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Shortening the Duration of Prone Positioning After Macular Hole Surgery—Comparison Between 1-Week and 1-Day Prone Positioning

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Purpose: To shorten the duration of prone positioning after macular hole surgery from 1 week to 1 day, and to evaluate preoperative factors and the initial hole closure rate.

Methods: The subjects were 33 patients (34 eyes) who underwent macular hole surgery between April 1998 and August 1999, and maintained the prone position for 1 week (1-week group) and 21 patients (21 eyes) who underwent this operation between September 1999 and March 2000, and maintained the prone position for only 1 day (1-day group). The criteria for macular hole surgery were no more than 6 months since symptom development and no flattening of the fluid cuff. Eyes treated by removal of the retinal pigment epithelium (RPE) or internal limiting membrane (ILM) were excluded. In all phakic eyes, cataract surgery was combined with macular hole surgery. In the 1-day group, the patients maintained the prone position for 1 day and were instructed to avoid only the supine position for the subsequent 1 week.

Results: Preoperative factors possibly affecting the hole closure rate did not differ significantly between the two groups. Initial hole closure rates were similar in the 1-week (91.2%) and 1-day (90.5%) groups.

Conclusion: In eyes without symptoms of long duration, the duration of prone positioning after macular hole surgery may be shortened to 1 day even without using special techniques, such as removal of the RPE or ILM, in combination with macular hole surgery. **Jpn J Ophthalmol 2002;46:84–88**

Key Words: Initial hole closure rate, macular hole surgery, 1-day prone positioning, shortening of duration of prone positioning.

Introduction

In vitreous surgery for idiopathic full-thickness macular holes (referred to as macular holes hereafter), gas tamponade is necessary, and patients are advised to maintain the prone position for approximately 1 week or even longer after surgery. We previously shortened the duration of prone positioning after macular hole surgery from 2 weeks to 1 week and observed no decrease in the initial hole closure rate or postoperative visual acuity.[1] Recent studies have shown that techniques such as removal of the retinal pigment epithelium (RPE) in the hole base,[2] addition of autologous serum,[3,4] and removal of the internal limiting membrane (ILM)[5] performed in combination with macular hole surgery improved the hole closure rate[2] and shortened the duration of prone positioning, reducing the burden on patients.[3–5] However, to date, no studies have evaluated to what degree the duration of prone positioning can be shortened in patients who have undergone macular hole surgery not combined with such special techniques.[6] We reduced the duration of postoperative prone positioning from 1 week to 1 day in eyes treated by macular hole surgery not combined with special techniques, and evaluated the initial hole closure rate.

Materials and Methods

The subjects were patients with macular holes who underwent the initial vitreous surgery at our depart-

Received: October 10, 2000

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Published by Elsevier Science Inc.

0021-5155/02/$–see front matter
PII S0021-5155(01)00468-3

ment. The hole closure rate after the initial surgery was retrospectively compared between the 33 patients (34 eyes) who underwent surgery between April 1998 and August 1999, and maintained the prone position for 1 week (1-week group) and the 21 patients (21 eyes) who underwent surgery between September 1999 and March 2000, and maintained the prone position for 1 day (1-day group).

The 1-week group consisted of 8 men (8 eyes) and 25 women (26 eyes) 52–83 years of age (mean = 64.0 years). According to the Gass Classification[7] proposed in 1988, stage 2 was observed in 7 eyes, stage 3 in 21 eyes, and stage 4 in 6 eyes. In the 1-day group, there were 6 men (6 eyes) and 15 women (15 eyes) 51–76 years of age (mean = 62.2 years), and stage 2 was observed in 5 eyes, stage 3 in 15 eyes, and stage 4 in 1 eye.

The surgical indications were the same as those in our previous study.[1] In principle, the interval between symptom development and surgery was 6 months or less. Even when the patients reported having been asymptomatic prior to the period 6 months before surgery, cases showing flattening of the fluid cuff around the hole, suggesting long-standing lesions, were excluded. In addition, patients less than 50 years of age who underwent surgery with preservation of the lens after September 1999 were excluded, because after that previous surgery they had maintained the prone position for 1 week to prevent the development and/or progression of cataract.

