes after phacoemulsification. In this prospective study, the outcome of trabeculectomy with mitomycin C in patients having OAG was directly compared between phakic eyes and pseudophakic eyes after phacoemulsification.

**Methods**

**Patient Selection**

This study was approved by the institutional review board of Kumamoto University Hospital, Kumamoto, Japan. The protocol adhered to the tenets of the Declaration of Helsinki. The study was registered with the University Hospital Medical Information Network Clinical Trials Registry of Japan (identifier UMIN000001196; date of access and registration, June 18, 2008). Written informed consent was obtained from all patients after detailed explanation of the procedures involved.

This prospective clinical cohort study compared the outcome of trabeculectomy with mitomycin C between phakic eyes (phakic group) and pseudophakic eyes after phacoemulsification (pseudophakic group) among patients having OAG. Patients were recruited between June 18, 2008, and December 31, 2010, at Kumamoto University Hospital using the following inclusion criteria: age 55 years or older, primary OAG or exfoliation glaucoma, no history of intraocular surgery other than phacoemulsification, phakic eyes or pseudophakic eyes previously treated with phacoemulsification, and eyes with IOP of 22 mm Hg or higher (despite administration of antiglaucoma medication) measured at least once within 3 months before trabeculectomy. The pseudophakic group included only eyes with previous phacoemulsification and posterior chamber intraocular lens implantation. Exclusion criteria were aphakic eyes, eyes with previous vitrectomy, eyes with a history of glaucoma surgery before trabeculectomy, and pseudophakic eyes previously treated with intracapsular or extracapsular cataract extraction. If both eyes in the same patient satisfied the inclusion criteria, the eye with the higher preoperative IOP was included in the study.

**Surgical Procedures**

All trabeculectomy procedures were identically performed by 3 experienced surgeons (M.I., T.I., and H.T.) during the study period. A 5-mm conjunctival incision was made along the limbus to create a fornix-based conjunctival flap at the superior conjunctiva. If mobility in the conjunctiva of the pseudophakic eye was disturbed because of previous scleral incisions related to phacoemulsification, the mobile conjunctiva, which was separated from the immobile conjunctiva, was chosen for the conjunctival flap during trabeculectomy. A 4-mm-wide half-layer scleral flap was also created. Mitomycin C (0.4 mg/mL) was applied on and under the scleral flap, as well as under the conjunctiva, for 4 minutes, after which the eye was irrigated with physiological saline (200 mL). A deep limbal block was excised to create a fistula in the anterior chamber, after which peripheral iridectomy was performed. The scleral flap was closed using 3 sutures of 10-0 monofilament nylon. The conjunctival flap was also sutured with 10-0 monofilament nylon. All patients received similar postoperative topical medication with levofloxacin, 0.5%, for 1 month and betamethasone sodium phosphate, 0.1%, for 3 months.

**Data Collection**

Patient data were collected, including sex, age, visual field, type of glaucoma, preoperative IOP, postoperative IOP, best-corrected visual acuity (BCVA), the number of laser suture lysis procedures, and the number of postoperative antiglaucoma medications, as well as postoperative complications. Visual field testing was performed using static automated white-on-white threshold perimetry program 24-2 (Swedish interactive thresholding algorithm standard, model 750; Zeiss). If the eye had advanced visual field loss, perimetry program 10-2 was used. A logarithm of the reciprocal of the decimal BCVA was used to approximate the logarithm of the minimal angle of resolution (logMAR).

The initial study-related visit was scheduled 2 weeks after surgery; thereafter, visits were conducted 1, 3, 6, 9, and 12 months later. The IOP, BCVA, and number of postoperative antiglaucoma medications were measured before surgery and at all postoperative visits. Complications were also assessed at all postoperative visits. Laser suture lysis and bleb needling were completed within 2 months of surgery depending on postoperative IOP and bleb formation. The study protocol included the timing of antiglaucoma medication following trabeculectomy. After surgery, IOP of all eyes was measured without antiglaucoma medication. If IOP was 21 mm Hg or higher at the time of the study visit at 1 month after surgery or later, we performed laser suture lysis or bleb needling and remeasured IOP 1 month later. If IOP was 21 mm Hg or higher at 2 consecutive visits after completion of laser suture lysis and bleb needling, antiglaucoma medication was initiated to prevent glaucoma progression.

