

Long-Term Visual Recovery After Scleral Buckling for Macula-off Retinal Detachments

Shunji Kusaka, Atsuko Toshino, Yuichi Ohashi and Ei Sakaue

Department of Ophthalmology, Ehime University School of Medicine, Ehime, Japan

Abstract: The authors retrospectively investigated the long-term visual recovery in 32 macular reattached eyes that had been monitored for more than 5 years after surgery. The best corrected visual acuities were better at 5 years postoperatively than at 3 months by two lines or more in 17 eyes (53%). In these 17 eyes, visual acuities continued to improve for up to 10 years after surgery. In the other 15 eyes, the visual acuities remained within one line of the 3-month values. Improvement of the long-term postoperative visual acuity was found to be statistically correlated with younger age, no or mild myopia (> -5 diopters), and shorter duration of macular detachment (≤ 30 days). Surgeons should be aware that the visual function of reattached retinas may continue to improve over the long term, especially when these beneficial factors are present. **Jpn J Ophthalmol 1998;42:218-222** © 1998 Japanese Ophthalmological Society

Key Words: Long term, macula, macula off, reattachment, recovery, retinal detachment, scleral buckling, visual acuity, visual function.

Introduction

Scleral buckling has become a well-established surgical procedure for the treatment of retinal detachment, and the anatomic success rate has been reported to be over 90%.¹⁻⁶ Although there have been a number of reports^{1,2,4-19} concerning the change in visual function after this procedure for the repair of rhegmatogenous retinal detachments, little is known about long-term changes. For most reports,⁴⁻¹⁵ the follow-up period is relatively short (less than 2 years). Furthermore, even in reports¹⁶⁻¹⁹ with relatively long follow-up periods, factors affecting long-term changes in visual function have not been documented.

In this report, we focus on the factors affecting the long-term visual function after scleral buckling for macula-off rhegmatogenous retinal detachments.

Materials and Methods

Among patients who had scleral buckling (diathermy coagulation and explant buckling) for

rhegmatogenous retinal detachments between December 1976 and July 1984 at Ehime University Hospital, 32 eyes of 32 patients were selected by the following criteria: retinal detachment involving the macula; no macular disorders affecting pre- and postoperative visual acuities, such as a macular hole, a macular pucker, age-related macular degeneration; the retina was reattached with a single operation; minimum follow-up was for 5 years; there were no complications affecting visual acuity postoperatively, such as cataract and glaucoma; there was no past history of ocular trauma. The patients ranged in age from 9 to 71 years (mean \pm SD = 37.2 \pm 21.5 years). There were 17 men and 15 women. Thirty-one eyes were phakic, and the spherical equivalent of these eyes at the 3-month postoperative follow-up examination was between -10 and $+4$ diopters (-3.4 ± 3.8). An encircling band was used in only three eyes. All the patients were followed for at least 5 years (5 to 10 years; average = 7.3 years), and 11 patients were followed for 10 years after surgery.

To quantify the visual acuity changes after the reattachment of the retina, the 3-month and 5-year postoperative best corrected visual acuities were compared. In addition, we studied the relation between the postoperative visual acuity changes and

Received: June 30, 1997

Address correspondence and reprint requests to: Shunji KUSAKA, MD, Department of Ophthalmology, Osaka University Medical School, 2-2 Yamada-oka, Suita, Osaka, 565, Japan