In all phakic eyes, cataract surgery was performed in combination with macular hole surgery. In all stage 2 or 3 eyes, posterior vitreous detachment was artificially produced, and the membrane around the hole, even if fine, was removed to the extent possible using a micro-hooked needle.[8] The remaining vitreous cortex around the hole was passively aspirated using a blush-type back-flush needle. As these techniques were adopted in November 1995, two surgeons were sufficiently experienced in April 1998, when this study was initiated. There were no changes in the techniques during the study period.

Gas tamponade with 11% C_3F_8 was performed in all eyes. The prone position was initiated when the patient was placed on the stretcher postoperatively. In the 1-week group, the patients maintained the prone position both day and night until 1 week after the operation, and all restrictions were lifted thereafter. In the 1-day group, the patients maintained the prone position for 24 hours after the operation and were told to avoid only the supine position thereafter until 1 week after surgery. The patients were instructed not to assume the supine position during the night as well, but were not closely watched. The patients were discharged on postoperative day 3 or 4. The macular hole was considered to be closed when we confirmed the hole had disappeared by slit-lamp microscopy using a contact lens postoperatively.

The postoperative observation period was 10–26 months (mean = 18.2 months) in the 1-week group and 3–10 months (mean = 7.1 months) in the 1-day group.

The initial hole closure rates of the two groups were compared. Among preoperative factors possibly affecting the hole closure rate, patient age, the interval between symptom development and surgery, hole diameter, disease stage, and the preoperative $\log_{MAR}$ visual acuity were compared between the two groups.

Statistical analysis was performed using the χ^2 test, Fisher's direct probability calculation method, and the unpaired *t*-test. $P < .05$ was considered to be significant.

Results

Preoperative Factors

Table 1 shows the results of comparing preoperative factors between the two groups.

The age at the time of surgery was 64.0 ± 6.9 years (mean ± SD) in the 1-week group and 62.2 ± 7.5 years in the 1-day group. The interval between symptom development and surgery was 2.7 ± 1.4 months in the 1-week group and 2.4 ± 1.3 months in the 1-day group. The hole diameter was 0.3 ± 0.1 disc diameters (DD) in the 1-week group and 0.3 ± 0.1 DD in the 1-day group. The percentages of stage 4 cases to all cases were calculated. The stage 4 percentage was 17.6% in the 1-week group and 4.8% in the 1-day group. The preoperative $\log_{MAR}$ visual acuity was 0.78 ± 0.30 in the 1-week group and 0.85 ± 0.26 in the 1-day group. Comparison of preoperative factors between the two groups revealed no significant differences in any factor ($P = .36$ for age, $P = .56$ for the interval between symptom development and surgery, $P = .87$ for the hole diameter, $P = .23$ for staging, and $P = .56$ for preoperative $\log_{MAR}$ visual acuity; unpaired *t*-test).

Based on these results, the preoperative conditions were considered to be similar in the two groups, allowing the initial hole closure rates of the two groups to be compared without adjusting for other variables.

Initial hole closure rate. The initial hole closure rate was 91.2% (31/34 eyes) in the 1-week group and 90.5% (19/21 eyes) in the 1-day group, showing no significant difference ($P > .99$, Fisher's direct proba-

Jpn J Ophthalmol
Vol 46: 84–88, 2002

Table 1. Preoperative Factors in Each Group

Group	Age (years)	Duration* (months)	Hole Diameter (DD)	Stage† (%)	LogMAR Visual Acuity
1-week group	64.0 ± 6.9	2.7 ± 1.4	0.3 ± 0.1	17.6	0.78 ± 0.30
1-day group	62.2 ± 7.5	2.4 ± 1.3	0.3 ± 0.1	4.8	0.85 ± 0.26
P value	.36	.56	.87	.23	.56

*Interval between development of symptoms and surgery.
†Percentage of stage 4 eyes to all eyes.

bility calculation method) (Table 2). No eye showed re-opening of the hole during follow-up.

