Long-term Follow-up of Full Macular Translocation for Choroidal Neovascularization

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Abstract

Purpose: To report the long-term (>5 years) results of full macular translocation in patients with choroidal neovascularization (CNV). **Design**: A retrospective, interventional case series. **Methods**: This study involved 32 eyes of 32 patients who had undergone full macular translocation for CNV. The median follow-up was 6.5 (range, 5.2-7.7) years. We evaluated the best corrected visual acuity, fundus examinations before, 1 year, and 5 years after operation, and postoperative complications. **Results**: At the 1-year follow-up, foveal retinal pigment epithelium (RPE) atrophy was observed in only 3 eyes (12%), and the mean logarithm of the minimum angle of resolution (logMAR) at that time (1.39±0.67) was not significantly changed from that before operation (logMAR, 1.31±0.66) in 25 eyes with age-related macular degeneration (AMD). However, at 5-year follow-up, foveal RPE atrophy increased (18 eyes, 72%), and final mean logMAR (1.88±0.76) was significantly lower ($P<0.01$). Five eyes with myopic CNV maintained their visual acuity (VA) from before operation (mean logMAR, 0.88±0.35) until final follow-up (mean logMAR, 0.73±0.31). The final VA was significantly better in myopic CNV than in exudative AMD on multiple regression analysis ($P=0.019$). **Conclusion**: Long-term follow-up of full macular translocation showed that the final VA was poor in AMD, but relatively better in myopic CNV.

Introduction

Age-related macular degeneration (AMD) is the leading cause of legal blindness among the elderly in industrialized countries[1], and there has been a recent trend for the number of such patients to increase in Japan[2]. Full macular translocation has been performed to treat exudative AMD[3]. Recently, however, the main treatments for choroidal neovascularization (CNV), including exudative AMD, have become anti-vascular endothelial growth factor (VEGF) therapy[4] and photodynamic therapy (PDT)[5], because long-term follow-up has shown that macular translocation is not effective[6] and has a high rate of postoperative complications, such as proliferative vitreoretinopathy and retinal detachment.

Most studies have reported a favorable outcome with 2 years of follow-up after full macular translocation[7-12]. On the other hand, there are a few reports with follow-up of 3 years or longer, and their results were poor[6]. In this report, the long-term results (at least 5 years of follow-up) are reported for patients who underwent full macular translocation.

Methods

Full macular translocation was performed for CNV in 45 eyes of 45 patients from November 1999 to June 2002 at Nagasaki University. This study involved 32 eyes of

32 patients with follow-up of 5 years or longer. CNV was classified, and CNV lesion sizes were measured by fluorescein angiography preoperatively[13]. The best corrected visual acuity (BCVA), fundus examinations before, 1 year, and 5 years after operation, and postoperative complications were reviewed retrospectively using the patients' clinical records.

Surgical technique: The surgical procedure included phacoemulsification and implantation of an intraocular lens (IOL) in phakic eyes. Then, three-port pars plana vitrectomy was performed, posterior vitreous detachment was induced, and the vitrectomy was completed to the vitreous base. Balanced saline solution was injected to induce total retinal detachment, and 360° retinotomy was performed at the posterior edge of the vitreous base. Then, CNV was removed, a small amount of perfluorocarbon liquid was injected onto the retinal surface, and the retina was rotated in order to move the fovea to the normal area of retinal pigment epithelium (RPE). Perfluorocarbon liquid was added up to the edge of the retinotomy site, and peripheral laser retinopexy was performed at the edge of the retinotomy sites in all quadrants after retinal re-attachment. Silicone oil tamponade was performed at the end of the procedure. The mean duration of silicone oil tamponade was 5 months.

Statistical analysis: Results are expressed as means±standard deviation. Analysis of variance with Tukey's test was used to compare BCVA before and after

operation. Multiple regression analysis was used to evaluate final BCVA, which is known to be related to age, etiology of CNV (AMD, myopic), and preoperative BCVA. Logistic regression analysis was used to evaluate the relationships between CNV recurrences and age, sex, etiology of CNV (AMD, myopic), type of CNV (classic, occult), lesion size, preoperative BCVA, final BCVA, and tobacco use. Statistical analysis was performed using Statflex ver. 5.0 software.

