VITRECTOMY FOR EPIRETINAL MEMBRANES: VISUAL OUTCOME AND PROGNOSTIC CRITERIA

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ABSTRACT

The treatment of choice for epiretinal membranes (ERM) causing marked retinal distortion and substantial visual impairment remains vitreoretinal surgery. The purpose of this study was to evaluate the results of surgery performed in our department and to investigate the prognostic value of different factors such as preoperative best-corrected visual acuity (BCVA), pre-existing cystoid macular edema (CME), intra-operative peeling of the internal limiting membrane (ILM), age and duration of symptoms. Eighty-eight consecutive eyes of 88 patients were operated on for ERM from July 1998 to June 2000. Both idiopathic and secondary cases were included. In all cases the ERM was successfully removed from the fovea. Mean BCVA after surgery increased from Snellen 0.2 (hand motion (HM) - 0.6) to Snellen 0.5 (HM - 1.0) ($p<0.0001$). Our results confirm the efficacy of surgical removal of the ERM in improving the visual acuity. Although not statistically significant, mean postoperative BCVA was slightly better in the group without pre-existing CME ($p>0.05$) and in the group where peeling of the ILM was performed ($p>0.05$). The data suggest that early surgery is likely to decrease the risk of developing irreversible macular damage ($p<0.05$). Because accelerated nuclear sclerosis with visual impairment is a common phenomenon after vitrectomy, one might consider performing a phaco-emulsification at the same time, especially in the elderly.

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SAMENVATTING

Wanneer een epiretinale membraan aanleiding geeft tot retinale distortie, metamorfopsieën en een belangrijke visusdaling, blijft vitrectomie de eerste keuze behandeling. Het doel van deze studie was enerzijds de resultaten van de chirurgische behandeling voor epiretinale membranen, uitgevoerd in onze afdeling, weer te geven, alsook de prognostische waarde van verschillende factoren te onderzoeken die de best gecorrigeerde postoperatieve visus kunnen beïnvloeden, namelijk de preoperatieve best gecorrigeerde visus, de preoperatieve aanwezigheid van cystoid maculair oedeem, het peroperatief verwijderen van de membrana limitans interna, leeftijd en de tijdsduur van de subjectieve symptomen. Van juli 1998 tot juni 2000 werd een vitrectomie verricht voor maculaire pucker bij 88 ogen van 88 patienten. Zowel idiopathische als secundaire epiretinale membranen werden geïncludeerd. In alle gevallen werd het epiretinale membraan succesvol verwijderd. De best gecorrigeerde postoperatieve visus verbeterde gemiddeld van Snellen 0.2 (handbeweging - 0.6) tot Snellen 0.5 (handbeweging - 1.0) ($p<0.0001$). De doeltreffendheid van een vitrectomie voor maculaire pucker met een duidelijke verbetering van de postoperatieve visus wordt bevestigd door onze resultaten. Hoewel niet statistisch significant verbeterde de gemiddelde best gecorrigeerde postoperatieve visus discreet meer in afwezigheid van pre-operatief cystoid maculair oedeem ($p>0.05$), en wanneer peroperatief de membrana limitans interna werd verwijderd ($p>0.05$). Vroegtijdig ingrijpen verhindert de ontwikkeling van onomkeerbare maculaire schade met blijvende visusbeperking ($p<0.05$). De ontwikkeling van nucleaire lenssclerose met secundaire visusdaling blijft de meest frequente complicatie na vitrectomie voor maculai-

re pucker. Daarom moet een gecombineerde ingreep overwogen worden, zeker bij oudere patienten.

