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Macular pucker

I. Prognostic criteria *

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Abstract. Thirty-three eyes with symptomatic epimacular membranes were treated by vitreous surgery and membrane removal. Vision improved in 79%. Eyes with clinically transparent membranes, but without preoperative cystoid macular edema, were most likely to achieve good vision, while opaque membranes had worse vision. Because cystoid macular edema was the most common obstacle to improved vision, membranes should be removed before this process begins, or as soon as possible thereafter.

Angiography should precede consideration of surgery. Even though large parts of the internal limiting lamina of the retina were often peeled with the membranes, excellent vision was possible.

Zusammenfassung. Symptomatische epimakuläre Membranen wurden von 33 Augen mikrochirurgisch entfernt. Der Visus konnte in 79% der Augen verbessert werden. Der beste Visus wurde in Augen mit klinisch transparenten Membranen aber ohne zystoides Makulaödem erzielt. Da zystoides Makulaödem der Hauptgrund für fortdauernden schlechten Visus ist, sollten Membranen entfernt werden, bevor es zu seiner Entwicklung kommt. Präoperative Fluoreszeinangiographic ist daher angeraten. Ausgezeichneter Visus wurde trotz Entfernung der Lamina interna erzielt.

Introduction

Epimacular membranes are a known cause of decreased central vision (Gass 1977). Surgical removal of these membranes often improves vision (Machemer 1978; Michels 1981; Michels and Gilbert 1979). In this study we report the results of vitreous surgery for 33 patients with macular pucker. An attempt is made to find factors which may influence the final visual results, factors such as density of the membranes, preoperative edema of the retina and previous retinal detachment. We also offer an explanation of how puckers cause reduction in vision.

Materials and methods

Thirty-three consecutive patients with epimacular membranes not involving the optic disc, symptomatic for 3–12 months, were studied retrospectively. All patients complained of metamorphopsia and decreased central vision (less than 20/60). The patients were examined by one examiner preoperatively, daily while hospitalized, and postoperatively at 1 week, 1 month, and 6 months, and at yearly intervals thereafter. Patients in this series were followed for 6 months to 2 years. Diagnostic evaluation included measurement of visual acuity, external and slit-lamp examination, funduscopy, and Amsler grid testing. All patients had preoperative fluorescein angiography, but only 26 angiograms were of interpretable quality. Follow-up evaluation was identical to initial evaluation, except that postoperative fluorescein angiography was done only if postoperative vision was unchanged or decreased. Lesions were pre- and postoperatively documented by written description, fundus photography, and fluorescein angiography.

All patients had vitrectomy and membrane peeling surgery done by one surgeon (RM) with the VISC X and hooked needle. Whenever possible, peeled membranes were removed from the eye for histologic study. Histologic features were correlated with clinical appearance and postoperative visual acuity. A detailed description of the histologic findings in presented elsewhere (Trese et al. 1983).

Statistical evaluation of our data was performed with the One Way Anova test. We tested to determine if the thickness of the membrane, the presence of preoperative macular edema, and a history of previous retinal detachment involving the macula had any influence on the final visual acuity.

Results

Thirty-three patients were followed postoperatively for 6–24 months. A breakdown of the possible causes of epimacular membranes is presented in Table 1.

All eyes showed wrinkling of the retinal surface and distortion of retinal vessels in the foveal area. By clinical appearance the membranes could be divided into two

Table 1. Breakdown of possible causes of macular pucker

Cause	No. of eyes
Retinal break, treated	12
Retinal detachment, treated	13
Retinal vascular occlusion	4
No known cause	3
Endophthalmitis	1
Total	33

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Fig. 1. Transparent epimacular membrane partially loosened from the retina; where thrown into folds, it is waxy-yellow and obscures vascular details of the underlying retina