Results

The study included 32 eyes of 32 patients (8 females, 24 males; mean age at operation, 66.6 years) that underwent full macular translocation. All patients were Japanese. The causes of CNV were exudative AMD in 25 eyes, myopic in 5 eyes, idiopathic in 1 eye, and angioid streaks in 1 eye. The mean duration of follow-up was 6.5 years (range, 5.2-7.7 years). A clear IOL was used in all patients. Fourteen patients were tobacco users.

The exudative AMD group included 5 female and 20 male patients, with a mean age at operation of 70.5 years (Table 1). On fluorescein angiography, 18 eyes had classic CNV, and 7 had occult CNV. The mean lesion size was 5.6±3.1 Macular Photocoagulation Study (MPS) disc areas (range, 2-16 MPS disc areas). Operative complications included iatrogenic retinal break, macular hole, subretinal

perfluorocarbon liquid, and subretinal hemorrhage in 1 eye each. The subretinal perfluorocarbon liquid was removed at the silicone oil removal operation if the perfluorocarbon liquid was located in the posterior pole. Macular holes and subretinal hemorrhages were likely to affect the visual acuity (VA), but the others had no effect on the VA because the complications were unrelated to the macular lesion. Postoperative complications within 1 year after operation were: proliferative vitreoretinopathy in 5 eyes; epiretinal membrane (ERM) in 5 eyes; superficial punctate keratitis in 3 eyes; and secondary glaucoma in 3 eyes. All cases of proliferative vitreoretinopathy were resected successfully by re-operation, and ERMs were removed at the silicone oil removal operation in 4 cases. It took over 1 month for superficial punctate keratitis to be cured by topical hyaluronate sodium treatment after operation. With respect to secondary glaucoma, silicone oil-induced glaucoma occurred in 2 eyes, but ocular tension improved when the silicone oil was removed. Neovascular glaucoma complicated with diabetic retinopathy occurred in 1 eye 3 years after full macular translocation, but ocular tension improved with topical β-blocker therapy after panretinal photocoagulation and cyclophotocoagulation. These postoperative complications were also likely to affect the VA. However, the mean logarithm of the minimum angle of resolution (logMAR) was not significantly different between the 13 cases with operative or postoperative complications and the

12 cases with no complications (p=0.77). CNV recurrence developed in 5 (20%) of 25 eyes. Two cases were under observation because of lower CNV activity. PDT was performed in 2 cases, after which the activity decreased. CNV removal was performed in 1 case by re-operation.

VA before operation, VA 1 year after operation, and final VA were compared in AMD (Figures 1-4). A normal fovea was defined as one without edema or RPE atrophy on ophthalmoscopic examination. At the 1-year follow-up, mean logMAR was 1.39±0.67, which was not significantly changed from the VA before operation (mean logMAR, 1.31±0.66) in AMD. However, at the 5-year follow-up, final VA (mean logMAR, 1.88±0.76) was significantly lower than before operation ($p<0.01$) (Figure 4). One year after operation, a normal fovea was observed in 18 eyes (72%), and RPE atrophy was observed in 3 eyes (12%). However, 5 years or longer after operation, a normal fovea was observed in only 4 eyes (16%), while RPE atrophy was observed in 18 eyes (72%) because of progressive degeneration (Table 1). VA was worse in the abnormal fovea group than in the normal fovea group 5 years or longer after operation, but the difference was not statistically significant (p=0.051). In the 4 eyes with a normal fovea at 5 years, VA was good in 3 eyes, but progressive visual loss due to an unknown cause occurred in 1 eye. At the final observation, VA was worse than before operation in 18 eyes (72%), there were no changes in 3 eyes (12%), and

VA was improved in 4 eyes (16%).

In the myopic CNV group, there were 3 female and 2 male patients, with a mean age at operation of 51.0 years (Table 1). Four eyes had classic CNV, and 1 eye had occult CNV. The mean lesion size was 2.8±1.1 MPS disc areas (range, 2-4 MPS disc areas). Postoperative complications within 1 year after operation were ERM, glaucoma, and ischemic optic neuropathy in 1 eye each. ERM was removed at the time of silicone oil removal. The glaucoma was under observation and treated with eye drops. VA was decreased in the ischemic optic neuropathy case because of optic nerve atrophy. CNV recurrence developed in 1 eye (20%), but no treatment was given because of low CNV activity. VA before operation (mean logMAR, 0.88±0.35) was maintained until the final follow-up (mean logMAR, 0.73±0.31) (Figure 5). Five years or longer after operation, a normal fovea was observed in 2 eyes (40%), and RPE atrophy was observed in 3 eyes (60%) (Table 1).