RÉSUMÉ

La vitrectomie reste le traitement de choix pour les membranes épirétiniennes associées à des métamorphopsies et à une baisse d'acuité visuelle importante. Le but de notre étude a été de montrer les résultats après chirurgie pour des membranes épirétiniennes, obtenus dans notre service, ainsi que de rechercher les facteurs qui pourraient avoir un effet favorable ou défavorable sur la meilleure acuité visuelle corrigée postopératoire. Nous avons recherché ainsi l'effet possible de l'acuité visuelle préopératoire, la présence préopératoire d'un oedème maculaire, le pelage peropératoire de la membrane limitante interne, l'âge et la durée des symptômes avant l'intervention chirurgicale. Quatre-vingt huit (88) yeux de 88 patients ont subi une vitrectomie pour membrane épirétinienne entre juin 1998 et juillet 2000. Les membranes épirétiniennes idiopathiques ainsi que les membranes secondaires étaient inclues dans cette étude. Dans tous les cas, la membrane épirétinienne a été effectivement réséquée. En postopératoire l'acuité visuelle de loin était significativement augmentée de Snellen 0.2 (mouvements de main - 0.6) à Snellen 0.5 (mouvements de main - 1.0) ($p<0.0001$). Notre étude confirme l'efficacité d'une vitrectomie pour des membranes épirétiniennes avec une amélioration importante de l'acuité visuelle en postopératoire. Bien que non-significatif, l'absence préopératoire d'un oedème maculaire et le pelage peropératoire de la membrane limitante interne semblent favoriser l'acuité visuelle en postopératoire ($p>0.05$). Les résultats suggèrent qu'une intervention chirurgicale relativement rapide évite une destruction irréversible de la macula avec une baisse permanente de l'acuité visuelle ($p<0.05$). Une progression de la cataracte avec diminution de l'acuité visuelle reste la complication la plus fréquente après vitrectomie pour membrane épirétinienne. On pourrait envisager une chirurgie combinée, surtout dans le groupe des patients âgés.

KEY WORDS

epiretinal membrane, vitrectomy, cystoid macular edema, internal limiting membrane

MOTS-CLÉS

membrane épirétinienne, vitrectomie, oedème maculaire, membrane limitante interne

INTRODUCTION

First described in 1865 by Iwanoff (11), epiretinal membranes (ERM) can be defined as membranes composed of avascular fibrocellular proliferations on the surface of the retina (30). Already in the 1970s, Machemer suggested vitreous surgery with peeling of these membranes after observing occasional spontaneous separation of ERM in some cases (14, 15). Up to now vitreous surgery remains the treatment of choice for ERM in more severe cases with marked retinal distortion and substantial visual impairment. The aim of surgical removal of an ERM is to obtain an improved appearance of the macular area that leads to an improvement of visual acuity (VA) and a decrease in metamorphopsia. Point of discussion remains when to operate on these membranes. The aim of this study was to evaluate the results of surgery performed in our department and to investigate the prognostic value of different factors regarding the final VA such as preoperative VA, pre-existing cystoid macular edema (CME), intra-operative peeling of the internal limiting membrane (ILM), age and duration of symptoms. These factors as well as the incidence of intra- and postoperative complications will be discussed.

MATERIALS AND METHODS

We reviewed the files of 88 consecutive patients operated on for ERM from July 1998 to June 2000 with a minimum follow-up of 6 months. Both idiopathic and secondary cases were included. Eyes with prior retinal detachment (RD) involving the macula were excluded. Eyes with ERM and a full thickness macular hole were also excluded. Pre- and postoperative investigations included: VA, Amsler grid, intra-ocular pressure (IOP), lens status, grade of lens opacity, retinal status and presence or absence of CME. A Pars Plana Vitrectomy (PPV) was carried out, using a three-port system.

A complete posterior vitreous detachment was created by active aspiration of the vitreous cutter. The epiretinal membrane as well as the ILM were peeled off. Then a complete peripheral vitrectomy was carried out and endophotocoa-

gulation was applied in the fundus periphery over 360°. In some cases, an air or gas tamponade was used when intra-operative retinal tears were present. In the period before 1999, the ILM was only removed in selected cases. Afterwards, ILM peeling was the standard procedure during vitrectomy for ERM. In none of the eyes were dyes injected for staining the ERM or ILM.

We included 88 consecutive eyes of 88 patients. The mean age of the patients was 70 years (range, 35 - 89). Thirty-two (36%) were men and 56 (64%) were women, with a female/male ratio of 1.75/1. Seventy-six (86%) cases were idiopathic and 12 (14%) were secondary cases of ERM. Secondary ERM included 5 eyes with prior RD, 1 eye with prior trauma, 4 eyes with prior retinal breaks (RB), 1 eye with Diabetes Mellitus (DM) and 1 eye with a prior branch vein occlusion. Mean preoperative best-corrected visual acuity (BCVA) was Snellen 0.2 (range, hand motion (HM) - 0.6). Cystoid macular edema was detected in 19 (22%) cases preoperatively, documented in all but one with fluorescein angiographic findings. In 11 (13%) eyes a pseudohole of the macula was observed. Preop there were 67 (76%) phakic eyes and 21 (24%) pseudophakic eyes. Nineteen eyes underwent a combined vitrectomy-phaco procedure. The mean duration of follow-up was 18.4 months (range, 6 - 36 months). Visual acuities were recorded using Snellen letter charts. For graphical representation and statistical analysis, they were converted to LogMAR format (31). Visual acuities of counting fingers (CF) and HM were awarded LogMAR scores of 1.9 and 2.2 respectively. After statistical analysis the LogMAR scores were transformed again into a decimal chart for a more comprehensive result. The correlation between the decimal visual acuity chart and the LogMAR units is listed in Table 1. Statistical analyses were performed using Student's *t*-test and linear regression analysis (GraphPad Prism, GraphPad Software Inc., San Diego, USA). Values of $p<0.05$ were considered to show significant differences.

