

# Macula off retinal detachments. How long can they wait before it is too late

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**PURPOSE.** *To determine the association between the duration of macula off detachment and the visual outcome following corrective surgery.*

**METHODS.** *Retrospective review of the medical records of patients who underwent surgery for macula off detachment over a 5 year period (April 1994- March 1999).*

**RESULTS.** *There were 104 patients in the study. Patients with macula off detachments wait a mean of 2.6 weeks ( $\pm 0.3$  SE mean) before presentation and 1.8 weeks ( $\pm 0.2$  SE of mean) thereafter before surgery. The mean duration of detachment prior to surgical repair was 4.2 weeks ( $\pm 0.3$  SE mean). 78% of patients achieved a postoperative improvement in visual acuity. 36.5% achieved functional visual success of 6/12 at 3 months, which increased to 51% at final discharge. There was no significant difference in visual outcomes for patient undergoing internal vs external procedures ( $p=0.188$ ). The preoperative visual acuity was the most significant predictor of post operative visual acuity ( $p<0.0005$ ). Less than 40% of macula off detachments of  $\geq 6$  weeks duration will achieve a vision of 6/12 or better compared with 68.2% of patients with macula off detachments of  $\leq 1$  week.*

**CONCLUSIONS.** *The best mean postoperative vision (LogMAR 0.35) was seen in patients with detachment of  $<1$  week duration. Patients  $<60$  years are more likely to achieve visual improvement despite the duration of the detachment. Macula off detachments of  $>6$  weeks duration have a significantly poor postoperative visual prognosis. Awareness of this visual prognosis can assist in planning the timing of surgery to ensure an acceptable result. (Eur J Ophthalmol 2005; 15: 109-17)*

**KEY WORDS.** *Macula off retinal detachment, Visual outcome, Surgical timing, Functional success, Wolverhampton*

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## INTRODUCTION

Kaufman (1) used multiple linear regression analysis and ANOVA testing to determine the parameters that would result in a favourable outcome in rhegmatogenous retinal detachment repair. His statistical analysis confirmed that patient's age; macular involvement

and duration of the detachment were significant parameters in determining the final visual acuity.

Burton's exemplary study in 1982 established evidence for proposing that macular detachments may be repaired with less urgency than macula on detachments (2). He demonstrated that there was a progressive decrease in postoperative visual outcome from the 5th

## Macula off detachments

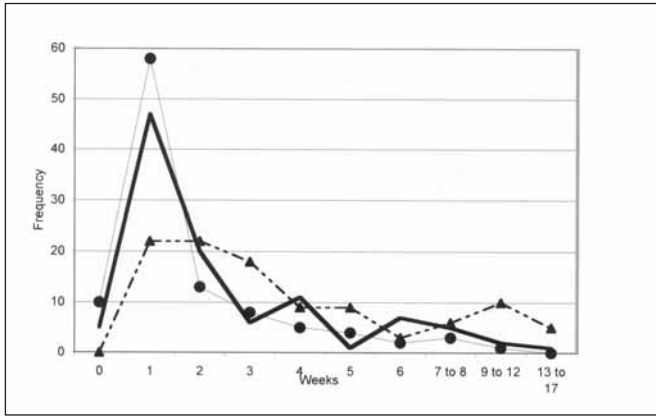


Fig. 1 - Duration of history, diagnosis to surgery and detachment duration.

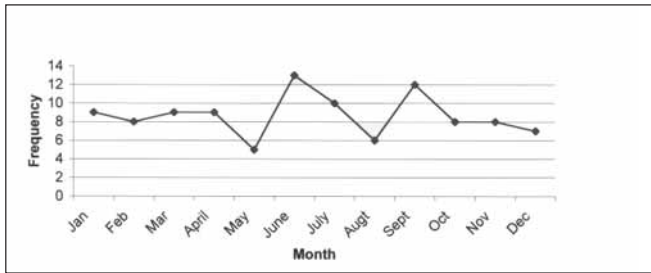


Fig. 2 - Monthly incidence of macula off detachments (1994-1999).

day of the macular detachment. Ross and Kozy (3) further showed that surgical repair within the 1st week of the detachment did not affect the final visual outcome. Hence the call for non emergency surgical repair for macula off detachment.