On multiple regression analysis, the final VA was better in myopic CNV than in exudative AMD ($p=0.019$). Logistic regression analysis showed that there were no significant differences in characteristics (age, sex, etiology of CNV, type of CNV, lesion size, preoperative VA, final VA, and tobacco use) between patients with CNV recurrence and those without CNV recurrence.

Discussion

Many cases of full macular translocation for exudative AMD have been reported[6-10]. However, most of these reported the results of follow-up of up to only 2 years[7-10], while only a few reported long-term follow-up results[6]. In reports with follow-up of up to 2 years after operation, full macular translocation was reported to be useful, because postoperative VA was improved or not changed compared to the preoperative VA[7-9]. Although Aisenbrey et al. also reported that full macular translocation was useful because VA improved by 3 lines in 25% of patients 1 year after operation[10], they later reported that final VA was poor in most of these cases 3 years after operation because of foveal RPE atrophy or CNV recurrences[6]. Although VA before operation was maintained and the new foveae were almost normal at 1-year follow-up in the present study, progressive visual loss was observed in over 70% of all patients because of foveal RPE atrophy, which is similar to the report by Aisenbrey et al[6].

The most common cause of visual loss was RPE atrophy in the new fovea, which advanced slowly in the present study. RPE atrophy spread from the original fovea to the new one in these cases. The natural history of the VA in patients with exudative AMD is poor with no therapy, and we often found that RPE atrophy spread widely in patients with low activity CNV. The choroidal abnormal vessel network is

often large, and RPE function in this area is considered to be low. Therefore, the new fovea would sometimes become atrophic if the original fovea was moved over the seemingly normal RPE. There was an interesting report that RPE geographic atrophy had spread rapidly after full macular translocation for atrophic AMD[14]. RPE cell implantation has been tried for RPE atrophy, but it did not achieve good results[15]. The other possible reason for RPE atrophy was RPE damage by CNV removal or artificial retinal detachment. However, the cause was unknown, because RPE atrophy did not develop immediately after the operation, and RPE atrophy did not always develop in the macular area in rhegmatogenous retinal detachment.

Long-term visual acuity was relatively better in full macular translocation for myopic CNV in the present study. Glacet-Bernard et al. compared the results of limited macular translocation for AMD and myopic CNV with follow-up of nearly 9 months[16]. The improvement in visual acuity was better in the myopic group than in the AMD group, and they considered that the prognosis for VA was affected by the smaller foveal displacement, the lower rate of recurrence and retinal detachment, and the younger age in the myopic group. The only prognostic factor for better VA after macular translocation was younger age in the myopic group in the present study, which is similar to the report by Glacet-Bernard et al.

It has been reported that the average VA was stable for 2 to 5 years after a

single PDT treatment, but decreasing VA was found in 35% of cases[5]. On the other hand, decreasing VA (3 or more lines decrease) was found in 14 eyes (56%) 5 years or longer after full macular translocation in AMD in this study. Therefore, VA with full macular translocation was worse than with a single PDT treatment 5 years after treatment. However, treatments for AMD were not simply compared because of the different populations and different types of AMD. We performed full macular translocation for CNV cases with very poor VA, such as 1.0 (logMAR) or worse, and with very wide degenerative lesions. Gelisken et al. suggested that full macular translocation should not be offered as a standard primary procedure for AMD because the era of anti-VEGF therapy would come, even though the chance for vision improvement was significantly higher in the full macular translocation group than in the PDT group 1 year after treatment in their study[17]. It has been reported that VA with a single anti-VEGF treatment was better than that without therapy 2 years after treatment [4]. In many reports, the current main treatment for CNV is combined PDT and anti-VEGF therapy or triamcinolone acetonide[18, 19]. It is necessary to consider the long-term follow-up results of such therapy.

In conclusion, full macular translocation for exudative AMD has a poor prognosis, but selected cases of myopic CNV with foveal fibrosis or high activity in which PDT[20] or anti-VEGF therapy is ineffective may benefit from full macular

translocation.

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d. Ethical approval for this study was obtained from the Ethics Committee, Nagasaki University School of Medicine, and informed consent was obtained from all patients.

