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Prognosis of Return of Macular Function after Retinal Reattachment

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Introduction

Detachment surgery up to date has concentrated on the anatomical reattachment. The rate of reattachment has reached to 90%. Restoration of visual function is another matter.

The return of visual function can be affected by the surgical procedure to the extent that it may diminish the transparency of the media, or destroy retinal function. The most cogent factor, however, is the preoperative state of the macula. In an earlier paper [KREISSIG and LINCOFF, 1974], we have noted that the duration of a macular detachment is critical; in a subsequent paper [KREISSIG *et al.*, 1975], the retinal function after reattachment was evaluated.

The subject has been reported upon by KROENFELD [1963], SALLMANN and SVEINSSON [1933], PANNARALE and PROTO [1964], HUDSON [1966], BERNDT [1966], POLLIOT and REGNAULT [1966], KISHIMOTO *et al.* [1967], DAVIES [1972], FOULDS *et al.* [1974], ANAGNOSTOPOULOS *et al.* [1975], etc. For this report, a prospective analysis of 266 retinal detachment patients has been made by testing pre- and postoperative macular function for qualitative and quantitative response.

Materials and Methods

The retinas of all 266 patients were reattached by using cryopexy and an external sponge technique as recommended by LINCOFF (the modified Custodis procedure). There was no drainage of subretinal fluid in 90% of the patients. Patients with cloudy media,






Group	Extension of retinal detachment	Number of patients
I	macula attached 	70
II	partial detachment of the macula 	28
III	total detachment of the macula 	23
IV	total detachment of the macula and partial detachment of the retina around the disc 	99
V	total detachment of the macula and the retina around the disc 	46

Fig. 1. 266 reattached detachment patients preoperatively divided into 5 groups on the basis of their detachment in the posterior pole.

macular pathology or severe myopia were excluded. To correlate the preoperative detachment with the postoperative function, the area of detachment in the posterior pole was measured. *Preoperatively five categories of retinal detachments were defined (fig. 1).*

Groups II-V should describe four different states of macular detachment: (a) the different extensions (groups II, III) and (b) the different heights - at least approximately - (groups III-V). The postsurgical examination was aimed at testing the validity of these divisions: if they were valid they would provide a basis for prognosis of postsurgical function. Three parameters of macular function were evaluated.

Visual acuity. It was tested with the Idem-projector with decimal divisions. Visual acuity was determined preoperatively and then postoperatively at 2 months and between 6 months and 1 year.

Light-difference threshold. It was tested with the Tübinger perimeter by Harms. 57 patients - almost equally distributed between groups II-V - were examined at least 2 months after operation. The patients' times for adaptation were 15 min. at a background luminance of 10 asb. The target size used was 10' in diameter. The examinations were not only confined to the area of the visual field correlating with the foveola, but the light-difference threshold was determined up to 12° nasal and temporal of the visual center. The examination was done in the meridian going exactly through the blind spot; therefore it was not always the 0° meridian. The illumination was 'white' light.

Testing for metamorphopsia. It was done 2 months after operation in 57 patients of groups II-V on the Amsler grid.

For statistical analysis, the t-test was applied.

Results

Visual Acuity

Group I. This group served as a control: it should show the effect of the operative procedure on macular function and define the time necessary after surgery to recover presurgical visual acuity. In none of 70 patients in whom the macula was attached preoperatively did visual acuity fail to recover. 56 patients regained preoperative vision between 4 and 8 weeks. 14 patients – because they were elderly and lived too far away – were not tested until 3 months when their vision was also found to have recovered to the preoperative level.

Groups II–V. The number of patients in each group is shown in figure 1. Figures 2a–d demonstrate the distribution of pre- and postsurgical visual