**Primary Outcome Measure**

The primary outcome measure was the probability of success at 1 year after trabeculectomy based on IOP. The definition of success was based on a previous retrospective study of trabeculectomy in phakic vs pseudophakic eyes, with slight modifications. Surgical failure was defined as the following 3 IOP lev-
Recruitment and Retention
In total, 64 patients (39 phakic eyes and 25 pseudophakic eyes) were enrolled in the study. One patient in the phakic group and 3 patients in the pseudophakic group were lost to analysis before the 1-year follow-up visit. No significant difference between groups was noted in the number of patients who completed the 1-year follow-up visit (P = .29, Fisher exact test).

Baseline Characteristics
Table 1 summarizes the baseline characteristics of all patients. Patients in the pseudophakic group were significantly older than those in the phakic group (P = .005). No other statistically significant differences between groups were found in preoperative status. All patients in the pseudophakic group were treated with sclerocorneal incision phacoemulsification.

Primary Outcome Measure
Among patients in the phakic group who completed the 1-year follow-up visit, surgical failure occurred in 2 of 38 (5%), 6 of 38 (16%), and 11 of 38 (29%) based on criteria A, B, and C, respectively. Among patients in the pseudophakic group who completed the 1-year follow-up visit, surgical failure occurred in 6 of 22 (27%), 9 of 22 (41%), and 11 of 22 (50%) based on criteria A, B, and C, respectively. Significantly higher failure rates were found in the pseudophakic group for criterion A (P = .04, Fisher exact test) and criterion B (P = .03, χ² test). No significant difference between groups was found for criterion C (P = .10, χ² test). Insufficient IOP reduction was the cause of failure in all patients in both groups for all 3 criteria. No surgical failure because of loss of light perception was observed. No reoperation to reduce IOP was necessary during the follow-up period.

In the phakic group, success without antiglaucoma medication (complete success) was achieved for 35 of 38 (92%), 32 of 38 (84%), and 27 of 38 (71%) patients based on criteria A, B, and C, respectively. In the pseudophakic group, complete success was achieved for 15 of 22 (68%), 12 of 22 (55%), and 11 of 22 (50%) patients based on criteria A, B, and C, respectively. The rate of complete success was also significantly higher in the phakic group for criterion A (P = .02, χ² test) and criterion B (P = .01, χ² test). No significant difference between groups was seen for criterion C (P = .10, χ² test).

The results of the Kaplan-Meier survival curve analysis comparing the 2 groups for criteria A, B, and C are shown in the Figure. Significantly lower cumulative probability of success for criterion A (P = .02) and criterion B (P = .04) was observed for the pseudophakic group. However, no significant difference between groups was found for criterion C (P = .10). The probabilities of success at the 1-year follow-up visit in the phakic vs pseudophakic groups were 95% vs 74% for criterion A (P = .02), 84% vs 62% for criterion B (P = .04), and 67% vs 53% for criterion C (P = .10).

Secondary Outcome Measures
Intraocular pressure values at various follow-up time points were compared between groups (Table 2). Significantly higher postoperative IOP levels were observed in the pseudophakic group compared with the phakic group at 6 months (P = .03) and 9 months (P = .047) after trabeculectomy.

No significant difference between groups was found in the number of postoperative antiglaucoma medications needed after surgery (Table 2). More patients in the pseudophakic group compared with the phakic group required postoperative antiglaucoma medication at follow-up completion, although the difference was not significant (23% [5 of 22] vs 8% [3 of 38]; P = .10, χ² test). Fewer mean (SD) postoperative laser suture lysis procedures were performed in the phakic group (1.7 [1.2] sutures) than in the pseudophakic group (2.0 [1.3] sutures), but the difference was not significant (P = .33). No significant difference in the mean (SD) logMAR BCVA at 1 year after surgery was seen between the phakic group (0.40 [0.62]) and the pseudophakic group (0.55 [0.87]) (P = .85).

No significant difference between groups was found in postoperative complications (Table 3). Cataract progression occurred in 7 eyes (18%) in the phakic group. Choroidal detachment was...
observed more frequently in the pseudophakic group than in the phakic group, although the difference was not significant \( (P = .06)\). Bleb leak, wound leak, and flat anterior chamber were more common in phakic eyes, but no significant difference was observed compared with pseudophakic eyes. Deterioration of decimal BCVA to at least 0.3 at 1 year after surgery occurred more frequently in phakic eyes, but no significant difference was observed compared with pseudophakic eyes.