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FIGURE 1. Visual acuity before and 1 year after full macular translocation for age-related macular degeneration. Visual acuity shows almost no change. VA = visual acuity; logMAR = logarithm of the minimum angle of resolution

FIGURE 2. Visual acuity before and best visual acuity after full macular translocation for age-related macular degeneration. Best visual acuity is better than that before operation, but the difference is not statistically significant. The period of best visual acuity was 9 months after operation in 16 cases and 15 to 32 months after operation in 9 cases. VA = visual acuity; logMAR = logarithm of the minimum angle of resolution

FIGURE 3. Visual acuity before and final visual acuity after full macular translocation for age-related macular degeneration. Final visual acuity is significantly lower than before operation ($p<0.01$). logMAR = logarithm of the minimum angle of resolution

FIGURE 4. Progress of visual acuity in age-related macular degeneration. Final visual acuity is significantly lower than before operation. The period of best visual acuity was 9 months after operation in 16 cases and 15 to 32 months after operation in 9 cases. logMAR = logarithm of the minimum angle of resolution. *Analysis of variance with Tukey's test.

FIGURE 5. Progress of visual acuity in myopic choroidal neovascularization. The period of best visual acuity in 3 eyes was within 8 months after operation and in 1 eye 20 or 27 months after operation. Visual acuity is not significantly changed. logMAR =

logarithm of the minimum angle of resolution

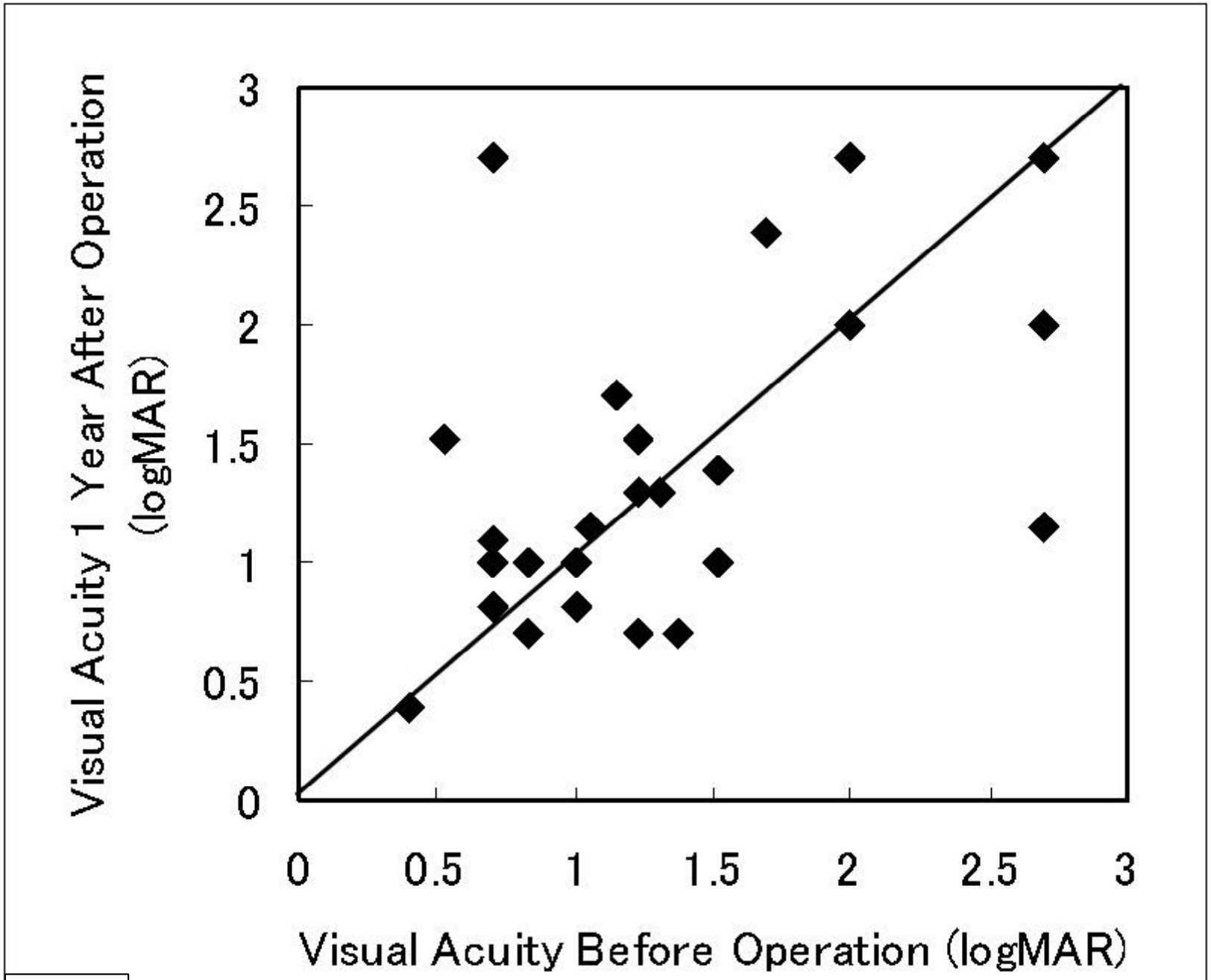
Visual Acuity 1 Year After Operation (logMAR)
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
Visual Acuity Before Operation (logMAR)

