'EN BLOC' DISSECTION OF EPIMACULAR MEMBRANES USING ASPIRATION DELAMINATION

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SUMMARY

'En bloc' dissection is a technique in which epiretinal membranes (ERM) are separated from the retina as a single lamina with a 20-gauge blunt flute needle. We used this technique to remove epimacular membranes of various aetiologies in a consecutive series of 25 eyes, with a minimum follow-up of 5 months (mean 10.4 months). Small residual epicentres of ERM away from the fovea remained in 7 (29.1%) eyes only; 3 were inside and 4 outside the temporal vascular arcades. Postoperatively 64% (16/25) of patients achieved a final visual acuity of 6/12 or better and 76% (19/25) achieved a final visual acuity of 6/18 or better. Progressive lens opacities were the most important postoperative complication in phakic eyes that significantly affected the visual results. This technique successfully removed epimacular membranes over a wide area, without the need to find a starting edge or the use of sharp instruments near the retina. Diaphanous ERMs with ill-defined borders and tenaciously adherent membranes could be removed with minimal trauma to the underlying retina. Histopathological and immunohistochemical examination of 10 ERMs demonstrated the absence of internal limiting lamina in 6 (60%).

The technique of using aspiration to remove cortical vitreous was first described for the treatment of impending idiopathic macular holes.[1,2] In treating cases of full-thickness macular holes associated with epiretinal membranes (ERMs) we have been impressed with the effectiveness of simple aspiration at removing the ERM over a wide area. We have therefore planned and carried out a prospective study of the use of this technique of aspiration delamination for the treatment of cases of macular pucker.

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Vitreoretinal surgery for epiretinal macular membranes (EMMs) without a surgical edge traditionally involves the use of a bent needle[3] to create an edge. Once the edge is created, the membrane is peeled with a pick or intraocular forceps[3–7] in the same way as ERMs with a pre-existing edge. Sharp instrumentation at the vitreoretinal interface may result in damage to the inner retina. Indeed, in a large series of EMMs examined histologically it was reported that 76.2% of all EMMs removed contained fragments of internal limiting lamina (ILL).[8,9] Tangential stripping of adherent ERM often resulted in fragmentation of the membrane.[4]

This report describes the use of the 'en bloc' dissection technique that involves passive aspiration with a 20-gauge blunt-ended cannula mounted on a back flush flute handle to remove EMMs in a consecutive series of 25 cases of macular pucker of various aetiologies. Our aim was to leave the ILL intact and reduce damage to the underlying retina. The study was designed to evaluate the efficacy of this technique by (i) clinical assessment and (ii) histopathological study of ERMs for evidence of ILL or retina as an index of damage. The results of this series are reported and the advantages of this technique are discussed.

PATIENTS AND METHODS

Patients

From July 1992, we adopted this 'en bloc' dissection technique and treated a consecutive series of 25 EMMs (Table I). The series included 16 male and 9 female patients, ranging in age from 11 to 77 years (mean 59.5 years). The preoperative visual acuity ranged from 6/18 to only hand motion (HM) at 30 cm (mean 6/36). All cases were unilateral. The follow-up ranged from 5 to 20 months (mean 10.1 months). The EMM was associated with acute retinal tears and their treatment in 6 eyes. In 5 eyes the formation of EMM followed retinal detachment (RD) and its treatment. The macula was involved in the RD in 2