Table 1. *The correlation between the decimal visual acuity chart and the LogMAR units.*

Decimal	LogMAR
2.00	–0.3
1.60	–0.2
1.25	–0.1
1.00	0.0
0.80	0.1
0.63	0.2
0.50	0.3
0.40	0.4
0.32	0.5
0.25	0.6
0.20	0.7
0.16	0.8
0.13	0.9
0.10	1.0

RESULTS

Functional results

Mean postoperative BCVA improved to Snellen 0.5 (range, HM - 1.0) ($p<0.0001$) (Fig. 1). This corresponds with a mean gain of 4 lines. Figure 2 and 3 show the postoperative BCVA as a function of the preoperative BCVA. This demonstrates a linear regression between the preoperative and postoperative BCVA ($r^2=0.6356$; $p=0.0318$) (Fig. 2). In 67 eyes (76%) the postoperative BCVA was Snellen 0.4 or better.

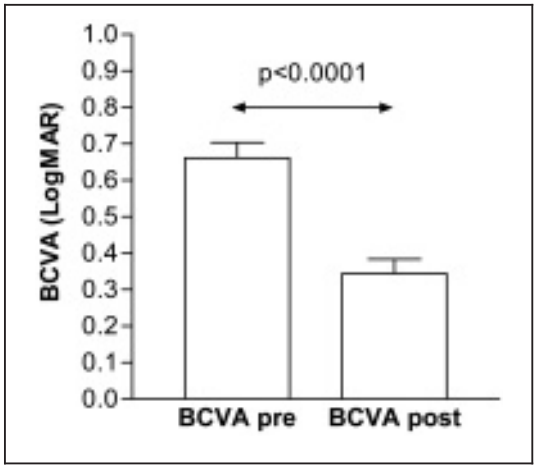


Fig 1. Mean pre- and postoperative best-corrected visual acuity (BCVA) of 88 eyes included in this group ($p<0.0001$).

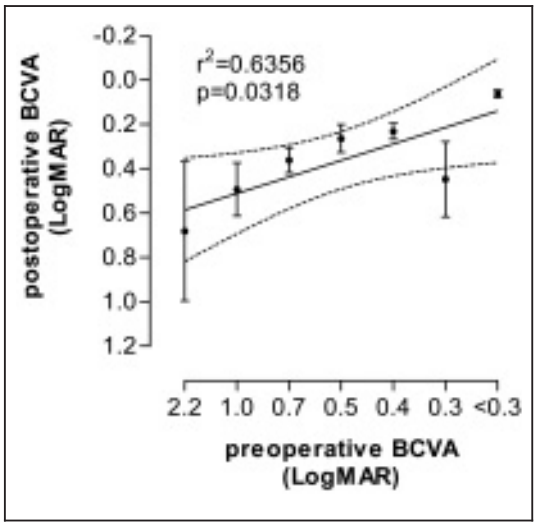


Fig 2. Best-corrected postoperative visual acuity as a function of the best-corrected preoperative one. This demonstrates a linear regression between the preoperative and postoperative BCVA (r^2=0.6356; p=0.03). Eyes with a preoperative BCVA (≥ Snellen 0.3) have a higher probability to reach a postoperative BCVA of Snellen 0.5 or better.