### Prognostic Factors for Failure of Trabeculectomy

Baseline characteristics, including sex, age, pseudophakia, logMAR BCVA, type of glaucoma, preoperative IOP, and the number of postoperative antiglaucoma medications, were evaluated as possible predictors of surgical failure. In analyses using univariable Cox proportional hazards regression models, pseudophakia was a significant risk factor based on criterion A (relative risk [RR], 5.20; \( P = .03\)) and a borderline risk factor based on criterion B (RR, 2.75; \( P = .05\)) (eTable in the Supplement). Multivariable analysis identified only pseudophakia as significantly associated with surgical outcome for criterion A (RR, 9.37; \( P = .01\)) and criterion B (RR, 5.52; \( P = .01\)) (Table 4). Pseudophakia was not significantly associated with surgical outcome for criterion C (RR, 2.33; \( P = .10\)).

### Discussion

In this study, the rate of failure of trabeculectomy with mitomycin C among patients with OAG was higher in pseudophakic eyes after phacoemulsification than in phakic eyes. In ad-
dition, significantly lower cumulative probabilities of success for criterion A \((P = .02)\) and criterion B \((P = .04)\) were observed among patients in the pseudophakic group. After adjustment for other potential prognostic factors in the Cox proportional hazards regression models, the independent contribution of pseudophakia to the prediction of surgical failure was confirmed for criterion A (RR, 9.37) and criterion B (RR, 5.52) \((P = .01)\) for both.

Numerous studies\(^9\)\(^-\)\(^13\) indicate that patients with glaucoma who undergo cataract surgery exhibit resistance to maintaining target IOP after trabeculectomy. Previous reports included pseudophakic and aphakic eyes after extracapsular or intracapsular cataract extraction. Cataract extraction may cause extensive scarring in the superior location of the conjunctiva, where trabeculectomy should be performed. Surgical scarring in the conjunctiva may contribute to a poor outcome of trabeculectomy in pseudophakic or aphakic eyes. Phacoemulsification causes less scar formation in the conjunctiva of patients with glaucoma. A recent retrospective study compared the surgical prognosis of trabeculectomy between 175 phakic eyes and 51 pseudophakic eyes after phacoemulsification among patients with OAG.\(^7\) In that study, the probabilities of

![Kaplan-Meier Survival Curves of the Probability of Success in the Phakic Group and the Pseudophakic Group](image-url)

**Figure.** Kaplan-Meier Survival Curves of the Probability of Success in the Phakic Group and the Pseudophakic Group

A, Criterion A (intraocular pressure \(\geq 21\) mm Hg, \(P = .02\)). B, Criterion B (intraocular pressure \(\geq 18\) mm Hg, \(P = .04\)). C, Criterion C (intraocular pressure \(\geq 15\) mm Hg, \(P = .10\)).

<table>
<thead>
<tr>
<th>Time</th>
<th>Phakic Group</th>
<th>Pseudophakic Group</th>
<th>(P) Value</th>
<th>Phakic Group</th>
<th>Pseudophakic Group</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wk</td>
<td>9.6 (3.4)</td>
<td>9.2 (5.1)</td>
<td>.32</td>
<td>0.0 (0.0)</td>
<td>0.0 (0.0)</td>
<td>...</td>
</tr>
<tr>
<td>1 mo</td>
<td>12.0 (5.3)</td>
<td>14.3 (5.7)</td>
<td>.08</td>
<td>0.0 (0.0)</td>
<td>0.0 (0.0)</td>
<td>...</td>
</tr>
<tr>
<td>3 mo</td>
<td>11.8 (4.9)</td>
<td>13.3 (5.3)</td>
<td>.27</td>
<td>0.0 (0.0)</td>
<td>0.1 (0.4)</td>
<td>.22</td>
</tr>
<tr>
<td>6 mo</td>
<td>10.7 (4.2)</td>
<td>13.9 (5.4)</td>
<td>.03</td>
<td>0.1 (0.2)</td>
<td>0.3 (0.8)</td>
<td>.25</td>
</tr>
<tr>
<td>9 mo</td>
<td>11.2 (4.1)</td>
<td>13.9 (4.7)</td>
<td>.047</td>
<td>0.2 (0.6)</td>
<td>0.4 (0.9)</td>
<td>.49</td>
</tr>
<tr>
<td>12 mo</td>
<td>12.0 (4.8)</td>
<td>14.4 (5.7)</td>
<td>.09</td>
<td>0.2 (0.6)</td>
<td>0.5 (1.0)</td>
<td>.11</td>
</tr>
</tbody>
</table>