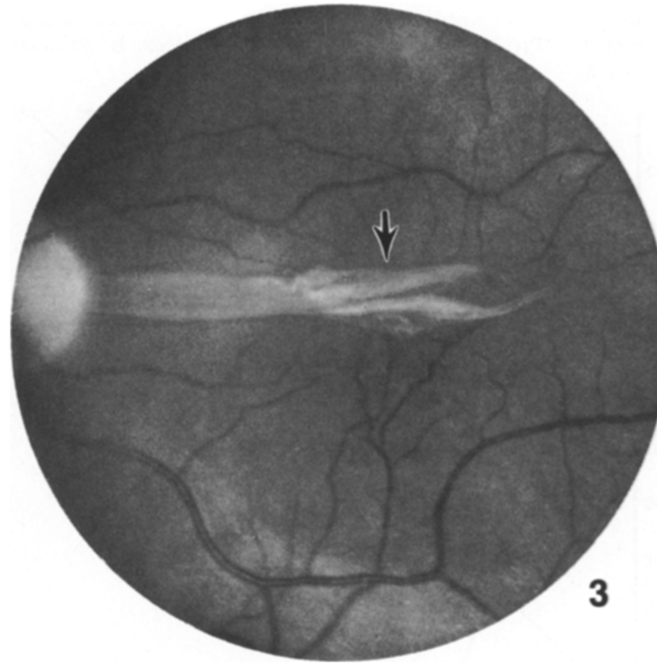


Fig. 3. Membranous bridge (*arrow*) between two fixation points on the retinal surface. The bridging was visible with biomicroscopy and was confirmed at surgery

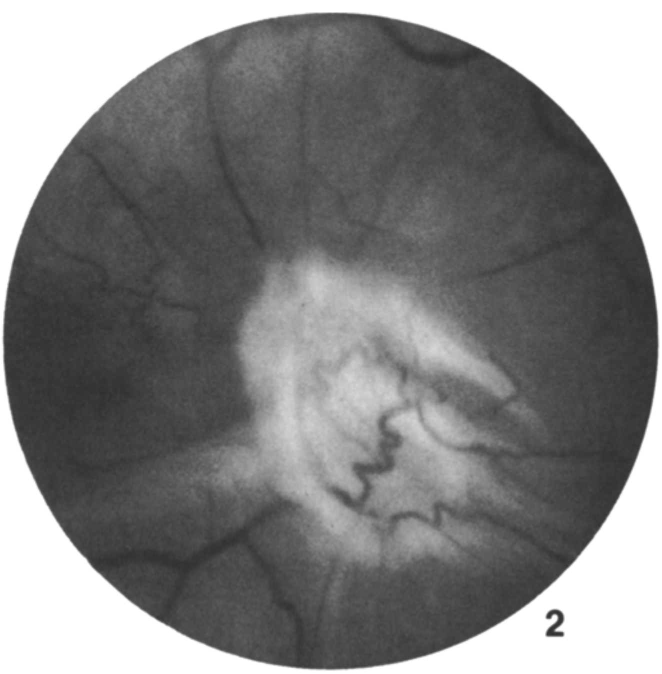


Fig. 2. Opaque membrane, gray-white, obscuring underlying retinal details

groups, transparent and opaque. In the first group, transparent membranes, retinal details such as vessels could be seen clearly through the wrinkled surface of the membrane. In some areas, these transparent membranes folded on themselves and took on a yellowish color, partly obscuring details of the retina (Fig. 1). In the second group, the dense, opaque, gray-white appearing membranes obscured the view of the underlying retina completely (Fig. 2).

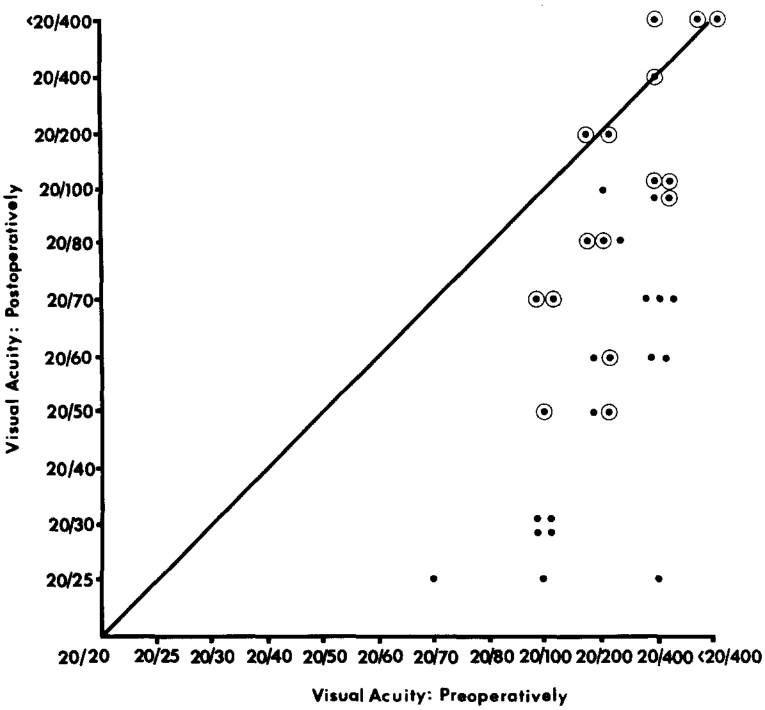
The membranes were not always in complete apposition to the retina; some were raised from the retinal surface in bridging configuration in (Fig. 3). This bridging of tissue was only visible biomicroscopically and confirmed during surgery by the ease with which the hooked needle could be placed under the bridge. Other membranes adhered so strongly to the underlying retina that it was difficult to find an edge of the membrane. The tissue peeled at surgery was generally covering a larger area than anticipated preoperatively on the basis of the membrane's clinical appearance. The more peripheral part of this tissue was often clear and glossy in appearance and microscopic appearance of these parts was consistent with that of basal lamina of the retina (Trese et al. 1983).