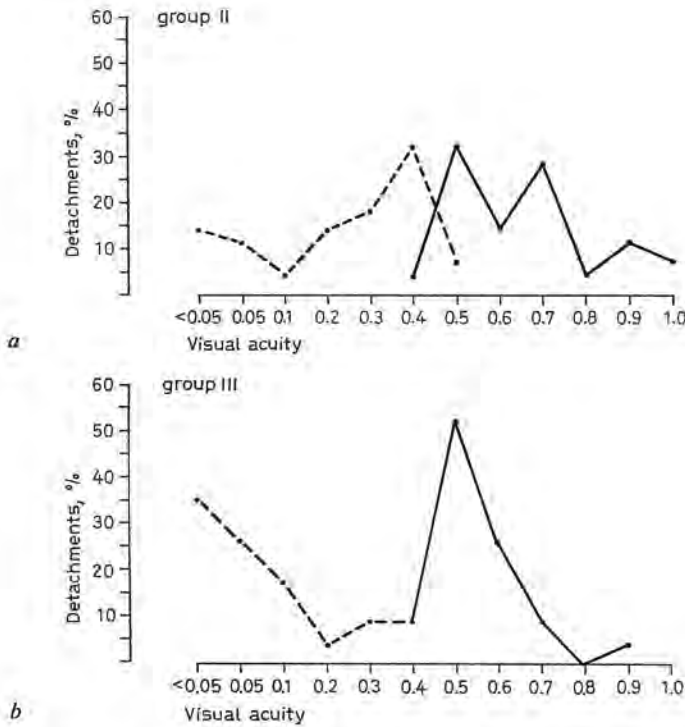


Fig. 2. Preoperative (---) and postoperative (—) visual acuity in groups II (a), III (b), IV (c) and V (d). Number of patients per group as in figure 1. fc = finger counting.

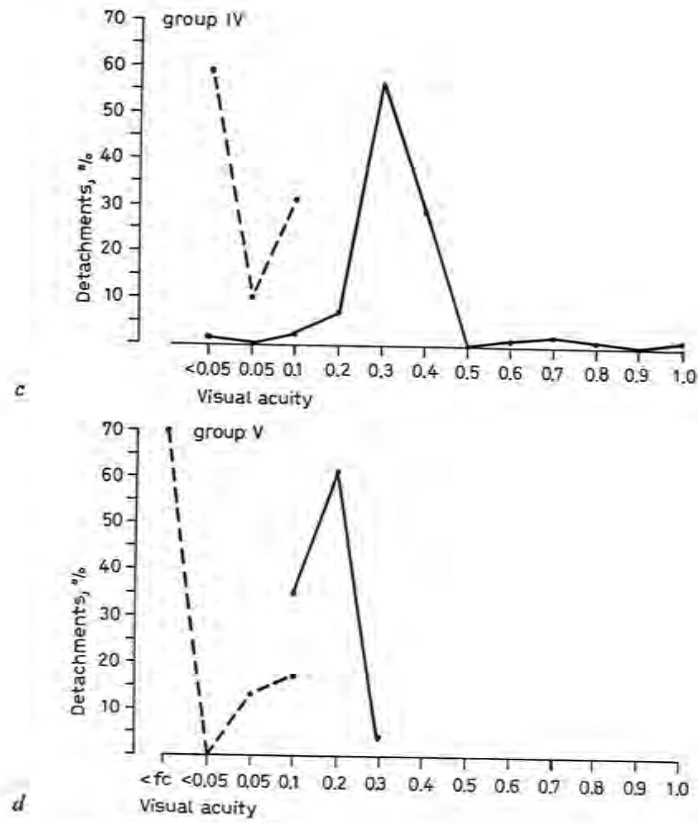


Fig. 2

acuity of groups II–V. In each group there is an apparent increase of the postsurgical visual acuity which is expressed by the shift of the second curve to the right.

As might be expected, the presurgical and postsurgical visual acuity parallels the degree of macular detachment. To demonstrate this, the mean of pre- and postsurgical visual acuity was calculated for each group (table I). The differences noted between groups lend validity to the preoperative divisions.

Functional prognosis based on presurgical grouping: in group I, visual acuity remains unchanged. The difference between groups I and II is not significant (table II). This suggests that complete recovery may be expected to a large degree from a partially detached macula.

Table I. Mean of pre- and postoperative visual acuity in 196 patients after retinal reattachment

Group	Number of patients	Mean of visual acuity	
		preoperative	postoperative
II	28	0.25	0.66
III	23	0.1	0.55
IV	99	0.04	0.33
V	46	0.02	0.17

Table II. Analysis of statistical significance of differences in postoperative visual acuity between groups II-V

Group	p-values	Significance
I/II	0.20-0.10	nonsignificant
II/III	0.02	significant
III/IV	0.001	significant
IV/V	0.001	significant

Statistical analysis was done according to t-test.