However, we are at present uncertain as to the safe time period within which macula off detachment repairs should be undertaken to obtain a minimally acceptable result. This study was performed to determine the effect of duration of detachment and patient's age on the postoperative visual acuity.

## METHODS

A five year retrospective study of patients who underwent surgical repair of their rhegmatogenous retinal detachment (RRD) between April 1994- March 1999 (Single surgeon, NJP) at Wolverhampton Eye Infirmary (WEI).

Patients were identified from the operation codes and cross checked against the theatre book records. Over 500 notes were reviewed for all patients who un-

TABLE I - SNELLEN EQUIVALENT FOR THE LogMAR

Snellen	LogMAR
6/6	0
6/9	0.2
6/12	0.3
6/18	0.5
6/24	0.6
6/36	0.8
6/60	1
CF at 3 feet* <sup>2</sup>	1.8
HM at 3 feet* <sup>3</sup>	3

\*<sup>2</sup> and \*<sup>3</sup> Adapted from Friberg and Eller<sup>(4)</sup> (1992)

derwent vitrectomies or cryotherapy and scleral buckling procedures to establish those who had undergone RRD repair during this period at WEI. Subjects were excluded if they had associated proliferative retinal fibrovascular disease, dialysis without a retinal detachment, tractional or exudative detachment and intraocular foreign body. Blunt trauma cases were included. Data was abstracted from the medical records including the patients age, sex, month of initial symptoms, presence of macula on or off detachment, time period from symptoms to diagnosis (history), diagnosis to surgery, symptoms to surgery (duration of the detachment), surgical procedures performed, number of operations, refraction, phakic status, preoperative visual acuity and postoperative visual acuity at 3 and 6 months and final best corrected visual acuity at discharge.

The Snellen acuity was converted to LogMAR (logarithm of the minimum angle of resolution) equivalent for statistical purposes. LogMAR are calculated by using the logarithm of the reciprocal of the visual acuity (LogMAR value = log (1/Snellen equivalent)). Counting fingers were estimated to be at 3 feet (3/200) which was a logMAR equivalent of 1.8 (Tab. I) (4).

341 eyes (319 patients, 11 bilateral cases) met this criteria. Of this 113 were macula on detachments and 228 were macula off detachments. Of the 11 cases with bilateral retinal detachments within this 5 year period, 2 cases had bilateral macula off RD and 9 cases had a macula on RD in one eye and macula off RD in the other. There were no cases of bilateral macula on rhegmatogenous retinal detachment.

Of the 228 eyes with macula off detachment there were 24 anatomical failures (Final anatomical success 89.5%).

The duration of the history varied from 0- 104 weeks, but because of the difficulty in ascertaining the precision of the duration of histories of greater than 16 weeks duration, it was decided to only include histories (symptoms to diagnosis) of 16 weeks duration or less.\*

Patients underwent between 1 and 4 procedures for their retinal detachments. Only patients whose primary procedure achieved successful reattachment were included in the final analyses, as redetachments, depending on their duration could affect the final visual outcome.

104 eyes (104 patients) met the final inclusion criteria after exclusion of anatomical failures, more than one operation and incomplete postoperative data less than one month. Statistical analysis was done by Minitab 13.1.

## RESULTS

There were 42 females (aged 20-80 years, mean 57.2 yrs  $\pm$  2.6 SE mean) and 62 males (12-89 years, mean 58.9 yr  $\pm$  2.4 SE mean). Mean age for the whole group was 58.2 years  $\pm$  1.8 SE mean). The right eye was affected in 52.4% (55) of cases and the left eye was involved in 47.1% (49) of cases.

There were 3 aphakic eyes, 15 post extracapsular cataract extraction with implant (1 developed the detachment 3 weeks post op and 2 developed it after YAG laser posterior capsulotomy) and 86 phakic eyes. There were no retinal detachments following phacoemulsification during this period. The refractive error was variable with 62.5% (65) emmetropic, 33.6% (35) myopic and 2.9% (4) being hypermetropes.

Post operative follow up ranged from 1 to 54 months, mean 7.6 months ( $\pm$  0.9SE mean). No significant intraoperative complications occurred.

### Types of surgery

87.5% (91) patients had cryotherapy and scleral buckling (11.0% had adjuvant gas injection). 11.5% (12) had vitrectomies and 1% (1) had pneumatic retinopexy.