Postoperatively 79% (26/33) of the patients could read an additional two or more lines on the chart, and 21% (7/33) could read at the 20/30 level or better 6 months postoperatively (Table 2).

The 26 patients with good angiograms were further divided into four groups, based on the appearance of the membrane and presence or absence of cystoid macular edema (CME): (1) transparent membranes with CME (seven eyes); (2) transparent membranes without CME (six eyes): (3) opaque membranes with CME (nine eyes); (4) opaque membranes without CME (four eyes). We found that postoperative vision tended to be better in eyes of patients whose membranes were transparent and that vision in all patients with transparent membranes and no preoperative CME improved to 20/40 or better. Of the eyes with opaque membranes only one improved to the 20/40 level or better. Most patients with opaque membranes and cystoid macular edema had little or no improvement in vision.

It was significantly apparent ($P < 0.05$) that eyes with preoperative cystoid macular edema had less improvement in vision than eyes without edema (Table 2). All patients whose vision improved to 20/40 or better had no preoperative CME. Since we have not evaluated all patients

Table 2. Pre- and postoperative visual acuity of 33 eyes with macular pucker. Presence of preoperative macular edema is indicated by *circle*



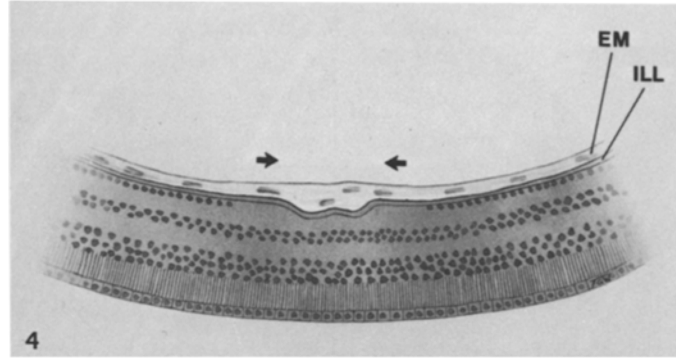


Fig. 4. Schematic drawing of retina with intimately attached epimacular membrane (*EM*), causing sinusoidal, wrinkling of the internal limiting lamina (*ILL*)

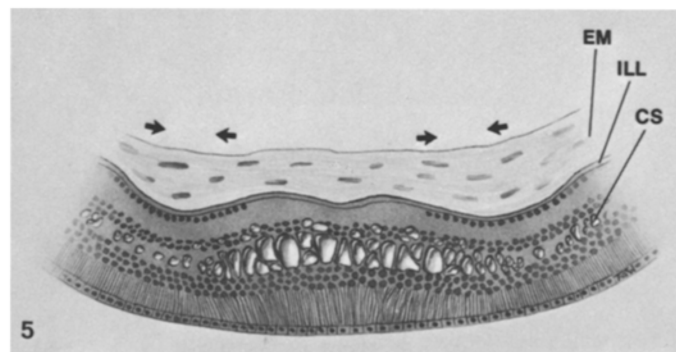


Fig. 5. Schematic drawing of thick epimacular membrane (*EM*), intimately connected to retina, causing full thickness distortion of the retina including the photoreceptor layer and cystoid spaces (*CS*); *ILL*, internal limiting lamina

6 months postoperatively with fluorescein angiography we cannot make a statement as to how many of those patients with improved vision had persistent edema. However, the six patients that had no visual improvement showed continuation of their CME.