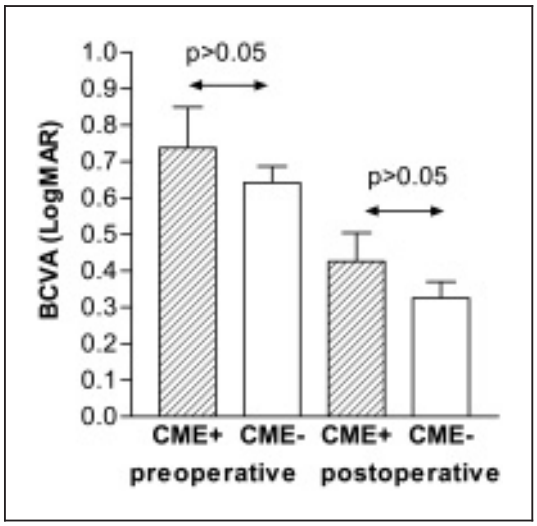


Fig 4. Prognostic factor: preoperative presence of cystoid macular edema (CME+). Mean pre- and postoperative BCVA in the group of eyes without preoperative CME (CME-) compared with the group with fluorescein angiography documented CME.

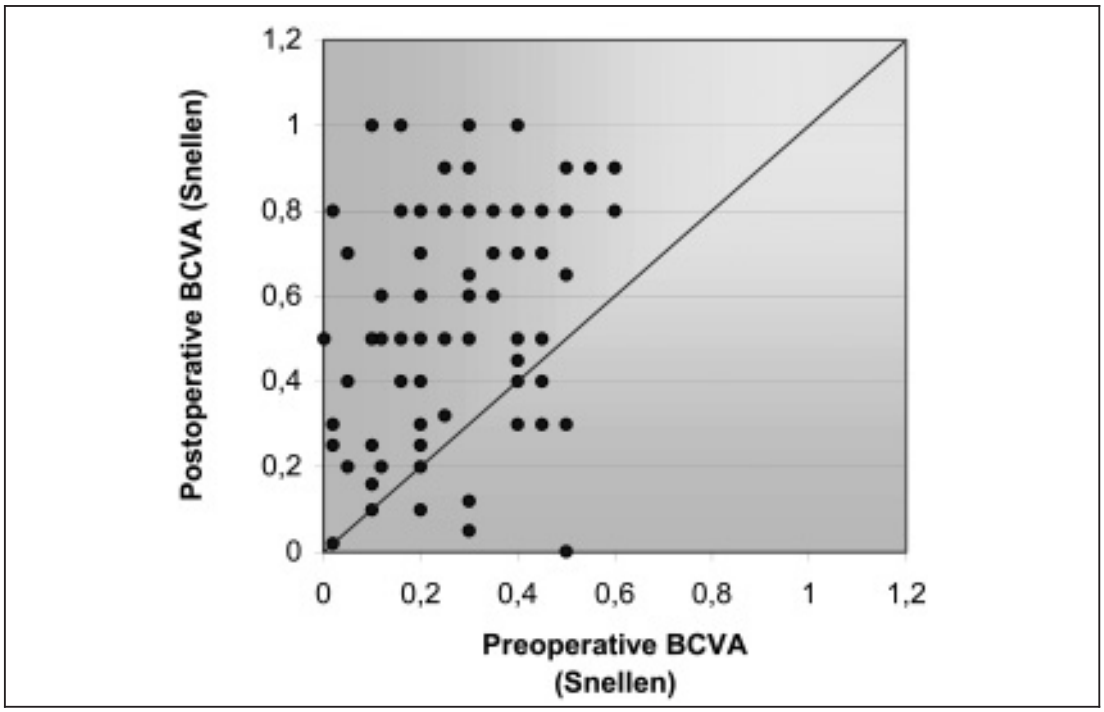


Fig 3. Best-corrected visual acuity before and after surgical removal of an epiretinal membrane. A postoperative BCVA of Snellen 0.5 or better can be obtained even in eyes with a poor preoperative BCVA.

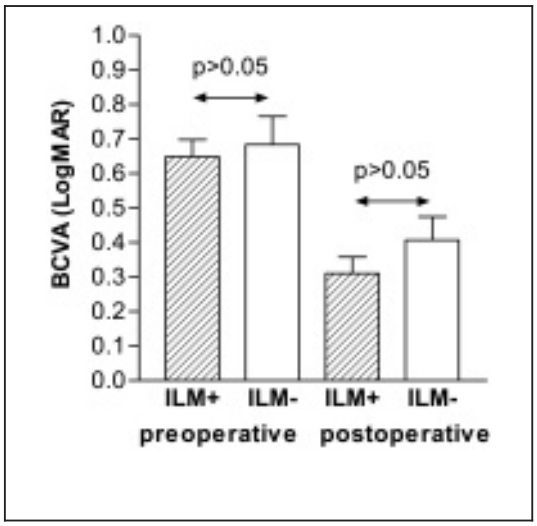


Fig 5. Prognostic factor: intra-operative peeling of the internal limiting membrane (ILM+). Mean pre- and postoperative BCVA in the group treated with ILM peeling compared with the group of eyes in which no ILM peeling was performed (ILM-).