Fig. 1

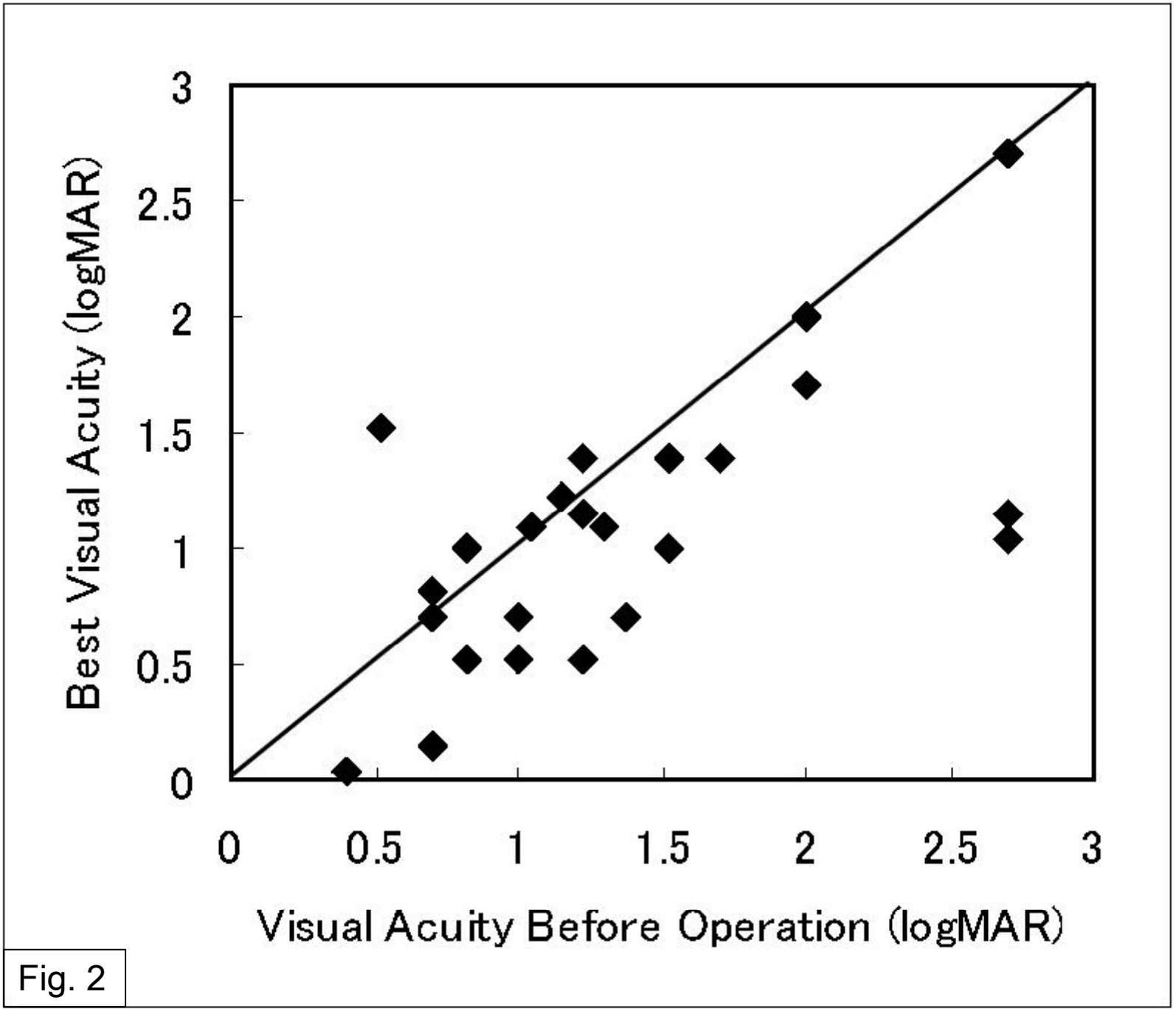
Best Visual Acuity (logMAR)
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
Visual Acuity Before Operation (logMAR)