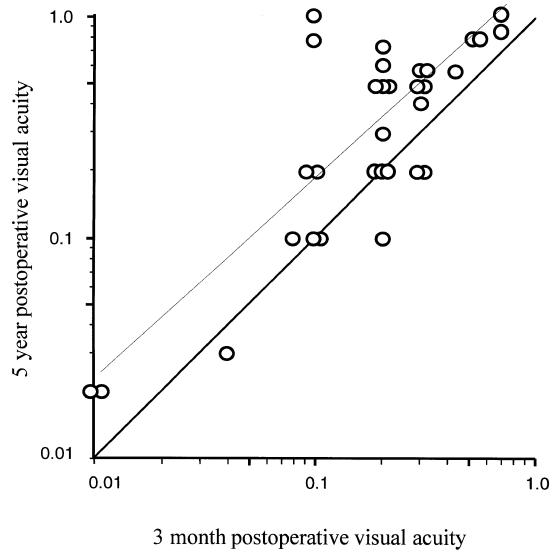
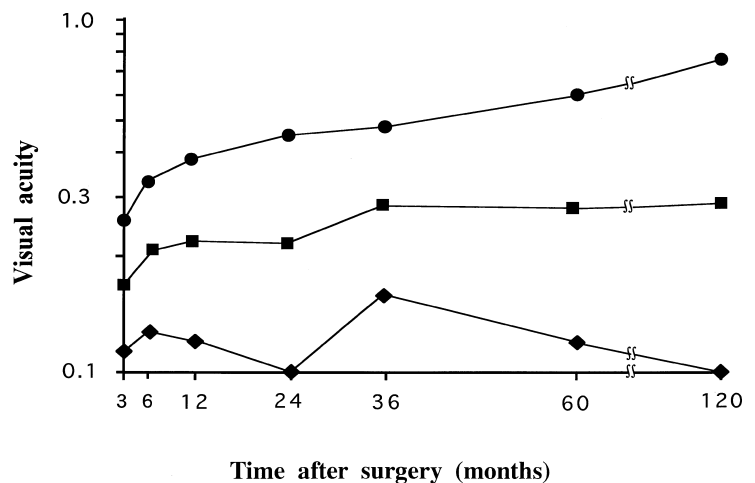


Figure 1. Relation between the 3-month and 5-year postoperative visual acuities. The 5-year postoperative visual acuity can be expressed by $y = 0.164 + 0.922x$ ($r = 0.820$, $P < 0.0001$), where y and x are the logarithm of 5-year and 3-month postoperative visual acuities, respectively.

various factors, such as patient's age, preoperative visual acuity, spherical equivalent value at the 3-month postoperative follow-up examination, duration of macular detachment, and the preoperative and 3-month postoperative best corrected visual acuities. Visual improvement was defined as an increase in 5-year postoperative visual acuity by two lines or more on the standard eye chart between 3 months and 5 years postoperatively.

Figure 2. Time course of visual acuity after surgery. Closed circles show the 5-year postoperative visual acuities that were two or more lines better than the 3-month postoperative acuity (17 eyes). Closed diamonds show changes within one line (15 eyes). Values for all the patients are indicated by the closed squares (32 eyes).



A Mann-Whitney U Test was used for the analysis of visual acuity (the mean logarithm of the visual acuity and the change in visual acuity measured by line), a Kruskal-Wallis test for visual acuities among three groups, and a two-tailed Fisher's exact test for visual improvement rate. A probability of less than 5% ($P < 0.05$) was considered statistically significant.

Results

A relation between visual acuity 3 months and 5 years after surgery in each eye is shown in Figure 1. The 5-year postoperative visual acuity can be expressed by the following:

$$y = 0.164 + 0.922x \quad (r = 0.820, p < 0.0001),$$

where y and x are the logarithm of 5-year and 3-month postoperative visual acuity, respectively. Hence, if a patient's 3-month postoperative visual acuity is 0.1, 0.2, or 0.3, then 5-year postoperative visual acuity would be 0.17, 0.33, or 0.48, respectively. Visual acuity improved in 17 eyes (improved group). Five-year postoperative visual acuity was within one line of 3-month postoperative visual acuity in 15 eyes (unchanged group). There were no eyes of which 5-year postoperative visual acuities were two lines or more worse than 3-month postoperative visual acuities. The time courses of the mean change in visual acuity for these two groups and the entire group are shown in Figure 2. For the 32 eyes, the mean visual acuity continued to improve for up to 3 years postoperatively and remained unchanged between 3 and 10 years postoperatively. In contrast, in the improved group, the mean visual acuity continued to improve up to 10 years postoperatively.

Table 1. Age and Visual Changes

Years of Age	Visual Improvement (Eyes)	Mean 3-Month Postoperative Visual Acuity	Mean 5-Year Postoperative Visual Acuity ^a	Mean Visual Improvement (Lines)
<20 (11 eyes)	7 (73%)	0.27	0.52	3.1 ± 2.9
20–39 (7 eyes)	3 (43%)	0.20	0.35	1.3 ± 1.5
>40 (14 eyes)	6 (43%)	0.14	0.22	1.7 ± 2.1

^a $P = 0.043$ (Kruskal-Wallis test).