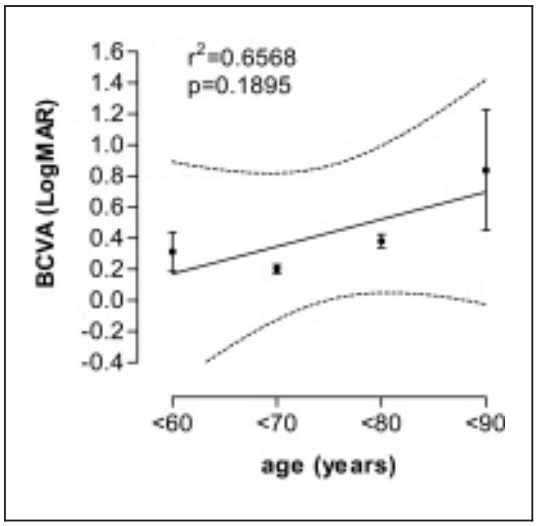


Fig 6. Prognostic factor: postoperative BCVA as a function of the age of the patient.

Preoperative CME was present in 19 eyes (group 1, n=19). In one eye, the presence or absence of preoperative CME was unknown. Mean preoperative BCVA in group 1 was Snellen 0.2. In group 2 with no preoperative CME (n=68), mean preop BCVA was Snellen 0.2. After surgery mean BCVA in group 1 improved to Snellen 0.4. Mean postop BCVA in group 2 was Snellen 0.5 (p=0.29) (Fig. 4).

Peeling of the ILM was performed in 57 eyes. In this group, mean BCVA improved from Snellen 0.2 to Snellen 0.5. In the group where no peeling of ILM was performed during surgery (n=31), mean BCVA improved from Snellen 0.2 to Snellen 0.4 (p=0.24) (Fig. 5). We also studied the correlation between the final BCVA and age (Fig. 6). The postoperative BCVA tends to be worse in the elderly group but we could not demonstrate a linear regression (r^2=0.6568; p=0.19) in this series.

Patients were asked when they first noticed a significant image distortion or decrease in VA. In 30 eyes complaints of visual impairment and metamorphopsia had been present for a period of 10 months or longer (group A), in 38 eyes surgery was performed within 9 months after the eye became symptomatic (group B), in 20 eyes the duration of complaints was unknown.

In group A (≥10 months, n=30) mean preoperative BCVA was Snellen 0.2. In group B (<10 months, n=38) mean preoperative BCVA was Snellen 0.2. After surgery, postoperative BCVA in group A improved to Snellen 0.3, in group B postoperative BCVA was Snellen 0.6 (p=0.0025) (Fig. 7). The pre-existence of a pseudohole is reported to have no adverse prognostic value (17). In this study, in the group with associated pseudohole (n=11), mean postoperative BCVA improved to Snellen 0.5. This was not statistically different from the overall mean (n=77), Snellen 0.4 (p=0.44).

Complications:

Accelerated nuclear sclerosis was the most common complication after vitrectomy. In 60% of the remaining phakic eyes, we observed an accelerated sclerosis of the crystalline lens in the operated eye, with no similar progression in the fellow eye. This acceleration of nuclear sclerosis with impairment of visual acuity occurred within 6 to 12 months after surgery. In 34 eyes a cataract operation was performed in a second time with an important improvement in vision.

We observed peripheral retinal tears during surgery in 12 eyes, 3 of them with a local RD.