In this group of 33 eyes, none of the membranes reappeared during the follow-up period of 6 months to 2 years.

In two eyes retinal detachment developed as complication during the postoperative period; both were successfully repaired.

Discussion

This study confirms that peeling of epimacular membranes often yields major and lasting improvement of vision. Of the eyes we studied, 79% had a two-line or greater improvement in visual acuity at a 6-month follow-up visit, results comparable to those of Michels, who reports significant post-surgical improvement of vision (Michels 1981, Michels and Gilbert 1979). Cystoid macular edema is the most important factor which prevents good postoperative visual acuity. Transparent membranes and the absence of preoperative cystoid macular edema carry a better prognosis for improved vision; conversely, opaque membranes together with cystoid macular edema carry the worst visual prognosis. It should be mentioned that prior retinal detachment does not appear to be a determining factor for the degree of visual improvement.

Histologic study demonstrated that clinically transparent membranes were composed of nests of cells with little or no collagen, resting on large sheets of internal limiting lamina of the retina (Trese et al. 1983). Opaque membranes were a lamellar structure composed of multiple cell types and collagen, some of it densely packed. These opaque membranes contained small amounts of internal limiting lamina of the retina (Trese et al. 1983).

Epimacular membranes probably affect vision in at least three major ways. First, opaque membranes contain large amounts of densely packed collagen, which constitutes a barrier to light, as evidenced by the examiner's inability to see the underlying retina. Eyes with opaque membranes had worse preoperative visual acuity as a group (20/100 to less than 20/400) than eyes with transparent membranes (20/70 to 20/200).

A second way these membranes reduce vision is by distortion. There is evidence that epiretinal membranes undergo a cell-mediated period of contraction (Gabbiani et al. 1978). If the membrane is firmly adherent to the underlying retina along its entire surface at the time of contraction, the retina can become folded in a sinusoidal pattern. When the contraction is weak, only the surface of the retina becomes wrinkled. There may be no symptoms as long as the deeper layers are not affected (Fig. 4). All of our patients, however, suffered from decreased vision and metamorphopsia. Therefore the strength of the contraction must have been great enough to cause distortion of outer retinal layers (Fig. 5).

A third mechanism for decreased visual acuity is the development of cystoid macular edema. Our data indicate that persistent cystoid macular edema following surgery is one of the main causes of reduced or unimproved postoperative vision. The opaque membranes consist of multiple layers of cells which can exert an even greater force on

Table 3. Results of surgery 6 months postoperatively

	No. of patients with preoperative angiogram and photographs	% with improved visual acuity (≥2 lines)
Transparent membranes		
With CME	7	85%
Without CME	6	100%
Opaque membranes		
With CME	9	44%
Without CME	4	75%
Overall totals	26	

the underlying retina when the cells contract (Kenyon and Michels 1977) than the weaker transparent membranes. This membrane on the retina may cause either pulling on retinal vessels causing leakage into the retina, or direct traction on the retina causing formation of cystoid spaces (Fig. 5). This may explain why eyes with opaque membranes were found to have cystoid macular edema more frequently than those with transparent membranes (Table 3).

With visual acuity being best improved in cases with transparent membranes without cystoid macular edema (Table 3), one should recommend surgery when visual acuity is decreased to an annoying level (i.e., 20/70), but before the edema develops. In addition to visual acuity, fluorescein angiography is an important tool in the evaluation of the patient. Thus, we do recommend early surgery for treatment of macular pucker.

We were surprised that every membrane peeled brought with it small or large amounts of internal limiting lamina. It was even more surprising that eyes with transparent membranes from which most large sheets of internal limiting lamina of the retina were peeled had the better prognosis for good vision. Although breaks in the internal limiting lamina are thought to play a part in causing glial proliferation along the anterior retinal surface, removal of small or large pieces of the internal limiting lamina of the retina during surgery did not appear to contribute to reformation of the membranes (Foos 1974; Roth and Foos 1971; Foos 1977; Wise 1975). None of the epimacular membranes in this series had recurred after periods of 6 months to 2 years.

Constable et al. (1981) have demonstrated that the internal limiting lamina of the retina can regenerate in dogs; we assume that the internal limiting lamina regenerates in humans as well. No major loss of retinal function occurred when the internal limiting lamina was removed surgically. This is not surprising since normal vision has also been found in eyes in which a sublaminar hemorrhage caused dissection of the internal limiting lamina of the retina in the posterior pole.

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