**Table 2. Intraocular Pressure and the Number of Postoperative Antiglaucoma Medications Over Time After Trabeculectomy**

<table>
<thead>
<tr>
<th>Time</th>
<th>Intraocular Pressure, mm Hg</th>
<th>No. of Postoperative Antiglaucoma Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Phakic Group</td>
</tr>
<tr>
<td>2 wk</td>
<td>9.6 (3.4)</td>
<td>9.2 (5.1)</td>
</tr>
<tr>
<td>1 mo</td>
<td>12.0 (5.3)</td>
<td>14.3 (5.7)</td>
</tr>
<tr>
<td>3 mo</td>
<td>11.8 (4.9)</td>
<td>13.3 (5.3)</td>
</tr>
<tr>
<td>6 mo</td>
<td>10.7 (4.2)</td>
<td>13.9 (5.4)</td>
</tr>
<tr>
<td>9 mo</td>
<td>11.2 (4.1)</td>
<td>13.9 (4.7)</td>
</tr>
<tr>
<td>12 mo</td>
<td>12.0 (4.8)</td>
<td>14.4 (5.7)</td>
</tr>
</tbody>
</table>

**Table 3. Postoperative Complications**

<table>
<thead>
<tr>
<th>Postoperative Complication</th>
<th>No./Total No. (%)</th>
<th>Phakic Group ((n = 39))</th>
<th>Pseudophakic Group ((n = 25))</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract progression</td>
<td>7 (18)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Choroidal detachment</td>
<td>6 (15)</td>
<td>9 (36)</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>Flat anterior chamber</td>
<td>9 (23)</td>
<td>2 (8)</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>Hyphema</td>
<td>6 (15)</td>
<td>5 (20)</td>
<td>.63</td>
<td></td>
</tr>
<tr>
<td>Wound leak</td>
<td>4 (10)</td>
<td>1 (4)</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Bleb leak</td>
<td>2 (5)</td>
<td>0</td>
<td>.52</td>
<td></td>
</tr>
<tr>
<td>Hypotony maculopathy</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Endophthalmitis or blebitis</td>
<td>0</td>
<td>0</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Deterioration of decimal BCVA</td>
<td></td>
<td>14/38 (37)</td>
<td>9/22 (41)</td>
<td>.75</td>
</tr>
<tr>
<td>≥0.2</td>
<td>14/38 (37)</td>
<td>9/22 (41)</td>
<td>.26</td>
<td></td>
</tr>
<tr>
<td>≥0.3</td>
<td>14/38 (37)</td>
<td>5/22 (23)</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: ellipsis, not applicable.

Abbreviations: BCVA, best-corrected visual acuity; ellipsis, not applicable.
success at 1 year after trabeculectomy in phakic eyes vs pseudophakic eyes were 97.8% vs 78.6% for IOP of less than 21 mm Hg, 92.9% vs 72.8% for IOP of less than 18 mm Hg, and 73.1% vs 53.1% for IOP of less than 15 mm Hg. In another recent study, prognostic factors for failure of trabeculectomy in uveitic glaucoma eyes were retrospectively analyzed. In addition to the association with granulomatous uveitis, previous cataract surgery was a prognostic factor for failure of trabeculectomy. In contrast, in a 20-year longitudinal study of surgical outcomes of patients who underwent trabeculectomy between January 1988 and December 1990, Landers et al10 showed that extracapsular cataract extraction was not significantly associated with qualified success of trabeculectomy. In another retrospective study, Supawaje et al44 reported that the probability of success of trabeculectomy for pseudophakic eyes was comparable to that for phakic eyes. The present study is unique in its prospective comparison between phakic eyes and pseudophakic eyes after phacoemulsification. In addition, the surgical procedure of trabeculectomy with mitomycin C was identical for all patients in this prospective study.