Table 2. Spherical Equivalent Values and Visual Changes

Spherical Equivalent (Diopters)	Visual Improvement (Eyes) ^a	Mean 3-Month Postoperative Visual Acuity	Mean 5-Year Postoperative Visual Acuity	Mean Visual Improvement (Lines) ^b
≤−5 (15 eyes)	5 (33%)	0.16	0.22	1.4 ± 2.5
>−5 (16 eyes)	12 (75%)	0.18	0.36	2.7 ± 2.1

^a $P = 0.032$ (Two-tailed, Fisher's exact test).

^b $P = 0.047$ (Mann-Whitney U Test).

By dividing the patients into three groups by age (ie, 19 years old or younger, 20 to 39 years old, and 40 years old or older), we found a statistically significant difference ($P = 0.043$) in the mean visual acuities at 5 years. However, there were no statistical differences in the mean visual acuities among the three groups at the 3-month postoperative examination (Table 1). Although visual improvement rate and the mean improvement in lines were best in the group of patients aged 19 years and younger, no statistical differences were observed.

Patients whose spherical equivalent values were >−5 diopters (no myopia or less myopic than −5 diopters) showed significantly better visual improvement rates ($P = 0.032$) and mean visual improvement in lines ($P = 0.047$) than patients whose spherical equivalent values were ≤−5 diopters (more myopic than or equal to −5 diopters) (Table 2).

With regard to the estimated duration of macular detachment, there was no statistical difference in mean 3-month postoperative visual acuity ($P =$

0.231). However, the mean 5-year postoperative visual acuity of patients with macular detachment of 30 days or shorter was statistically better ($P = 0.048$) than that of patients with macular detachment of 31 days or longer (Table 3).

Table 4 shows the comparison of the visual acuity changes between patients with <0.1 and ≥0.1 preoperative visual acuities. Despite the significant difference in the mean 3-month postoperative visual acuity ($P = 0.020$), there was no statistically significant difference in the mean 5-year postoperative visual acuity ($P = 0.656$). In addition, there was no statistically significant difference in the visual improvement rate ($P = 1.00$) or the mean visual improvement in lines ($P = 0.552$) between the two groups.

In comparison with visual acuity changes between patients with 3-month postoperative visual acuities of ≥0.3 and <0.3, the patients in the former group showed significantly better 5-year postoperative visual acuity ($P < 0.0001$) (Table 5). However, no statistically significant difference was observed between

Table 3. Duration of Macular Detachment and Visual Changes

Duration of Macular Detachment (Days)	Visual Improvement (Eyes)	Mean 3-Month Postoperative Visual Acuity	Mean 5-Year Postoperative Visual Acuity ^a	Mean Visual Improvement (Lines) ^b
≤30 (15 eyes)	10 (67%)	0.22	0.45	3.1 ± 2.7
>30 (17 eyes)	7 (41%)	0.13	0.19	1.2 ± 1.6

^a $P = 0.026$.

^b $P = 0.048$ (Mann-Whitney U Test).

Table 4. Preoperative Visual Acuity and Visual Changes

Preoperative Visual Acuity	Visual Improvement (Eyes)	Mean 3-Month Postoperative Visual Acuity ^a	Mean 5-Year Postoperative Visual Acuity	Mean Visual Improvement (Lines)
<0.1 (19 eyes)	10 (53%)	0.12	0.25	2.6 ± 2.7
≥0.1 (13 eyes)	7 (54%)	0.27	0.34	1.4 ± 1.7

^a*P* = 0.020 (Mann-Whitney *U* Test).

these two groups in the rate of visual improvement (*P* = 0.076) or in the mean visual improvement (*P* = 0.552).