Table I. Clinical data of patients undergoing vitrectomy and membrane peel

Patient no.	Age (years)	Preop. VA	Best postop. VA	Final postop. VA	Aetiology	Follow-up (months)	Lens status	Comment	Histo-pathology
1	61	6/36	6/9	6/18	After RRD (macula on)	5	Cataract[a]	Distortion and blurring 4 mos; PVD	—
2	13	2/60	6/36	2/60	After traumatic RRD and vitreous haemorrhage (macula on)	9	Clear lens	Blurring 3 mos; PVD; pucker nasally	ILL present
3	56	6/18	6/6	6/6	Idiopathic	20	Clear lens	Distortion and blurring 6 mos; PVD; entry site tear treated with cryotherapy and air	—
4	77	6/60	6/36	6/36	After U-tear, R/cryotherapy	17	Cataract[b]; pseudophakia 5 months later	Blurring 17 mos; PVD; preop. atrophic fovea	—
5	73	6/36	6/18	6/18	Idiopathic	5	Preop. cataract unchanged	Blurring 6 mos; no PVD; postop. RPE changes	—
6	72	6/36	6/9	6/9	Idiopathic	15	Cataract[b]	Distortion and blurring 15 mos; PVD	—
7	68	3/60	6/9	6/12	After RRD (macula off)	14	Cataract[a]	Blurring 8 mos; PVD; ERM very tenacious	—
8	76	6/36	6/12	6/12	Idiopathic	10	Cataract[a]	Distortion and blurring; PVD; preop. cystoid macular oedema and RPE changes	—
9	49	6/60	6/9	6/9	After 2 U-tears; R/laser	12	Clear lens	Distortion and blurring 5 mos; PVD; postop. RPE atrophy	—
10	70	6/60	6/9	6/9	After 2 U-tears and vitreous haemorrhage; R/cryotherapy	14	Cataract[a]	Distortion and blurring 18 mos; PVD; ERM with edge	—
11	70	6/24	6/12	6/12	Idiopathic	7	Cataract[b]	Distortion and blurring 2 years; PVD; epicentre outside arcade	—
12	72	6/18	6/6	6/18	Idiopathic	12	Cataract[b]	Blurring 10 mos; PVD; postop. RPE changes	—
13	75	6/18	6/18	6/24	After U-tear R/laser and gas tamponade	11	Cataract[b]	Distortion and blurring 7 mos; PVD; entry site tear, R/cryotherapy; SRF pocket at macula at last visit	—
14	57	6/36	6/9	6/18	Idiopathic	9	Cataract[b]	Distortion and blurring 12 mos; PVD; epicentre inside arcade	
15	75	6/36	6/6	6/9	Idiopathic	14	Cataract[b]	Blurring 12 mos; PVD; epicentre inside arcade; postop. RPE changes	—
16	76	6/18	6/9	6/12	Idiopathic	13	Cataract[a]	Distortion and blurring 9 mos; no PVD; preop. RPE changes	—
17	45	HM	6/60	6/60	After penetrating injury and IOFB; vitreous haemorrhage; R/vitrectomy, lensectomy, removal of FB and ERM peel	5	Lens removed at same time	Blurring 1 mo; no PVD; epicentre outside arcade; raised IOP; RRD 1 mo after surgery	ILL present
18	65	6/60	6/12	6/18	After RRD (macula off)	11	Cataract[a]	Distortion and blurring 15 mos; PVD; preop. cystic changes	ILL absent
19	11	6/36	6/6	6/6	Pars planitis	8	Clear lens	Blurring 15 mos; no PVD	—
20	47	6/36	6/9	6/9	PDR treated with laser	15	Cataract[a]	Distortion and blurring 9 mos; no PVD; preop. TRD involving macula; epicentre inside arcade	—
21	68	6/24	6/9	6/9	After RRD	12	Preop. cataract unchanged	Distortion and blurring 7 years; PVD	ILL absent
22	45	6/18	6/6	6/6	After U-tear and peripheral angioma, R/cryotherapy	15	Clear lens	Blurring 5 mos; PVD; preop. asteroid hyalosis; epicentre outside arcade	—
23	62	6/36	6/18	6/18	After U-tear R/cryotherapy	7	Cataract[a]	Blurring 13 mos; PVD; epicentre inside arcade; postop. RPE changes	—
24	44	6/18	6/6	6/6	Idiopathic	5	Clear lens	Distortion and blurring 12 mos; no PVD	ILL absent
25	70	6/18	6/18	6/24	BDR	20	Cataract[a]	Distortion and blurring 3 years; no PVD; postop. RPE changes	—