\* Although we have also analysed the visual results of patients with macular detachments of greater than 16 weeks duration, we have kept them as a separate group and they are not analysed in the main study because of the previously mentioned reason.

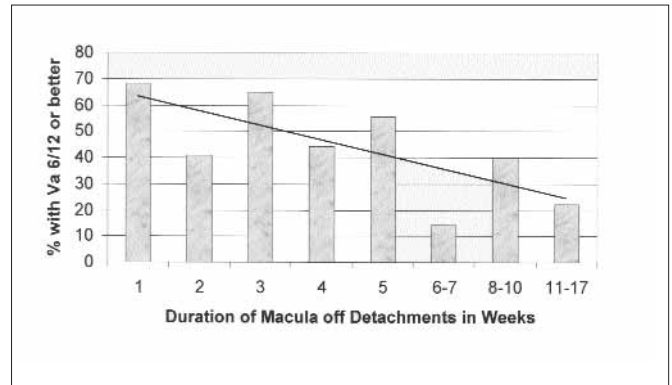


Fig. 3 - Final postoperative visual succes of 6/12and better with respect to duration of the detachment in weeks (+trendline).

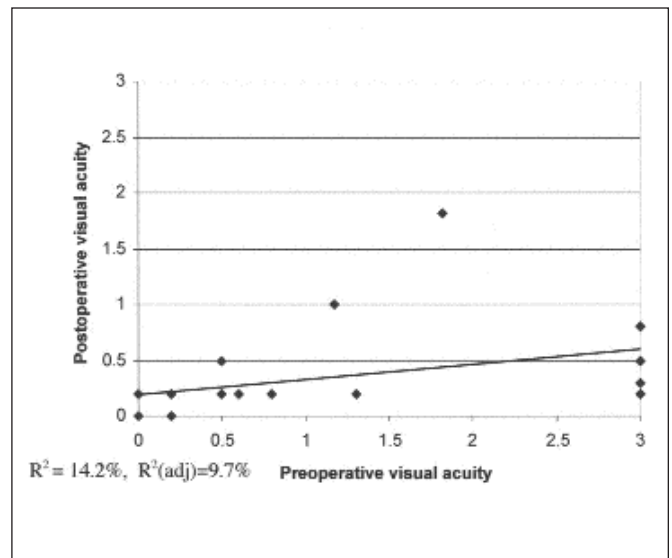


Fig. 4 - Preoperative vs postoperative visual acuity (LogMAR) for macula off detachments of  $\leq$  1 week duration.

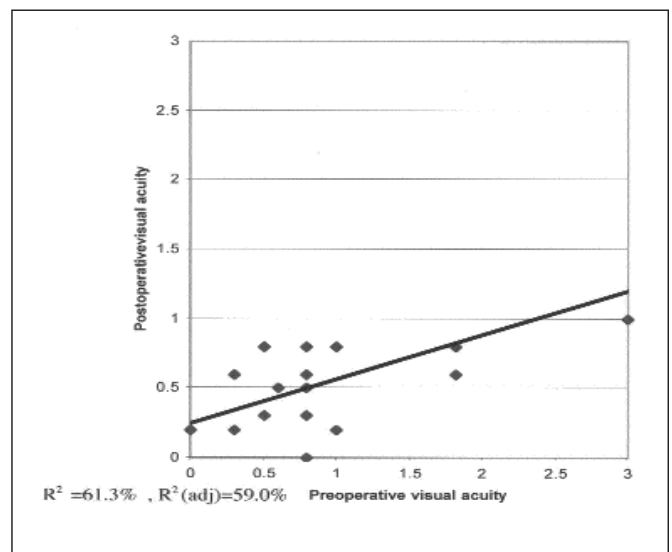


Fig. 5 - Preoperative vs postoperative visual acuity (LogMAR) for macula off detachments of  $\geq$  7 week duration.