Discussion

The goals of this study were to understand the long-term visual function changes after successful scleral buckling for macula-off retinal detachment and to identify factors correlating with the changes in visual function. From our results, 5-year postoperative visual acuities of 17 of 32 eyes were better than the 3-month postoperative visual acuities. Furthermore, in these 17 eyes, there was a tendency for visual improvement to continue for 10 years or more. The long-term visual improvement was correlated with a younger age, less or no myopia, and shorter duration of macular detachment. Thus, the visual function of the reattached retina can improve over the long term, and this improvement is likely to be seen in patients with features such as youth, low or no myopia, and short duration of detachment of the macula.

In previous studies focusing mainly on short-term visual postoperative changes, various factors have been reported to be correlated with good postoperative visual function. These factors include youth,^{9-14,16} short duration of macular detachment,^{8,15,16} good preoperative visual acuity,^{7,9,10} low or no myopia,⁹⁻¹² and limited extent of retinal detachment.^{7,9-11}

Among these factors, youth, short duration of macular detachment, and low or no myopia were

also identified in our study. Therefore, these three factors appear to be important for both short-term and long-term visual recovery.

It is still unclear why these factors are correlated with long-term visual acuity. However, knowledge based on histopathologic observations in animal eyes is available. In experimental studies of retinal detachment in the cat eye, it has been shown that a number of morphologic changes occur in the retina after detachment from the retinal pigment epithelium (RPE), such as loss of apical processes in the RPE within a few hours, outer segment changes within 12 hours,²⁰ and the onset of RPE and glial proliferation within 24 hours and 48 hours, respectively.²¹ Following reattachment, the ultrastructural relationship between the photoreceptors and the RPE is reestablished. Although shorter duration of retinal detachment is associated with better morphological recovery, the morphology of the reattached retina never returns to the normal state even if the duration of detachment was for only 1 day.²² Morphologic recovery is generally poor in the area with glial or RPE proliferation, because these cells appear to prevent the RPE-photoreceptor reapposition.²² In contrast, other studies^{23,24} using the rabbit retina indicate that morphologic changes in the detached retina are reversible. A reattached retina may appear normal approximately 12 weeks after reattachment. Therefore, there may be a species difference in the morphologic recovery of a reattached retina. These experimental studies investigated the morphologic recovery of the reattached retina for up

Table 5. Three-Month Postoperative Visual Acuity and Visual Changes

3-Months Postoperative Visual Acuity	Visual Improvement (Eyes)	Mean 3-Month Postoperative Visual Acuity ^a	Mean 5-Year Postoperative Visual Acuity ^b	Mean Visual Improvement (Lines)
<0.3 (20 eyes)	8 (40%)	0.10	0.19	2.1 ± 2.6
≥0.3 (12 eyes)	9 (75%)	0.38	0.54	2.2 ± 1.9

^a*P* = 0.0090.

^b*P* < 0.0001 (Mann-Whitney *U* Test).

to 6 months after reattachment. Based on our results, however, functional recovery in humans appears to continue for much longer.

Young age and low or no myopia may be associated with good morphologic recovery. At present, however, no data with regard to age and degree of myopia are available from experimental studies.

One characteristic feature of the patients in this study is that they had a rather long duration of macular detachment. This probably results from the use of long-term bed rest before the surgery to wait for the absorption of the subretinal fluid. Also, at that time, there may have been a long waiting time for hospitalization at our institution. In contrast, currently in most facilities (including our own), patients with retinal detachments are likely to have surgery promptly. Because of this change, our data concerning macular detachments of long duration may be valuable.

In this study, we used only the best correlated visual acuity as a parameter of visual function, because preoperative and postoperative examination data were often limited. Although best corrected visual acuity is still the best parameter of macular function, more detailed analysis using various parameters, such as threshold macular perimetry and multifocal electroretinography, will be required in future studies.

The authors thank Donald G. Puro, M.D., Ph.D., for comments on the original manuscript. This paper was published in the *Nippon Ganka Gakkai Zasshi* (J Jpn Ophthalmol Soc) 1997;101:862-5.