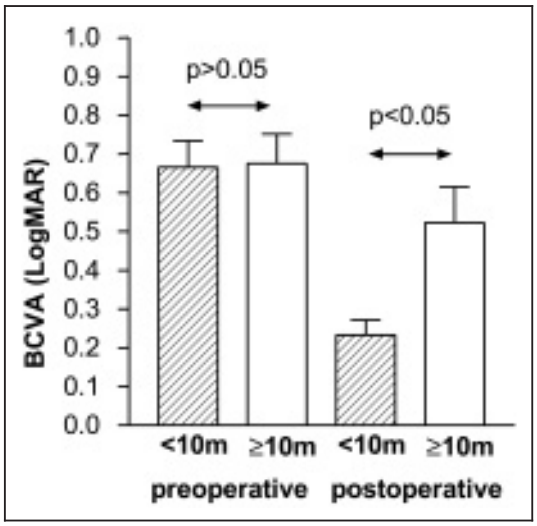


Fig 7. Prognostic factor: duration of symptoms. Mean pre- and postoperative BCVA in the group of patients with symptoms less than 10 months (< 10 months) compared with the group with symptoms for longer than 10 months (≥10 months) before treatment. This shows that eyes with a duration of symptoms of at least 10 months had a statistically significant worse final BCVA ($p<0.05$).

None of the 88 eyes developed a retinal detachment after vitrectomy.

The mean preoperative IOP was 14.0 mmHg ±0.28 (n=83) and 14.87 mmHg ±0.34 (p=0.0184) after surgery. A transitory hypotony was seen in 1 eye, with spontaneous resolution and no impact on the final vision. In 5 (6%) eyes we noticed an increase in retinal pigment epithelial alterations (RPEA) within 12 months after surgery. In every case, the patient was over 70 years old. Unfortunately, 1 eye suffered a postoperative endophthalmitis. In this series, recurrence of the ERM occurred in 4 eyes (5%). Two underwent additional surgery. Three of the 4 cases still had a final BCVA of Snellen 0.5 or more. Of the 19 eyes with preexisting CME, CME persisted after surgery in 6 eyes. We observed 5 cases (7%) of de novo CME after surgery, all documented with fluorescein angiography. Four of them had a BCVA of Snellen 0.5 or less, the fifth patient still had a final VA of Snellen 0.8. In this group of de novo CME after surgery, one patient showed residual traction, one suffered a branch retinal vein occlusion and one patient had general vascular permeability disorders.

DISCUSSION

Despite the fact that the surgical technique no longer represents major problems, there are still many questions to be answered concerning macular pucker surgery. What is the best timing? Which are the prognostic factors? Should we perform ILM peeling or not? Should we perform cataract surgery at the same time? Can we reduce the incidence of complications? Some surgeons, encouraged by the facility of membrane removal, have a propensity to propose surgery even in the early stage of the disease and in eyes with a very good visual acuity. On one hand, this attitude is supported by many papers that report a better visual outcome if the patient is operated on in an early stage (19, 23, 24, 32). On the other hand, we all know that some patients with minor visual symptoms can remain stable for years and will probably never progress to a serious visual loss. For these patients surgery could be unnecessary. Moreover, we should not underestimate the possible complications of this type of surgery and their potential threatening effect on the visual function. Looking at the prognostic factors, we have considered the preoperative BCVA, preoperative CME, the role of ILM peeling, the age of the patient and the influence of the duration of symptoms.

In the literature, surgery for idiopathic macular ERM has been reported to result in visual improvement in 60% to 82% of eyes, and 44% to 55% achieve a visual acuity of 0.4 or better (5, 12, 16, 21). In ERM secondary to retinal tears or retinal detachment, the postoperative VA is reported to improve at least 2 Snellen lines in 63% to 100% of patients (5, 21, 26). Our results confirm the efficacy of surgical removal of the ERM in improving the visual acuity. The mean BCVA improved from Snellen 0.2 to Snellen 0.5 ($p < 0.0001$), resulting in a mean gain in BCVA of 4 lines. In 67 eyes (76%) the postoperative BCVA was Snellen 0.4 or better. Figure 2 shows that eyes with a preoperative BCVA (Snellen 0.3 or better) have a higher probability to reach a postoperative BCVA of Snellen 0.5 or better. Nevertheless, a postoperative BCVA of Snellen 0.5 or better can be obtained even in eyes with poor preoperative BCVA (Fig. 3).

In the literature, the incidence of CME secondary to ERM varies from 22% in mild cases up

to 71% in severe cases requiring vitreous surgery (10, 13, 29, 33). In our series, CME was documented in 22% of eyes. Although not statistically significant, preoperative CME tends to induce less improvement in BCVA after surgery ($p=0.29$) (Fig. 4). Ten of 19 eyes with preoperative CME underwent ILM peeling during surgery. In this group, CME resolved in all but one eye of a diabetic patient. In the eyes with no ILM peeling, CME disappeared during the follow-up period in 44% of the cases (4/9).