Fig. 2

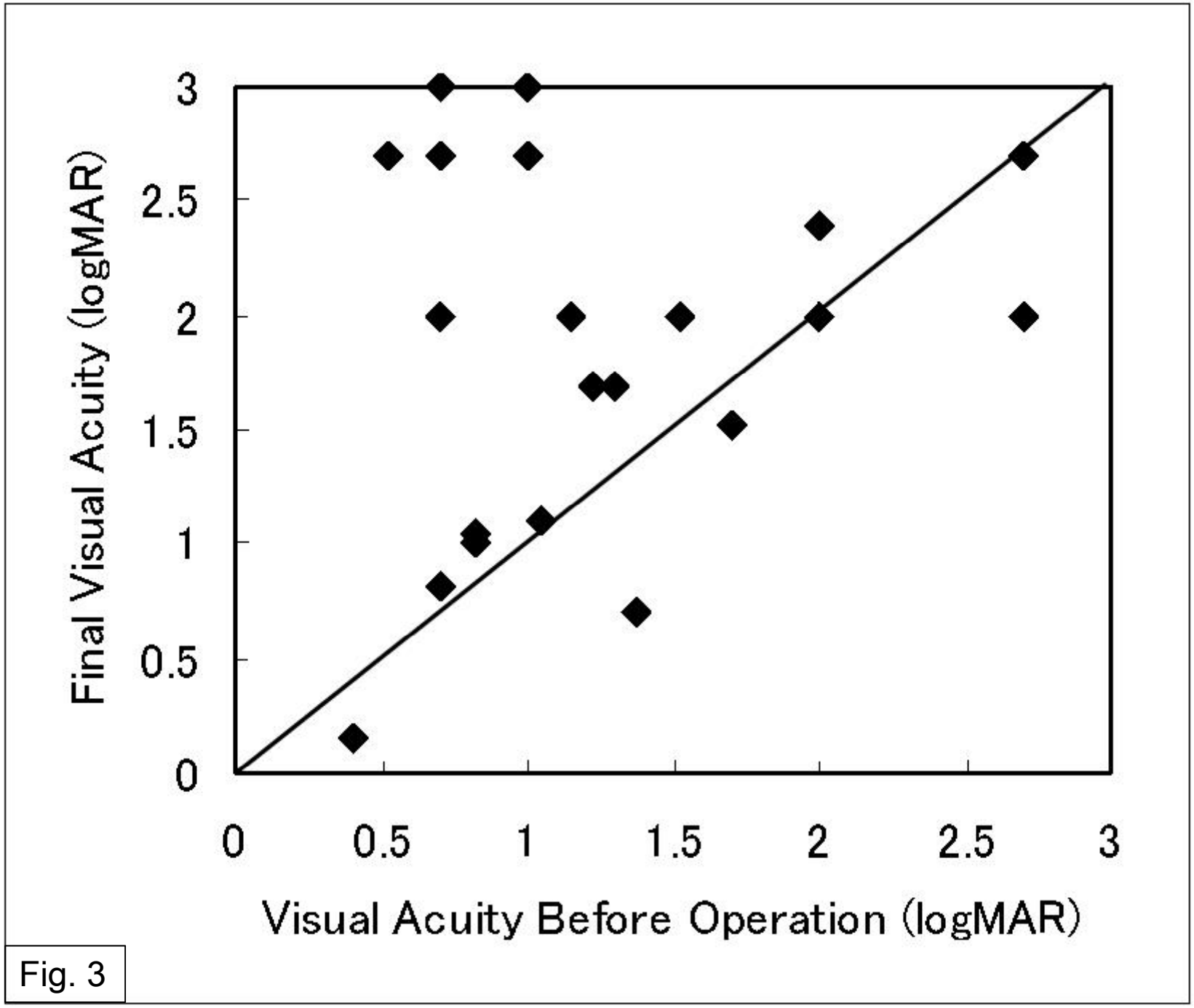
Final Visual Acuity (logMAR)
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
Visual Acuity Before Operation (logMAR)