Evaluation of eyes showing non-closure. There were 5 eyes showing non-closure after the initial surgery (3 eyes in the 1-week group and 2 in the 1-day group). The patient age was 57.8 ± 7.0 years, and the interval between symptom development and surgery was 3.8 ± 2.2 months. The hole diameter was 0.4 ± 0.1 DD, and stage 3 was observed in 4 eyes and stage 4 in one. The preoperative $\log_{MAR}$ visual acuity was 1.0 ± 0. These mean values in the 5 eyes showing non-closure were compared with those in the other 50 eyes showing closure. The eyes showing non-closure had a significantly greater hole diameter (P = .003, unpaired t-test) and a significantly longer interval between symptom development and surgery (P = .03, unpaired t-test) (Table 3).

Discussion

Since the report by Kelly and Wendel[9] the possibility of treating full-thickness macular holes with vitreous surgery has become a reality. The initial hole closure rate reported by Kelly and Wendel[9] was 58%. However, subsequent studies such as that by Wendel et al[10] have shown an initial closure rate of 73% in all cases and 80% in cases in which the interval between symptom development and surgery is 6 months or less. Preoperative factors reported to significantly affect the hole closure rate include the interval between symptom development and surgery, hole diameter, the presence or absence of long-standing symptoms, and stage according to the Gass Classification.[11,12] In addition, the mechanism of hole closure[13] has been clarified, and special techniques to improve the hole closure rate, such as addition of transforming growth factorβ_2[14] or autologous serum,[3,4] and removal of the RPE[2] have been described. A recent study also showed the hole closure rate to be improved by removal of the ILM.[5]

Table 2. Hole Closure Rate in Each Group

Group*	No. of Eyes	%
1-week	31/34	(91.2)
1-day	19/21	(90.5)

*$P > .99$.

When the association between the duration of prone positioning and the hole closure rate is evaluated, it is necessary to adjust for preoperative factors, and the effects of special techniques should be excluded. We previously reported the results of a comparison of two groups without long-standing findings who had similar preoperative findings and maintained prone positioning for 2 weeks or 1 week, after exclusion of cases treated by special techniques.[1] There were no significant differences between the two groups in the initial hole closure rate or visual outcomes, and surgical results after 1-week prone positioning were comparable to those after 2-week prone positioning.

In this study, hole closure rates in two groups, maintaining prone positioning for 1 week versus 1 day, were compared. The two groups were similar in preoperative factors, and cases treated by special techniques were excluded. The initial hole closure rate was 91.2% in the 1-week group and 90.5% in the 1-day group, showing no significant difference.

Visual outcomes were not compared in this study. Our previous study showed visual acuity improvement 12 months after surgery as compared to 6 months after the operation.[15] We considered comparison of visual acuity to be inappropriate in this study because the 1-day group included some patients for whom the postoperative period was less than 6 months.

Relaxation of restrictions on positioning after macular hole surgery has been reported. In a study that used silicone oil instead of gas in patients unable to assume the prone position for physical reasons,[3] autologous serum was added, and the patients were instructed to maintain the prone position overnight and to avoid only the supine position thereafter. An initial hole closure rate of 86% was achieved. Tornambe et al[4] who used 15% C_3F_8, placed patients in the recumbent position with the affected eye upper-

Table 3. Preoperative Factors in Eyes Showing Non-closure and Closure

	Age (years)	Duration* (months)	Hole Diameter (DD)	Stage† (%)	LogMAR Visual Acuity
Eyes showing non-closure (5 eyes)	58.7 ± 7.0	3.8 ± 2.2	0.4 ± 0.1	20	1.0 ± 0
Eyes showing closure (50 eyes)	63.9 ± 7.0	2.4 ± 1.2	0.3 ± 0.1	12	0.79 ± 0.29
P value	.69	.03	.003	.51	.12

*Interval between development of symptoms and surgery.
†Percentage of stage 4 eyes to all eyes.

