

249.4 ± 71.3 μm (postoperative). Postoperative BCVA (range, 20/100 to 20/12.5; median, 20/32) was better than preoperative BCVA (range, 20/100 to 20/40; median, 20/50) in ERM cases (Table 2). Eight patients (80%) had an improvement of ≥2 Snellen lines, whereas BCVA remained the same or improved by 1 line for the other two patients. The only complication was the protraction of vitreous hemorrhage in one case, which was absorbed after observation. No other adverse effects such as retinal pigment epithelium atrophy were observed during the follow-up period in all cases.

### Discussion

The application of dyes such as ICG and TB has enabled surgeons to perform ILM and ERM peeling procedures with improved ease.<sup>1-6</sup> However, the adverse effects of these dyes on the retina have been widely reported.<sup>7-16</sup> Furthermore, there have been several recent reports demonstrating that the damage to retinal cells by ICG and TB causes apoptotic cell death.<sup>24,25</sup>

In the present study, a low dose of BBG (0.25 mg/mL) was found to selectively stain the ILM safely and with ease. The staining mechanism of BBG at the ILM still remains unknown. To our knowledge, this clinical study is the first report of the ophthalmic use of BBG in humans. Seventeen patients (85%) had visual acuity improved by at least 2 Snellen lines, and no adverse effects were observed postoperatively during the observation period.

BBG is a blue dye (color index 42655) with the formula C<sub>47</sub>H<sub>48</sub>N<sub>3</sub>O<sub>7</sub>S<sub>2</sub>Na (molecular weight, 854.0) that is also known as acid blue 90 and Coomassie BBG. BBG has been used for protein staining in biologic fields, because it binds nonspecifically to virtually all proteins. It is also used as a protein electrophoresis dye. The pharmacological function of BBG still remains unconfirmed. However, although there are no reports on the medical use of this dye, there is a long history of biologic use in which no apparent toxicity has been reported. Before this study, we examined the effects of intravitreal BBG on the morphology and functions of the retina in rat eyes and continued the investigation to examine the possible use of BBG for ILM staining and ILM peeling in primate eyes, because BBG is for experimental use only at present. In the rat eyes, no apparent pathologic changes were observed in all dose groups (from 0.01 mg/mL to 10 mg/mL) by light microscopy. Although electron microscopy showed cyst formation in the inner retinal cells in high-dose groups (1.0 mg/mL and 10 mg/mL), the apparent apoptotic cell death of the

retinal cell was not detected, and the amplitude of electroretinogram waves demonstrated no remarkable reduction after both 14 days and 2 months. In the primate eyes, the ILM was clearly visualized after the intravitreal injection of 0.5 mg/mL BBG.<sup>18</sup>

BBG has a number of advantages over other dyes such as ICG and TB. BBG is easier to handle than both ICG and TB because it is produced in a granular form that can be easily dissolved with intracocular irrigating solution alone and subsequently sterilized with a syringe filter. When compared with saline or intraocular irrigating solution, the osmolality and pH of the BBG solution are very stable.<sup>17,18</sup> The ILM staining pattern produced by the BBG solution was similar to that produced by the ICG solution. However, because BBG is not a fluorescent dye, there is little possibility of light toxicity such as that produced with ICG. Besides, no additional techniques such as fluid-gas exchange, which TB use requires, are needed for BBG staining.<sup>3,4</sup> Furthermore, the BBG concentrations required for staining the ILM are ≈1/10 to 1/20 lower than those required with ICG. The improvements in visual acuity achieved in this case study using BBG are comparable with those of previous studies using different dyes,<sup>2,4,7,12,15</sup> although it is thought that further safety evaluations of BBG for use in human eyes will be required in the future. Further investigation is necessary before any clinical recommendations can be given. From the results of our preclinical study<sup>17,18</sup> and this clinical study, we conclude that BBG is a potentially useful dye for ILM staining, making BBG-assisted membrane peeling a potentially effective and safe means of managing MH and ERM surgery.

**Key words:** brilliant blue G, vitrectomy, internal limiting membrane, epiretinal membrane, macular hole, clinical case series.

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