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*Macula off detachments*

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**TABLE II - MULTIPLE LINEAR REGRESSION ANALYSIS OF POSTOPERATIVE VISUAL ACUITY (Va)**

Variable	Correlation (Va at 3 months)	Correlation (Va at 6 months)	Correlation (Final visual acuity *)
Numbers (n)	84	50	104
History	-0.13 (p=0.2)	-0.1 (p=0.44)	-0.04 (p=0.63)
Presentation-surgery	-0.13 (p=0.2)	-0.1 (p=0.36)	-0.06 (p=0.44)
Duration of Detachment	0.16 (p=0.1)	0.1 (p=0.36)	0.08 (p=0.32)
Preoperative Visual Acuity	0.15 (p<0.0005)	0.1 (p=0.05)	0.15 (p<0.0005)

\* Final visual acuity is the best corrected postoperative vision on discharge

**TABLE III - DIRECT CORRELATION (r) OF PREOPERATIVE AND POSTOPERATIVE OP VISUAL ACUITY**

Variable	Correlation (visual acuity 3 months)	Correlation (visual acuity 6 months)	Correlation (Final visual acuity)
Preoperative Visual Acuity	0.36 (p=0.001)	0.26 (p=0.07)	0.39 (p<0.0005)

**TABLE IV - DIRECT CORRELATION ACCORDING TO NUMBER OF WEEKS DURATION OF DETACHMENT. PREOPERATIVE VERSUS POSTOPERATIVE VISUAL ACUITY**

Week	No.	Mean Pre op Va ±SE of mean	Mean Discharge Post op Va + SE of mean	Mean Follow-up (months ±SE of mean)	Correlation (significance)
≤1	22	1.11 ± 0.26	0.35 ± 0.09	5.7 ± 0.9	0.38 (p=0.09)
2	22	1.76 ± 0.22	0.43 ± 0.07	7.9 ± 1.5	0.33 (p=0.16)
3	17	1.64 ± 0.25	0.36 ± 0.05	8.2 ± 3.2	0.58 (p=0.02)
4	9	1.52 ± 0.26	0.43 ± 0.09	9.6 ± 2.5	-0.18 (p=0.63)
5	10	1.71 ± 0.37	0.45 ± 0.09	4.4 ± 0.5	0.50 (p=0.18)
6-7	7	1.56 ± 0.4	1.02 ± 0.2	8.4 ± 4.5	0.55 (p=0.2)
8-10	10	1.034 ± 0.29	0.50 ± 0.1	8.2 ± 1.5	0.63 (p=0.05)
11-17	7	1.12 ± 0.41	0.70 ± 0.20	11.6 ± 6.2	0.96 (p=0.001)
17-122 <sup>§</sup>	12	1.89	1.618	9.4	0.80 (p=0.002)

§ Special group who presented with detachments >16 weeks duration

## *Timings in patients' history and surgical management*

### *Symptoms to diagnosis*

4.8% (5) of patients presented on the same day of their symptoms. The mean interval from symptoms to diagnosis was 2.6 weeks ( $\pm 0.3$  SE mean), most patients presented within the first 2 weeks of their symptoms. The range was 0 to 16 weeks. Patients with over 16 week histories were excluded in the main analysis as explained above.

### *Diagnosis to surgery*

Macula off detachment patients waited a mean of 1.8 weeks ( $\pm 0.2$  SE mean) from diagnosis to surgery. However, this ranged from 0-9 weeks. 9.6% (10) patients had their operation on the same day as their presentation. 65.4% (68) patients had their operation within 1 week of presentation.

### *Symptoms to surgery*

The mean duration between the development of symptoms and detachment surgery was 4.2 weeks ( $\pm 0.3$  SE mean). Fig. 1 summarises the timing of the detachment, illustrating that most patients presented within 2 weeks of their symptoms and had their operation within 2 weeks of presentation.

### *Monthly incidence of onset of retinal detachment*

The monthly incidence of retinal detachments (the estimated occurrence from extrapolation from the history) increased during the June- July period and in September (Fig. 2). Although the incidence was higher in June and July (over the 5 year period), there was no statistically significant difference in the incidence.

### *Visual outcome*

The visual outcome was measured at approximately 3 and 6 month periods and the final visual acuity at discharge (mean 7.6 months). There was a very strong post operative correlation of the 3, 6 and final post operative visual acuity.

## *Visual outcome analysed by surgical procedure*

The mean postoperative visual acuity was 0.45 (LogMAR) for patients undergoing external scleral buckling, compared to the mean postoperative vision of 0.65 (LogMAR) for those undergoing internal procedures (vitrectomies) ( $p=0.08$ ; ANOVA test).