There is significance in the changes between groups II-V that is to say that the four different states of macular detachment can yield statistically different visual acuities. On the basis of our material, the postsurgical visual acuity of group II has a mean of 0.66, group III of 0.55, group IV of 0.33 and of group V of 0.17. These results tend to confirm that the *extension* and *height of the macular detachment* influence the postsurgical visual acuity.

An analysis of the detachments whose postoperative visual acuities fell below the average revealed that the *duration of macular detachment* comes next in importance (table III). The resultant visual acuity of a macular detachment that has persisted less than 1 week is significantly better than one that has persisted from 1 to 2 weeks. In contrast, the resultant visual acuity of a macular detachment that has lasted from 1 to 2 weeks is not significantly better than after 2 weeks to 1 year. The mean of the resultant visual acuity after 1 year was still more reduced than after 2 weeks.

The *age of the patient* influenced the functional result. When the 196 patients with detached macula (groups II-V) were divided into 2 groups above and below 55 years of age, a comparison reveals that while there is no

Table III. 196 detachment patients (groups II-V) divided into three groups of different duration of macular detachment

Duration of macular detachment	Postsurgical visual acuity	
	significance	evaluation
A → B	0.05 > p > 0.025	S
B → C	0.1 > p > 0.05	NS

A = ½-7 days; B = 8-14 days; C = 15 days to minimal 1 year

Table IV. 196 detachment patients (groups II-V) divided into two age-groups

Age-group	Postoperative visual acuity	Significance	Evaluation
A → B	after 2 months	0.1 > p > 0.05	NS
A → B	after ½-1 year	0.005 > p > 0.001	S

A = 12-55 years; B = 56-89 years

Table V. 70 detachment patients (group I) divided into two age-groups

Age-group	Postoperative visual acuity	
	significance	evaluation
A → B	0.2-0.1	NS

A = 12-55 years; B = 56-89 years

statistical difference in recovery up to 2 months, after ½-1 year, the older age-group recovers significantly less (table IV). In contrast, there was no statistically significant difference in postsurgical visual acuity between two age-matched control groups (with macula attached preoperatively): neither at 2 months nor at 6 months to 1 year after surgery (table V).

Dividing the 196 patients of groups II-V into three different refractive groups (0 to +14 dpt; 0 to -5 dpt; -6 to -22 dpt) and comparing them revealed that the mean of postsurgical recovery of visual acuity in the high myopes (above -6 dpt) is less; but there is no significant difference in the recovery of the other refractive groups. It is to be emphasized that no patient

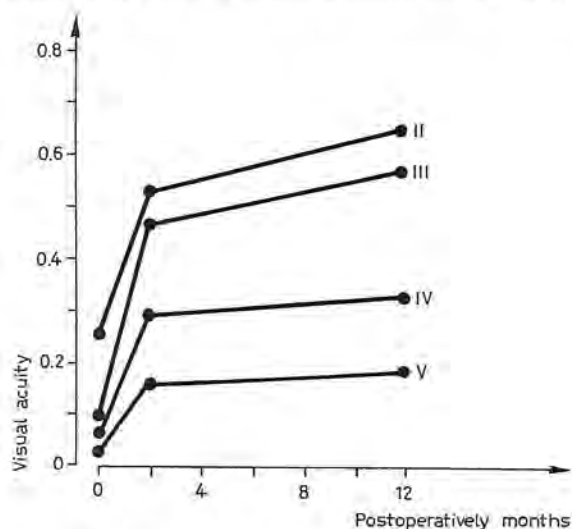


Fig. 3. Postoperative visual acuity of 196 patients (groups II-V) is analyzed over an extended period of time after reattachment. Number of patients per group as in figure 1.

was included for study who showed ophthalmoscopic evidence of myopic degeneration in the macula.

In conclusion, the postsurgical visual acuity after reattachment of the macula is dependent upon: (1) extension and height of macular detachment; (2) duration of macular detachment; (3) age of patient, and (4) degree of myopia.