The pathomechanism for failure of trabeculectomy in pseudophakic eyes is not fully understood.15 Alterations in the nature of the aqueous humor may contribute to failure of trabeculectomy. Intracocular surgery causes ocular inflammation and breakdown of the blood-aqueous barrier, which may cause bleb failure after trabeculectomy.16 A high concentration of inflammatory cytokines has been shown in the aqueous humor of pseudophakic eyes with glaucoma.8 A prospective clinical study17 compared the concentration of monocyte chemotactant protein 1, an inflammatory cytokine, in the aqueous humor of patients with no eye disease other than cataract before and after phacoemulsification. In all 21 patients, monocyte chemotactant protein 1, which was collected 1 to 2 years after phacoemulsification, was upregulated in the aqueous humor. This cytokine recruits leukocytes in the anterior ocular segments, which may promote subconjunctival fibrosis and bleb scarring after trabeculectomy in pseudophakic eyes.

In this study, significant differences in failure rates, complete success rates, and Kaplan-Meier survival curves of the probability of success for criterion A and criterion B were observed between groups. For criterion C, no significant difference was found, although a poorer surgical outcome was observed in the pseudophakic group. The lack of statistical significance in the results for criterion C may be attributable to the few patients in the present study. A larger study may determine the true significance of this criterion.

While postoperative IOP values were significantly higher in the pseudophakic group at 6 months and 9 months after trabeculectomy, no significant difference was found at 12 months. During the follow-up period, antiglaucoma medication was administered for IOP reduction. More patients in the pseudophakic group than in the phakic group were treated with antiglaucoma medication at 12 months (23% [9 of 39] vs 8% [2 of 25]), but this trend was not significant. The difference between groups in IOP values at 12 months may have been influenced by postoperative administration of antiglaucoma medication, although the timing of such drug use after trabeculectomy was included in the study protocol.

In the analysis of postoperative complications, choroidal detachment was more often encountered in the pseudophakic group than in the phakic group, but the significance was borderline (P = .06). Jampel et al18 reported that older patients were more likely to experience choroidal detachment after trabeculectomy. In the present study, patients in the pseudophakic group were significantly older than those in the phakic group (P = .005). Therefore, the higher frequency herein of choroidal detachment in the pseudophakic group may have been associated with the fact that these patients were older. Despite a better surgical outcome, cataract progression occurred in 18% (7 of 39) of patients in the phakic group. Postoperative cataract development is frequently observed in phakic eyes among older patients after trabeculectomy.19,20 Future studies should include age-matched patients for more accurate comparison of these complications.

Deterioration of decimal BCVA to at least 0.3 at 1 year after surgery was more frequently observed in the phakic group than in the pseudophakic group (37% [14 of 38] vs 23% [5 of 22], P = .26). This higher incidence of visual disturbance may be associated with cataract progression. Moreover, phacoemulsification after trabeculectomy may have a detrimental effect on bleb function.21,22 In our study, phacoemulsification was not performed in eyes in which cataract progression was ob-

### Table 4. Multivariable Analysis to Identify Prognostic Factors for Failure of Trabeculectomy Using Cox Proportional Hazards Regression Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>A (RR 95% CI)</th>
<th>P Value</th>
<th>B (RR 95% CI)</th>
<th>P Value</th>
<th>C (RR 95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudophakia</td>
<td>9.37 (1.52-87.06)</td>
<td>.01</td>
<td>5.52 (1.47-24.31)</td>
<td>.01</td>
<td>2.33 (0.86-6.67)</td>
<td>.10</td>
</tr>
<tr>
<td>Sex, female vs male</td>
<td>0.56 (0.07-2.88)</td>
<td>.50</td>
<td>1.20 (0.38-3.62)</td>
<td>.75</td>
<td>1.08 (0.41-2.64)</td>
<td>.87</td>
</tr>
<tr>
<td>Age, per 1-y increase</td>
<td>0.95 (0.85-1.06)</td>
<td>.33</td>
<td>0.94 (0.87-1.02)</td>
<td>.12</td>
<td>0.98 (0.92-1.03)</td>
<td>.40</td>
</tr>
<tr>
<td>Type of glaucoma, exfoliation</td>
<td>1.82 (0.40-12.84)</td>
<td>.45</td>
<td>2.10 (0.69-7.85)</td>
<td>.20</td>
<td>1.77 (0.70-5.11)</td>
<td>.24</td>
</tr>
<tr>
<td>Preoperative intraocular</td>
<td>1.00 (0.91-1.08)</td>
<td>.93</td>
<td>1.00 (0.94-1.05)</td>
<td>.94</td>
<td>1.00 (0.95-1.05)</td>
<td>.91</td>
</tr>
<tr>
<td>Preoperative antiglaucoma</td>
<td>1.10 (0.34-3.46)</td>
<td>.88</td>
<td>1.16 (0.49-2.75)</td>
<td>.73</td>
<td>0.52 (0.23-1.14)</td>
<td>.11</td>
</tr>
<tr>
<td>BCVA, per 1-logMAR increase</td>
<td>0.23 (0.009-1.34)</td>
<td>.12</td>
<td>0.33 (0.06-1.09)</td>
<td>.07</td>
<td>0.87 (0.31-1.87)</td>
<td>.74</td>
</tr>
</tbody>
</table>