References

1. Michels RG, Wilkinson CP, Rice TA. Results of retinal reattachment surgery. In: Retinal detachment. St. Louis: CV Mosby, 1990:917-58.
2. American Academy of Ophthalmology. The repair of rhegmatogenous retinal detachments. *Ophthalmology* 1990;97:1562-72.
3. Rachal WF, Burton TC. Changing concepts of failures after retinal detachment surgery. *Arch Ophthalmol* 1979;97:480-3.
4. Sanada Y, Sakaue E, Matsuda K, Yoshida H. Results of rhegmatogenous retinal detachment surgery in 530 eyes. *Folia Ophthalmol Jpn* 1982;33:481-8.
5. Kondo K, Takai K, Kimata M, et al. Surgical outcome in rhegmatogenous retinal detachment during the past five years in our institution. *Jpn Rev Clin Ophthalmol* 1991;85:236-41.
6. Isernhagen RD, Wilkinson CP. Recovery of visual acuity following the repair of pseudophakic retinal detachment. *Trans Am Ophthalmol Soc* 1988;86:291-306.
7. Friberg TR, Eller AW. Prediction of visual recovery after scleral buckling of macula-off retinal detachments. *Am J Ophthalmol* 1992;114:715-22.
8. Brenton RS, Blodi CF. Prognosis of foveal splitting rhegmatogenous retinal detachments. *Ophthalmic Surg* 1989;20:112-4.
9. Tani P, Robertson DM, Langworthy A. Prognosis for central vision and anatomic reattachment in rhegmatogenous retinal detachment with macula detached. *Am J Ophthalmol* 1981;92:611-20.
10. Burton TC, Lambert RW Jr. A predictive model for visual recovery following retinal detachment surgery. *Ophthalmology* 1978;85:619-25.
11. Kaufman PL. Prognosis of primary rhegmatogenous retinal detachment 2: Accounting for and predicting final visual acuity in surgically reattached cases. *Acta Ophthalmol Scand* 1976;54:61-74.
12. Kreissig I. Prognosis of return of macular function after retinal reattachment. *Mod Probl Ophthalmol* 1977;18:415-29.
13. McPherson AR, O'Malley RE, Butner RW, Beltangady SS. Visual acuity after surgery for retinal detachment with macular involvement. *Ann Ophthalmol* 1982;14:639-45.
14. Gundry MF, Davies EWG. Recovery of visual acuity after retinal detachment surgery. *Am J Ophthalmol* 1974;77:310-4.
15. Burton TC. Recovery of visual acuity after retinal detachment involving the macula. *Trans Am Ophthalmol Soc* 1982;80:475-97.
16. Yoshioka H, Endo Y, Otaguro S. Follow-up of visual acuity in reattached eyes. *Folia Ophthalmol Jpn* 1967;6:669-77.
17. Sasoh M, Kataoka M, Doi M, Uji Y, Mori K. Long-term results of transscleral retinal detachment surgery with special reference to visual function. *Nippon Ganka Gakkai Zasshi* (Acta Soc Ophthalmol Jpn) 1993;97:1203-10.
18. Harayama K, Amemiya T, Yoshida H. Long-term results in retinal detachment surgery 3: Visual function in the reattached retina. *Nippon Ganka Gakkai Zasshi* (Acta Soc Ophthalmol Jpn) 1980;84:483-7.
19. Kreissig I, Rose D, Jost B. Minimized surgery for retinal detachments with segmental buckling and nondrainage: An 11-year follow-up. *Retina* 1992;12:224-31.
20. Anderson DH, Stern WH, Fisher SK, Erickson PA, Borgula GA. Retinal detachment in the cat: The pigment epithelial-photoreceptor interface. *Invest Ophthalmol Vis Sci* 1983;24:906-26.
21. Anderson DH, Stern WH, Fisher SK, Erickson PA, Borgula GA. The onset of pigment epithelial proliferation after retinal detachment. *Invest Ophthalmol Vis Sci* 1981;21:10-6.
22. Anderson DH, Guerin CJ, Erickson PA, Stern WH, Fisher SK. Morphological recovery in the reattached retina. *Invest Ophthalmol Vis Sci* 1986;27:168-83.
23. Machemer R. Experimental retinal detachment in the owl monkey. IV: the reattached retina. *Am J Ophthalmol* 1968;66:1075-91.
24. Knoll AJ, Machemer R. Experimental retinal detachment in the owl monkey. V: Electron microscopy of the reattached retina. *Am J Ophthalmol* 1969;67:117-30.