Fig. 3

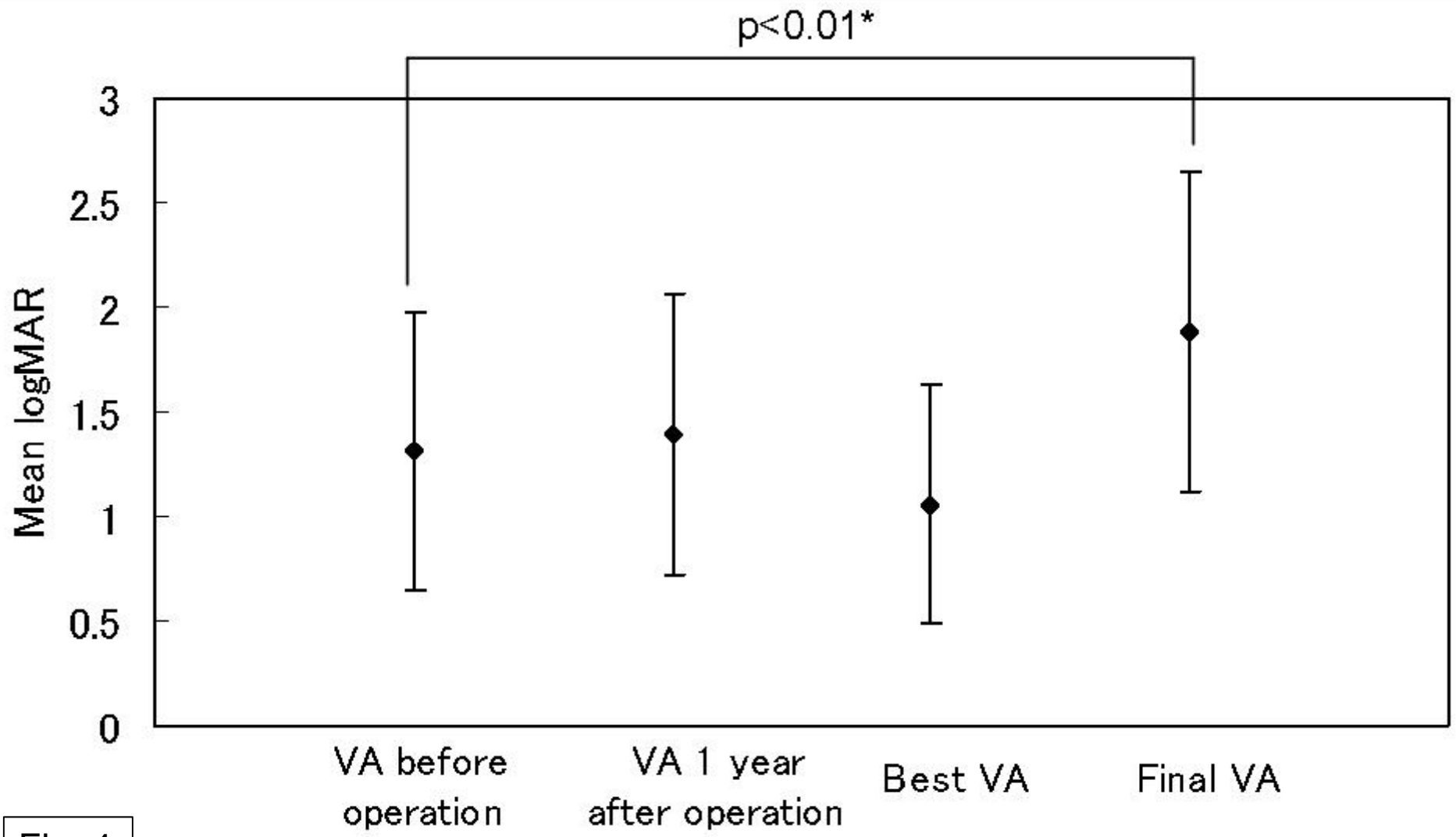
p<0.01*
Mean logMAR
3
2.5
2
1.5
1
0.5
0
VA before operation
VA 1 year after operation
Best VA
Final VA