Abbreviations: BCVA, best-corrected visual acuity; logMAR, logarithm of the minimal angle of resolution; RR, relative risk.
Trabeculectomy for Open-Angle Glaucoma

observed during the follow-up period. Future studies should include a longer follow-up period, in which phacoemulsification after trabeculectomy may be necessary in phakic eyes and in which the outcome of trabeculectomy in phakic eyes may be affected by phacoemulsification after trabeculectomy.

One major limitation of the present study was that patients in the pseudophakic group were significantly older than those in the phakic group. Although the patient recruitment criteria included age 55 years or older, no age matching was performed between groups. The findings of several clinical studies2,23,24 have suggested that trabeculectomy is more likely to fail in younger patients. In the present study, a better surgical outcome was observed among patients in the phakic group, who were younger than those in the pseudophakic group. However, pseudophakia was confirmed as a significant independent prognostic factor for surgical outcome described by criterion A and criterion B in the Cox proportional hazards regression model. This result suggests that the primary outcome in this study may not be significantly influenced by the age difference between groups. Another limitation was that the study did not evaluate whether clear corneal incision was effective for improving surgical success in pseudophakic eyes. While trabeculectomy was performed in the superior conjunctiva, which was separated from the previous corneoscleral incision in phacoemulsification, the possibility of a residual effect of the previous small conjunctival incision apart from that at the site of trabeculectomy cannot be excluded. A prior retrospective study14 of pseudophakic eyes treated with clear corneal incision showed that the success rate in the pseudophakic group was comparable to that in the phakic group. However, another study25 demonstrated that clear corneal incision did not contribute to an improved prognosis in trabeculectomy for pseudophakic eyes. In a previous retrospective study,7 the eyes that underwent trabeculectomy after clear corneal incision phacoemulsification had a lower probability of success than the phakic eyes. Because these retrospective studies included small samples, a larger-scale prospective study is necessary to determine the contribution of clear corneal incision phacoemulsification to prognosis after trabeculectomy for pseudophakic eyes.

In conclusion, among patients with OAG, pseudophakic eyes after phacoemulsification exhibit greater resistance than phakic eyes to maintaining target IOP of less than 21 mm Hg or less than 18 mm Hg after trabeculectomy with mitomycin C. A larger prospective study among patients with OAG is required to determine whether pseudophakic eyes are also more resistant than phakic eyes to preserving target IOP of less than 15 mm Hg.

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REFERENCES


**OPHTHALMIC IMAGES**

**Racial Melanosis: A Striking Presentation**

Amir A. Azari, MD; Julia Agapov, DO, MD; Mozhgan Rezaei Kanavi, MD; Christina Larsen, MD; Heather D. Potter, MD; Daniel M. Albert, MD

Darkly pigmented conjunctival areas are seen in the right (A) and left (B) eyes of an 87-year-old African American woman with a history of glaucoma and bilateral trabeculectomy. The dark conjunctival lesions have been present for at least 40 years and were seen before any glaucoma medications had been started. There is no history of epinephrine use. C, Histopathological analysis reveals increased pigmentation of epithelial cells, predominantly in the basal layer (hematoxylin-eosin, original magnification £100).