Additional analysis reveals that visual acuity improves after reattachment over an extended period. When the visual acuity of all 196 patients with detached macula is analyzed for recovery at 2 months and 1 year after reattachment (fig. 3), a rapid increase is found up to 2 months in all groups. Part of this recovery, as we know by the results of group I, is due to the recovery from the surgical trauma. The first improvement, a rapid one, is followed by a lesser increase of visual acuity up to 1 year, especially in groups II and III. These findings suggest that after a partial or just a total detachment of the macula, particularly in the younger age-group, visual acuity may improve after up to 1 year.

Light-Difference Threshold

The curves of mean values reveal a most obvious difference between groups II and V (fig. 4). The light-difference threshold is lower the more

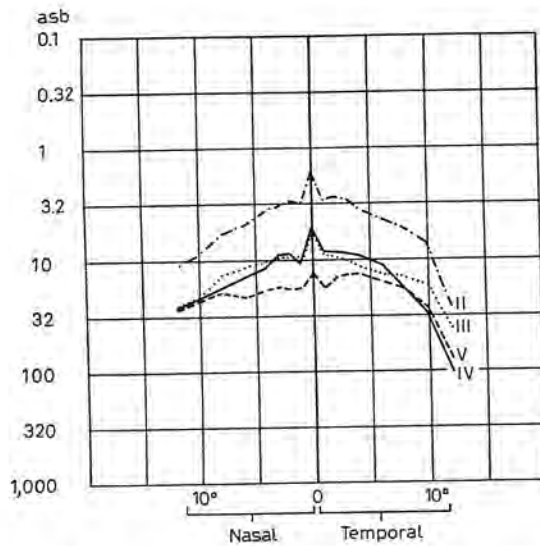


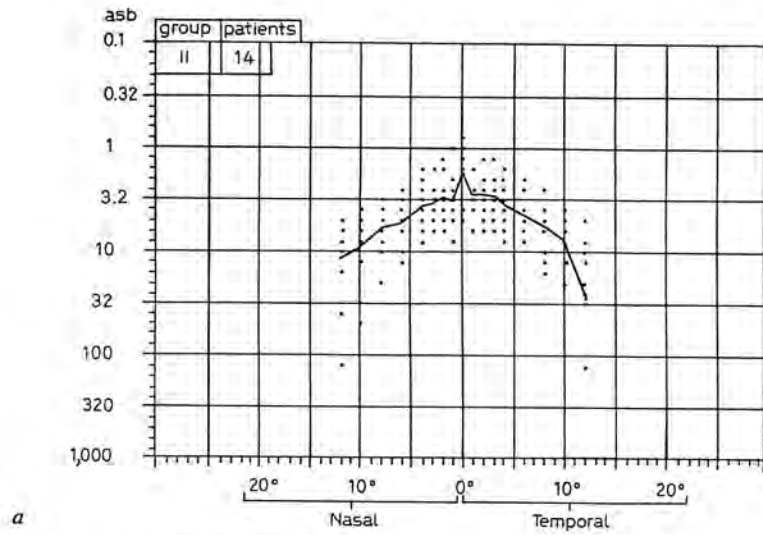
Fig. 4. Mean of postoperative light-difference threshold in 57 patients (groups II-V) after reattachment.

extensive the macular detachment was presurgically. This is further support for the validity of the presurgical grouping.

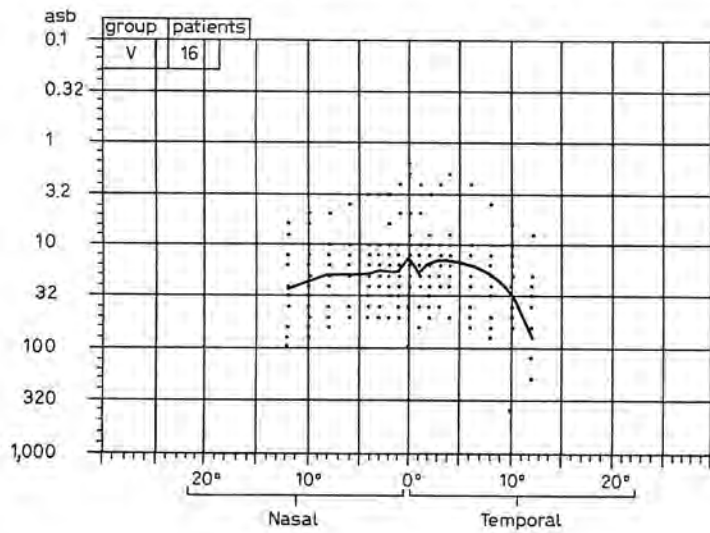
If we compare the mean curve of group II, i.e. the group with minimal detachment of the macula, and of group V, the group with maximal detachment of the macula (fig. 5a, b), the curves of group V – in contrast to group II – show a general flattening especially of the peaks. In all the single curves of group V there are relative central and paracentral scotomas, but no absolute scotomas using a test target of 10'. Thus the postoperative light-difference threshold, as the visual acuity, depends upon the extension of macular detachment.