It has been suggested that the ILM is an important structure for glial cell proliferation and that its removal eliminates the scaffold for proliferation (9, 17). The demonstration by Rice in 1994 that ILM peeling can be safe represented an important step forward, not only in macular hole surgery but also in macular pucker surgery (3, 6, 18, 25). We find a slightly better visual outcome in eyes that underwent ILM peeling (Fig. 5). Although not significantly apparent ($p=0.24$), these results might suggest that ILM peeling could be a positive prognostic factor for the final visual outcome.

Although we could not demonstrate a linear regression ($r^2=0.6568$; $p=0.19$) in this series, the postoperative BCVA tends to be worse in the group of the elderly (Fig. 6). This finding is also reported by other authors (2, 19, 24).

We are aware of the difficulty of assessing the exact duration of the symptoms. We recorded when the patient first noticed metamorphopsia. This is however a subjective awareness. Despite this limitation, we found that eyes with a duration of symptoms of 10 months or longer had a statistically significant worse final BCVA ($p=0.0025$) (Fig. 7). These data suggest that early surgery is likely to decrease the risk of developing irreversible macular damage.

Concerning the complications, rhegmatogenous retinal detachment and increased nuclear sclerosis are the most frequently reported complications after vitrectomy for ERM. The incidence of postoperative nuclear sclerosis after vitrectomy for macular pucker has been reported to vary between 12% and 68% (4, 16, 23).

In our study we observed an accelerated symptomatic nuclear sclerosis in 60% of the remaining phakic eyes, within 12 months after surgery. Although phaco-emulsification and IOL implantation can be performed safely after pars plana vitrectomy, cataract extraction after PPV can be more challenging than in control eyes, because of a lack of vitreous, increased cataract density, unstable posterior capsules, weak zonules, the sequelae of previous surgical trauma, inflammation and other underlying comorbidities (8, 22). A combined vitreoretinal surgery with simultaneous phaco-emulsification can be performed safely without increasing the risk of intra-operative and postoperative complications nor notably prolonging the operation time (1, 2, 7, 28). In our series, we did not notice any worsening of pre-existing CME or de novo development of CME after a combined approach. Especially in the elderly, one might consider performing a phacoemulsification at the same time.

Recently, a minimal vitrectomy has been suggested in order to reduce the incidence of cataract and to decrease the operation time (27). In our opinion, this technique has some disadvantages as well. In some cases, the epiretinal tissue cannot be removed easily in the presence of vitreous on the retinal surface, which can cause damage to the retina because of the repeated attempts to grasp the membrane and which can result in an incomplete removal of the epiretinal tissue. In addition, as reported by Saito et al., up to 20% of the patients complain about floaters (27). A third reason why we do not encourage the use of this technique is the increased risk of postoperative retinal detachment due to incarceration of vitreous in the sclerotomies. In our opinion, the technique is to be considered in young patients in order to preserve their accommodative function.

Peripheral retinal tears are described in 4% to 6% of the eyes (5, 20, 24). We observed the development of peripheral retinal tears during cleaning of the vitreous base in 13% of the cases (12/88). They were treated by laser-photocoagulation and intra-ocular air tamponade. This relatively high incidence of peripheral retinal tears is probably due to the extensive cleaning of the vitreous base. On the other hand, this technique permits to check the peripheral retina and to treat any suspected area. None of the eyes developed postoperative retinal detachment or new retinal tears. Detachment after vitrectomy may result from peripheral retinal breaks that occurred during surgery and were overlooked or from retinal tears caused by further contraction of the remaining peripheral

vitreous. The vitreous may also serve as scaffold for fibrous tissue ingrowth and tractional retinal detachment after surgery. Reasonably, a complete peripheral vitrectomy with extensive cleaning of the vitreous base, especially at the level of the sclerotomies, diminishes the risk of postoperative retinal detachment and proliferative vitreoretinopathy. Performing a complete vitrectomy decreases the incidence of symptomatic vitreous floaters as well. Care should be taken to avoid damage to the lens during anterior vitrectomy.
Finally, despite the fact that endophthalmitis after vitrectomy is a very rare complication, the ophthalmologist should always be aware of this potentially disastrous complication.

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