### *Visual outcome analysed by age*

In order to determine if age had an effect on the visual outcome, we split the data into 2 groups: Group 1 were those less than 60 years old (44 eyes) and Group 2, those  $\geq 60$  years old (60 eyes).

56.8% (25/44) of Group 1 achieved 6/12 compared to 46.6% (28/60) in Group 2. The mean visual acuity in group 1 was 0.43 ( $\pm 0.06$  SE mean) in group 2 was 0.49 ( $\pm 0.05$  SE mean). The analysis of variance (ANOVA) of 2 groups showed that the visual outcome was significantly better in the patients less than 60 years old, regardless of the duration of the detachment ( $p=0.007$ ).

### *Visual improvement*

78.8% (82) of patients had visual improvement. 14.4% (15) remained the same and 6.7% (7) of patients lost more than 1 line on the Snellen chart. The mean pre operative vision was 1.45 ( $\pm 0.1$  SE mean) and the mean post operative vision 0.47 ( $\pm 0.04$  SE mean).

### *Functional success*

25% (26) of patients achieved a visual acuity of 6/9 or better at 3 months and 35.5% (37) at final discharge. 36.5% (38) achieved visual acuity of 6/12 or better at 3 months post op and 51% (53) at final discharge. (Tab. I for LogMAR conversion). 68.2% (15/22) of patients whose detachment was of 1 week's duration or less achieved a visual acuity of 6/12 or better, with a noticeable decreasing trend line with 14.3% (1/7) and 27.8% (5/18) in the groups with macular detachments of 6-7 weeks and greater than 8 weeks respectively, achieving 6/12 (Fig. 3).

### *Multiple linear regression analysis of the post-operative visual acuity*

Multiple linear regression analysis of the post-operative visual acuity at 3 and 6 months and final visual acuity with respect to the history (commencement of symptoms to diagnosis), diagnosis to surgery, duration of the detachment and the pre-operative visual acuity was performed for postoperative visual acuity (Tab. II).

Note that some patients final visual acuity was recorded at 3 months when they were discharged. Of the variables the preoperative visual acuity had the strongest correlation with the visual acuity at 3 months, 6 months and on discharge (Tab. II).

Using direct correlation, without the variables of timing, a stronger correlation was noted of 0.39 ( $p < 0.0005$ ) (Tab. III).

There was a strong correlation between the pre-operative and postoperative visual acuity for detachments of  $\leq 1$  week duration, but this was not significant 0.38 ( $p = 0.09$ ) (Fig. 4).

However, for detachments of greater than 7 weeks duration there was a very strong correlation between the preoperative and postoperative visual acuity ( $r = 0.78$ ,  $p < 0.0005$ ) (Fig. 5)

The highest correlation of preoperative and postoperative visual acuity was found in the group whose duration of detachment was 8 weeks or more (Tab. IV).

### *Patients with history of macula off detachment > 16 weeks*

There were 12 patients with detachments who presented with a history of greater than 16 weeks who underwent successful primary repair. 3 had a 24 week history, 1 had a 28 week history, 1 had a 36 week history, 2 had a 40 week history, 4 had a 52 week history and 1 a 104 week history. They were not analysed with the main study group of 104 patients. Only their visual acuities were analysed for reasons previously discussed.

This group (§) with detachments with histories of greater than 4 month duration also showed a very strong correlation between the preoperative and post operative visual acuity.

The mean preoperative visual acuity was 1.897 and mean postoperative visual acuity was 1.618. The cor-

relation between preoperative and postoperative visual acuity was strong  $r = 0.80$  ( $p = 0.002$ ).

## DISCUSSION

Several studies have considered the predictive power of certain parameters on final visual acuity following retinal detachment repair. It is well known that preoperative visual acuity is the single most important factor predicting postoperative vision (5,6,7). Our Multiple regression analysis and ANOVA tests have demonstrated significant correlations for the parameters of macula off detachment duration, preoperative visual acuity and patient's age. Burton attributed 71% of the variation in the final visual acuity to the duration of the macula off detachment (2). Earlier studies had suggested that older patients, greater duration of detachment and increased sub retinal fluid BuChE (butyrylcholinesterase) is reflective of the degree of breakdown of the posterior segment blood ocular barrier) each had a significant inverse relationship to acuity (1).