The effect of duration of the macular detachment is demonstrated in figure 6a. The light-difference threshold diminishes with the duration of the macular detachment. The decrease after a 2 weeks detachment is substantially greater than after several hours and up to 1 week. In contrast, the light-difference threshold in a patient with a macular detachment that has lasted 2 weeks is not significantly better than after 1 year, though there is still a difference in their mean values.

The influence of the age of the patient is demonstrated in figure 6b. Comparing two age-groups, the light-difference threshold in the older age-



a



b

Fig. 5. Mean of light-difference threshold after retinal reattachment with deviations. *a* Group II (14 patients): after reattachment, no general decrease of the light-difference threshold or flattening of the peaks is present. *b* Group V (16 patients): there is a general flattening of the single curves and especially of the peaks. There is only one curve with an exceedingly high postoperative light-difference threshold; the patient was emmetropic and young, the macular detachment of half a day duration.

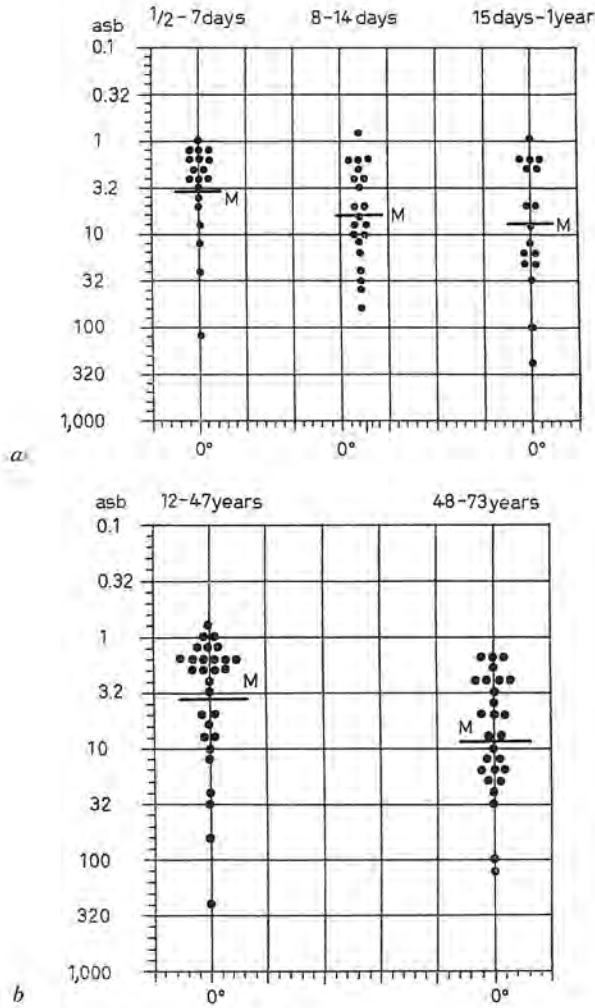


Fig. 6. Influence of duration of macular detachment (a), age of the patient (b) and myopia (c) on the light-difference threshold in the visual field center (0°) in 57 patients after macular reattachment. M = mean.

group is more reduced. This is taking into consideration the physiological decrease with age described by AULHORN [in press].

The influence of myopia is demonstrated in figure 6c. Comparing two refractive groups divided at -5 dpt, the higher myopes show a greater decrease in light-difference threshold following a macular detachment.