Fig. 4

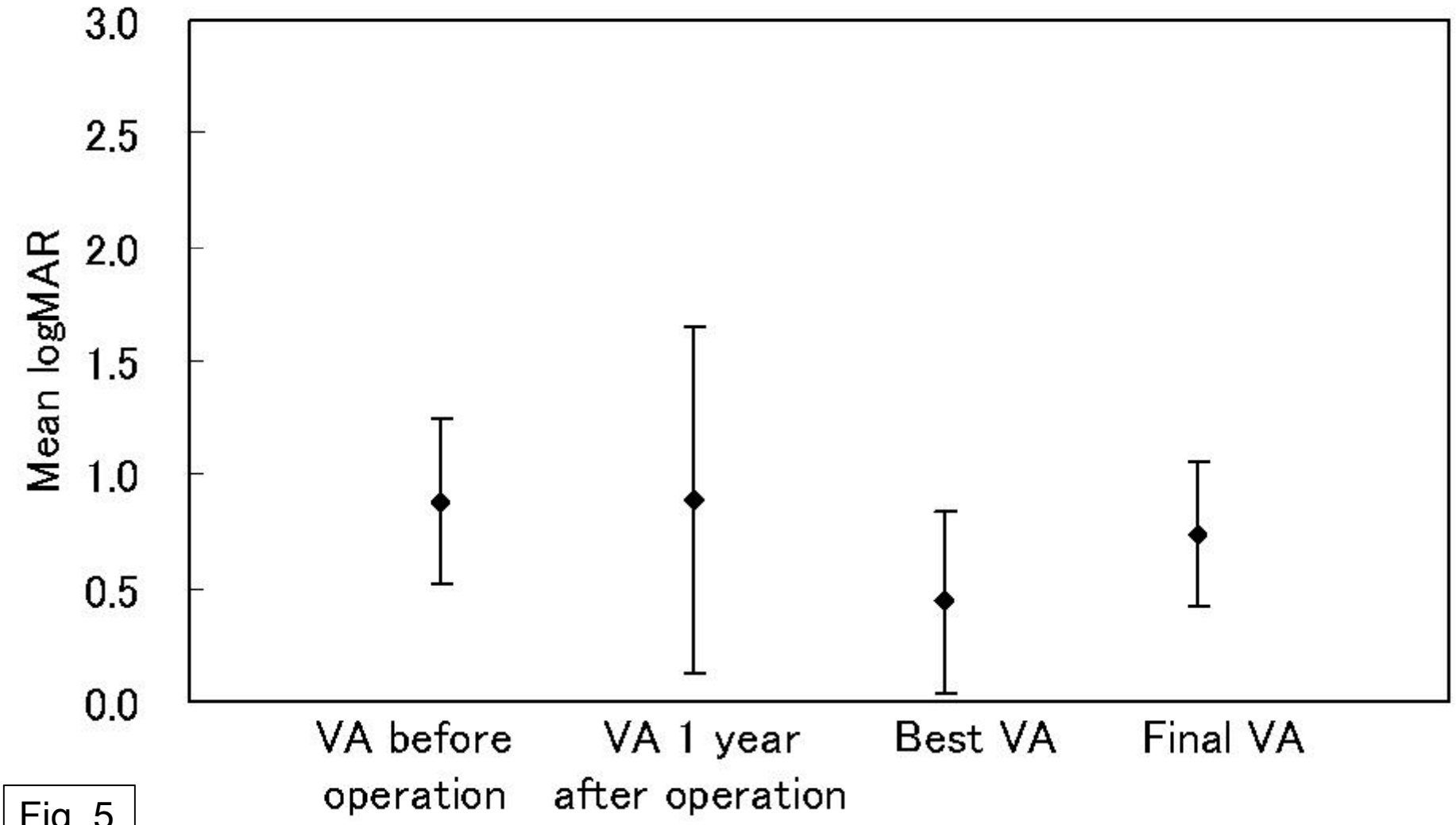
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Mean logMAR
VA before operation
VA 1 year after operation
Best VA
Final VA

Fig. 5

TABLE 1. Mean Visual Acuity and Fovea Status of Patients With Choroidal Neovascularization Following Full Macular Translocation

	No. of Eyes	Mean Age at Operation (years)	Preoperative Mean logMAR[a]	Final Mean logMAR[a]	Fovea at 1 Year after Operation No. (%) of Eyes	Fovea at Final Follow-up No. (%) of Eyes
AMD	25	70.5	1.31±0.66	1.88±0.76	Normal 18 (72) Atrophy 3 (12) ME 4 (16)	Normal 4 (16) Atrophy 18 (72) CNV Recurrence 2 (8) Unknown 1 (4)
Myopic CNV	5	51.0	0.88±0.35	0.73±0.31	Normal 3 (60) Atrophy 1 (20) CNV Recurrence 1 (20)	Normal 2 (40) Atrophy 3 (60)

AMD = age-related macular degeneration; CNV = choroidal neovascularization; ME = macular edema; logMAR = logarithm of the minimum angle of resolution

[a]Values are expressed mean ± standard deviation.