It has been demonstrated that there is no statistical difference in visual recovery in patients operated between 1-2, 3-4, or 5-7 days of the detachment (3). Further, it was established that a delay in surgery (next scheduled list operating list vs emergency), did not adversely affect the outcome (8). Burton (2) had shown that operations within 9 days had a better chance of achieving visual acuity  $> 20/50$  (LogMAR 0.77 or 6/15). This study showed a reduction of one line of Snellen acuity per subsequent week of detachment up to 27 days. Thereafter one line was lost every 10-11 day period until 71 days. However, he only looked at duration and not preoperative visual acuity as a variable.

An earlier study showed that one month was a critical period for the duration of a detachment (9). However, this was contradicted by another study (4) which showed no significant correlation between the duration of the macular detachment in weeks and the final vision. The authors felt that the patients' estimation of the duration of macular detachment was so imprecise compared to other variables that it was of limited value (4). Permanent macular damage has been demonstrated in detachments of greater than 2 months duration (10).

We have shown that the best mean postoperative

vision (LogMAR 0.35, Snellen equivalent ~ 6/12) was in the group of patients that had detachments of less than 1 week duration. However, in contrast to Burton's results we found, like Hassan et al (11), that there was no notable decrease of postoperative Snellen vision until the macula had been detached for at least 6 weeks.

We have demonstrated that after 6 weeks of detachment there was a strong correlation between the preoperative and the postoperative visual acuity. This suggests that if the preoperative visual acuity is poor, then postoperative visual acuity will be poor in macula off detachments of 6 weeks duration or more. This would suggest that for a minimally acceptable visual acuity, all macular detachments should be operated on within 5-6 weeks of the detachment.

We have clearly demonstrated that the postoperative visual acuity is significantly decreased with lengthy delay to surgery and hence poor visual prognosis for macular detachments of over 6 weeks duration.

We know that the final visual acuity was poorer in patients aged 60 years and older. This may not necessarily be a consequence of the macula detachment alone as a cross sectional study of 17,349 individuals demonstrated that visual acuity is a function of age and begins decreasing at 60 years of age (12).

It has been observed that patients aged between 20-29 years and 40-60 years had more favourable results than patients older than 70 years of age (13,14). Tani et al (6) also demonstrated that 55 year olds had a more favourable outcome than 59 year olds

We agree with Tan et al (6) and Hassan et al (11) as our patients under 60 years old had a better outcome than those over 60 years old. Further, we found that the effect of the duration of the detachment was more significant in the  $\geq 60$  year age group.

There are few recent studies in the literature with data on functional success compared with anatomical success (3,4,15, 16). An earlier study had suggested that beyond 8 weeks duration of a detachment there was poor macular recovery, although a functional visual field may be restored (17).

Final vision of 6/12 or better range from 30.2- 47% (6,16,18). This compares well with our functional success rate at 3 months (36.5%), although we had 51% achieving 6/12 vision at discharge for the whole group.

Hassan et al (11) achieved 6/12 or better in 71% of eyes with a duration of macula off detachment of  $\leq 10$

days, 27% of eyes 11 days – 6 weeks and 14% of eyes with a duration of  $> 6$  weeks. Further he showed that patients less than 60 years old achieved a mean post op Va of 20/47. He also showed that the duration of the macula off detachment and patient's age had no statistically significant effect on final anatomical reattachment rate. Interestingly, another study showed that 45.3% of primary retinal detachment repair achieved a visual acuity of 6/18 or better in 1987 compared with 46.8% in 1996 ( $p=0.849$ ,  $\chi^2$  test). The authors alluded that this may be due to an increase in the time interval from diagnosis to surgery and increased incidence of macular detachment (19).

There have been many studies of literature on the anatomical successes of detachment surgery and more recently on comparing earlier data with more recent data (16,18 - 21). Primary anatomical success rates averaged 75% in the '80's to 85% in the 90's and final anatomical reattachment rates of 94% (6,16,20, 22). Our study had an overall anatomical success of 89.5% for macula off detachments.