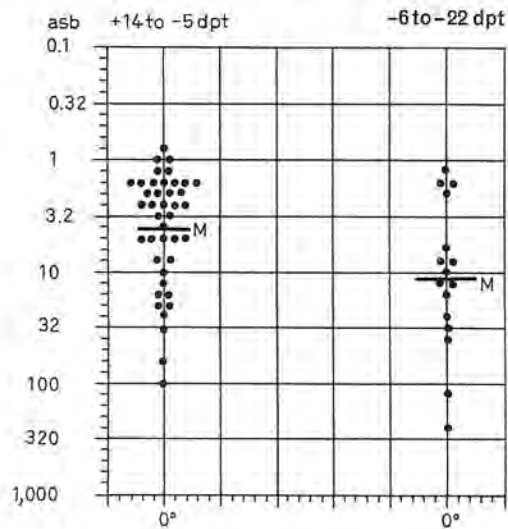


Fig. 6c

Table VI. Postsurgical metamorphopsia in 57 patients after macular reattachment

Group	Number of patients	Metamorphopsia
II	14	5
III	12	6
IV	14	10
V	17	11

Metamorphopsia

Metamorphopsia increases with the extent and the height of macular detachment (table VI). In group V, where one might expect the greatest decrease in postsurgical macular function, the number of patients with resultant metamorphopsia is less than expected. This might be an effect of the low visual acuity in these patients.

Discussion

The paper analyzes the macular function of 266 detachment patients after anatomical reattachment. The retina of all patients was reattached by

using cryopexy and an external sponge (Lincoff plombe) technique beneath the hole. Subretinal fluid was not drained in 90% of the cases. The patients were divided preoperatively into five groups according to the extension of retinal detachment in the macula and around the disc. To test the validity of the presurgical grouping, three parameters of macular function were analyzed postoperatively. The divisions provided a basis for prognosis of macular function. A statistical analysis revealed that in the four degrees of macular detachment (groups II-V) a significantly different visual acuity can be expected after reattachment. On the basis of our material, the postsurgical visual acuity of group II has a mean value of 0.66, group III has a mean of 0.55, group IV of 0.33 and group V of 0.17.

It was found that postsurgical visual acuity is also influenced by the duration of the macular detachment, the age of the patient, and the degree of myopia. Considering duration, the time within 1 week seems to be critical for macular recovery. If the macula has been detached less than 1 week, the resultant visual acuity is optimal and substantially better than if the detachment has been longer than 1 week. Macular recovery after a 6-month to 1-year detachment differs only slightly from the recovery after 2 weeks. The findings from postsurgical light-difference threshold testing also confirm this. When the postoperative visual acuities of all 196 patients with detached maculas were analyzed for recovery at 2 months and 1 year, a rapid increase in visual acuity was found within the first 2 months in every group, followed by a lesser increase up to 1 year.

The mean visual acuity in all four degrees of macular detachment was better after 1 year than 2 months. On the basis of our material, a late increase in visual function may be expected especially in the younger age-group. In a few cases an increase over several years was observed.

This twofold increase of postoperative visual acuity might be correlated with the experimental data of KROLL and MACHEMER [1969] and FOULDS and IKEDA [1966]. They found a regeneration of outer segments 4 weeks after retinal reattachment; the recovery of rods was faster than of cones. This coincides with our [LINCOFF (1970), and KREISSIG (1971)] animal experiments in which degeneration of rods was induced by cryopexy; regeneration of outer segments was observed by 14 days. Correlating these findings with the uneven postsurgical increase in visual acuity in the detachment patient, the initial rapid increase might be compared (in addition to the recovery of the eye from the surgical trauma) with the faster regeneration of rods and the later improvement with the delayed recovery of cones. This has to be verified by additional testings.

As a second postoperative parameter of macular function, light-difference threshold was examined in 57 detachment patients. The results lend validity to the presurgical grouping of detachments. They also confirmed that duration of macular detachment, age of the patient and degree of his myopia influence postsurgical function.

A third parameter of postoperative macular function was defined by testing for metamorphopsia in 57 patients. Metamorphopsia after retinal reattachment was described by BERNARDCZYKOWA [1969]. In our material, the frequency of metamorphopsia varied directly with the extension and height of macular detachment. These results supported the presurgical grouping of retinal detachments.