most for the entire first postoperative day and only during the night thereafter. The initial hole closure rate in their study was 79%. They also used autologous serum in 85% of the cases. With postoperative gas tamponade, the fluid cuff is pressed against the RPE, employing buoyancy, and entry of vitreous fluid into the hole is prevented by bubbles that are in contact with the hole.[16] In these studies, importance was attached not to pressing the fluid cuff against the RPE by maintaining the prone position, but to preventing entry of vitreous fluid into the hole using silicone oil or gas; therefore, the prone position was maintained only overnight or was not used at all. However, in eyes in which silicone oil infusion was used, removal of the oil by re-operation was necessary. Furthermore, the addition of autologous serum requires a complicated procedure and carries a risk of infection. We used 11% C_3F_8 for gas tamponade and instructed our patients to avoid only the supine position until 1 week after the operation. Even at the end of the first postoperative week, gas occupied 2/3–3/4 of the vitreous cavity, suggesting that entry of vitreous fluid into the hole can be prevented only by avoidance of the supine position.

Recent studies have shown removal of the ILM to reduce the need for prolonged maintenance of prone positioning, and very high hole closure rates have been achieved. Nagata et al[5] removed the ILM in all eyes, placed patients in the prone position on the day of the operation and then only during sleep, starting the next day, for approximately 2 weeks. An initial hole closure rate of 96% was achieved.

In macular hole surgery, persistence of vitreous cortex around the hole affects the hole closure rate.[17] Residual vitreous cortex is adequately removed by removal of the ILM, which may improve the hole closure rate. However, as the ILM is the basal layer of Müller cells, the possibility of retinal functional impairment due to mechanical removal cannot be ignored. To assess this possibility, further studies on the long-term outcomes of cases treated by removal of the ILM are necessary. However, obtaining a high initial hole closure rate without using such special techniques is desirable. The membrane around the hole, even if it is a very fine membrane, can be removed using a micro-hooked needle. During this procedure, the possibility of removing a portion of the ILM cannot be excluded. In 1 eye showing non-closure that was recently treated by re-operation, staining of the ILM with indocyanine green[18] revealed an island-shaped, unstained area around the hole. Based on this experience, accidental removal of a portion of the ILM may occur during removal of a fine membrane using a micro-hooked needle, while removal of a wide area in a sheet pattern is unlikely.

Ogino[11] reported initial hole closure without using special techniques in 60 (95%) of 63 eyes that fulfilled all the following criteria: age, less than 70 years; hole diameter, 0.3 DD or less; preoperative visual acuity, 0.1 or more; and interval between symptom development and surgery, 12 months or less. In this study, patient age at the time of surgery was 62.2 ± 7.5 years, hole diameter was 0.3 ± 0.1 DD, preoperative $\log_{MAR}$ visual acuity was 0.85 ± 0.26, and the interval between symptom development and surgery was 2.4 ± 1.3 months. Of the 21 eyes in our 1-day group, 16 (76.2%) fulfilled all four criteria proposed by Ogino. We excluded cases from our study with an interval between symptom development and surgery of 6 months or more and/or flattening of the fluid cuff. However, in the cases selected to undergo this surgery, the conditions were quite favorable in terms of preoperative factors. In these eyes, the initial hole closure rate was nearly 90% after maintenance of the prone position for only one day without using special techniques.

In eyes showing non-closure, the mean hole diameter was about 0.4 DD, which was significantly greater than that of cases showing closure (about 0.3 DD). In this study, an upper limit for hole diameter was not included among the surgical criteria. However, our results suggest that special techniques such as removal of the ILM should be combined with macular hole surgery for holes with a diameter of 0.4 DD or more.

A problem requiring further evaluation is the gas concentration. Complete disappearance of gas takes

6 weeks using 11% C_3F_8. During this period, patients are aware of the presence of gas as black shadows, and some complain that these shadows are obstacles to work. With the goal of early complete rehabilitation, we intend to perform further studies to determine whether a similar hole closure rate can be obtained at a lower gas concentration.

This paper was originally published in Japanese in the *Nippon Ganka Gakkai Zasshi* (J Jpn Ophthalmol Soc) 2001;105:167–70.It appears here in a modified form after peer review and editing for the *Japanese Journal of Ophthalmology*.

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