### *Experimental studies*

Experimental studies on feline eyes have shown that if the retina is reattached within 24 hours, it can greatly delay and reverse some of the cellular and molecular damaging events initiated by the detachment (23)

Hence, from a physiological point of view it can be argued that macular off detachments of very short duration would have a better result if operated upon within 24 hours, but studies have not borne this out and it may not be ethical to do a randomised controlled study on the surgical timing of such detachments. Morphological changes were most frequent in detachments lasting at least 2 months and all eyes without morphological changes in the macula had final visual acuities of 6/12 or better (10). Ross and Kozy (3) showed that some patients with macula off detachments for 1 – 2 days did not achieve a postoperative vision better than 20/50, whereas other patients whose macula were detached for 5- 7 days regained 20/20 vision.

Visual improvement does not simply occur as a result of returning the retina to an anatomical position. Lewis et al (24) has shown that early reattachment inhibits the proliferative and glial response of the Muller cells to the detachment. Further that after 7 days the

level of cone opsins in the surviving outer segments is dramatically reduced compared with the rod opsins.

Photoreceptor death occurs by apoptosis after detachment and there is a steady decline in the thickness of the outer nuclear layer if the retina remains detached, with reattachment having a profound preventative effect on cell death due to the plasticity of the 2<sup>nd</sup> order neurons (24). Even a month after reattachment the outer segments which had retracted with the detachment have not yet attained their pre detachment length (25).

Therefore, although functional recovery after surgery mainly occurs within 3–6 months, it can continue for a longer period. Functional recovery can improve by a further 2 or more lines at 5 years compared with 6 months, with visual acuities still improving up to 10 years postoperative (15, 26). Long term improvement after retinal detachment surgery was better in eyes with macular detachments of less than 30 days (26).

Hagimura et al (27) has shown that although the retina may appear flat on indirect ophthalmoscopy, optical coherence tomography has shown foveal detachment present in 46% at 1 month. However, 86% spontaneously resolved over the 12 month postoperative period which correlated with an improvement in visual acuity. This may explain those cases with a delay in visual recovery.

Intra retinal separation also has a negative effect on the postoperative vision (27). Foveal densitometry has shown that the recovery of the cone photopigments after reattachment is inversely related to the duration of the detachment. Metamorphopsia occurs in patients with decreased foveal cone photopigments and that complete resolution was seen in only one patient with the shortest detachment period of 5 days (28). Therefore, although functional outcomes as measured by Snellen, visual acuities may not differ significantly between detachments repaired over the first 7 days, perhaps the resulting metamorphopsia can be reduced with earlier surgery.

Although neurosensory retinal degeneration after detachment is a major cellular cause of limited visual outcome, patients may later also develop epiretinal membranes (33%), cataracts or glaucoma, as in the case of patients with vitrectomy and gas/silicone oil (29). Primary vitrectomy has the advantage over scleral buckling in allowing better intraopera-

tive visualisation (30).

Bartz-Schmidt et al (30) felt that the visual results of vitrectomy were better than scleral buckling because of the removal of vitreous opacities and a reduced rate of proliferative vitreoretinopathy. Although the number of vitrectomies in our study was small, there was no significant difference in the final comparative visual results.

The shortcomings of this study are that it was retrospective, non-randomised and uncontrolled. However, it would not be ethically acceptable to design a randomised controlled study.

The main inaccuracy of the study is estimating the duration of the detachment of the macula as a result of possible inaccuracy in determining the duration of symptoms particularly for those over one week.

The National Retinal Detachment Audit (22) has shown improved results with increasing sub specialization. Nevertheless, the increasing number of vitrectomies, improved equipment (wide angled panoramic systems, high speed vitrectomy cutters, endolaser) and tamponade techniques (perfluorocarbon gases and silicone oil), have not significantly improved the visual outcomes and anatomical reattachment rates. By knowing the duration of macular involvement beyond which poor visual recovery can be expected, we can ensure optimal results by timely surgical repair of macular off retinal detachments.

The effectiveness of surgical repair for retinal detachment must be based not only on anatomical reattachment rate but also visual acuity.

Duration of a macula off detachment strongly determines final visual acuity regardless of the type of operative procedure. Those with a duration from symptoms to surgery of less than 1 week have the best final visual acuity. Patients aged less than 60 have a better prognosis. We have shown that the visual outcome is better for retinal detachments of less than 6 weeks duration.

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