Analyzing the findings of the first two parameters, it seems that macular detachment affects visual acuity more than light-difference threshold. In part, this might be due to the size of our target for testing the light-difference threshold, and the presence of postoperative metamorphopsia. Therefore, the metamorphopsia seems to affect more the postoperative visual acuity and so will cause its greater decrease.

The analysis of 266 patients after retinal reattachment showed that the following factors influence the postsurgical quantity and quality of macular function: (1) extension and height of detachment in the macula; (2) duration of the macular detachment; (3) age of the patient, and (4) degree of myopia.

Apart from prognosis the consequences for clinical management are as follows: while neither the age of the patient nor the myopia can be influenced, the extension and duration of macular detachment may be modified by an immediate hospitalization; especially of a patient with a detachment of less than 1 week and an older or myopic patient. Binocular patching and bed rest to diminish the height and extent of macular detachment and surgical repair at the earliest moment for reattaching the macula seem appropriate. This will justify the requirement [KREISSIG and LINCOFF, 1974] for giving some retinal detachment patients an emergency status for entering the hospital and for a position on the operating schedule.

Summary

A prospective analysis of macular function in 266 retinal detachment patients has been made. All of the patients were reattached by using cryopexy, and an external sponge technique. No drainage was done in 90% of the cases.

To correlate the preoperative detachment with the postoperative function, the area of detachment in the posterior pole was measured and divided into five groups on the basis

of the extension of the detached retina in the area of the macula and around the disc. The validity of this presurgical grouping was tested by postsurgical evaluation of visual acuity, light-sensitivity threshold, and metamorphopsia. Visual acuity was tested over a period of 1 year.

Recovery of macular function appears to be dependent upon (1) presurgical extension and elevation of the macular detachment; (2) its duration; (3) the age of the patient, and (4) the degree of myopia.

Zusammenfassung

Gegenstand der Arbeit ist die zurückgewonnene Macula-Funktion nach operativ wiederangelegter Netzhaut-Ablösung. Untersuchung von 266 Ablatio-Patienten, deren Netzhaut durch die kryochirurgische Ablatio-Operation (von LINCOFF modifizierte CUSTODIS-Methode) zur Anlegung gebracht worden war. Präoperative Einteilung der Ablationen aufgrund des ophthalmoskopischen Befundes im Bereich der Macula und am Papillenrand in 5 verschiedene Gruppen. Es sollte dadurch die unterschiedliche Ausdehnung und – wenigstens in Annäherung – die verschiedene Abhebungshöhe im Macula-Bereich erfasst werden.

Zur Überprüfung der Zweckmässigkeit dieser präoperativen Gruppeneinteilung Untersuchung von 3 Teilfunktionen der Macula: der zentralen Tagessehschärfe, der Lichtunterschiedsempfindlichkeit und der Überprüfung auf Metamorphopsien. Es konnte gezeigt werden, dass die eingeführte Ablatio-Gruppeneinteilung eine Art Prognosegruppe für die postoperativ resultierende Macula-Funktion darstellt, d.h. es kann für jede Ablatio-Gruppe eine unterschiedliche Macula-Funktion nach Netzhaut-Wiederanlegung erwartet werden. Bei einer Verlaufskontrolle der postoperativen Sehschärfe konnte ein zweizeitiger Anstieg beobachtet werden: ein schneller Initialanstieg innerhalb der ersten 2 Monate, dem dann ein zweiter, aber langsamerer Anstieg – besonders bei den jüngeren Patienten – bis hin zu 1 Jahr folgt.

Es liess sich ausserdem feststellen, dass die postoperative Macula-Funktion nicht nur von der Ausdehnung und der Höhe der Macula-Abhebung – respektive den Ablatio-Gruppen II bis V – abhängt, sondern auch 2. von der Dauer der Macula-Abhebung, 3. dem Lebensalter des Patienten und 4. dem Ausmass einer hochgradigeren Myopie. Sich daraus ergebende Konsequenzen für die klinische Praxis: da Alter und Myopie des Patienten nicht vom Arzt zu beeinflussen sind, kann hingegen die Ausdehnung und Dauer der Ablatio durch eine sofortige stationäre Aufnahme und eine möglichst schnelle Operation verändert werden, wodurch zwangsläufig auch eine Ablatio zu einem echten Notfall werden kann.

Acknowledgements

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