VA, visual acuity; Final VA, corrected VA recorded at last examination; RRD, rhegmatogenous retinal detachment; TRD, traction retinal detachment; IOP, intraocular pressure; IOFB, intraocular foreign body; RPE, retinal pigment epithelium; PDR, proliferative diabetic retinopathy; BDR, background diabetic retinopathy; PVD, posterior vitreous detachment; ILL, internal limiting lamina; mos, months; SRF, subretinal fluid; ERM, epiretinal membrane.
[a]Development of cataract; [b]progression of preoperative cataract.

of the 5 cases. There was a history of trauma preceding the detachment in 2 cases. EMM developed in 1 case of penetrating injury without RD. EMM occurred in 1 patient with proliferative diabetic retinopathy treated with panretinal laser photocoagulation and another diabetic with minimal background diabetic retinopathy without laser treatment. In 1 patient the EMM was associated with pars planitis. In the remaining 10 cases no cause could be identified and they were labelled idiopathic. All cases were examined with slip lamp biomicroscopy using +90 dioptre lens and Goldman fundus contact lens.

Posterior vitreous detachment (PVD) was observed to be present prior to vitrectomy in all cases associated with RD, retinal tears, the single case of penetrating injury and 6 of the idiopathic cases. These findings were confirmed at the time of vitrectomy. Fundus fluorescein angiography was performed in selected cases to exclude retinal vascular occlusive disease.

Surgical Technique

A standard three-port pars plana vitrectomy[6,7] was performed in all cases. A 20-gauge blunt-ended cannula mounted on a flute handle with back flush (Altomed, A7670) was used to engage the EMM sequentially at adjacent spots all over its surface. The aspiration pressure was controlled by the height of the infusion bottle above the level of the patient's head and the back flush on the flute handle. The infusion bottle was usually 20–30 cm above the level of the patient's head. With gentle aspiration and fine side-to-side motion of the blunt needle tip, the EMM was separated from the underlying retina. To remove the EMM over a wide area and in an 'en bloc' fashion, any elevated edge was avoided and aspiration was applied to the attached areas sequentially. An intraocular forceps was then used to grasp and to remove the EMM when it came free from all its attachments to the underlying retina.

The two sclerotomies in the superior quadrants were closed with 8.0 Vicryl. The peripheral fundus was then examined by indirect ophthalmoscopy with scleral indentation. Any peripheral entry site breaks were treated with transscleral cryotherapy and fluid/air exchange to provide temporary internal tamponade during the early postoperative period.[4] The third sclerotomy was then closed with 8.0 Vicryl. Following suturing of the conjunctival flaps with 8.0 Vicryl, a subconjunctival injection of 20 mg gentamicin and a drop of atropine 1% were given.

Histology

Ten EMM (6 from the series and 4 obtained subsequently) removed by the 'en bloc' technique were submitted for histological evaluation. In addition, two pieces of retinal tissue bearing epiretinal membrane (freshly obtained from globes enucleated for proliferative vitreoretinopathies) were processed with the epimacular specimens to serve as controls for the histological methods.

Tissue specimens were placed in acetone before being processed into glycol methacrylate resin (JB4, Polysciences) at +4 °C as previously described.[10] Sections of resin-embedded specimens were stained with periodic acid-Schiff (PAS) to assess the contribution of the ILL to the tissue. Other sections were stained with haematoxylin and eosin. The histological preparations were viewed with bright field and differential interference contrast microscopy.

RESULTS

At the last follow-up visit, on biomicroscopy small residual epicentres of EMM away from the fovea remained in 7 cases; 3 were inside and 4 outside the temporal vascular arcades. In no case was the EMM considered to reduce the visual acuity (VA). The postoperative VA improved in 88% of cases (Fig. 1), with at least 2 lines on the Snellen chart in 21 (84%) of 25 eyes (mean 2.5 lines). Distortion of vision was reduced or eliminated in all the 16 patients whose predominant symptom was distortion. The final VA ranged from 6/6 to 6/60 (mean 6/12); 76% achieved final vision of 6/18 or better and 64% achieved final vision of 6/12 or better. Histopathological and immunohistochemical examination of 10 ERMs demonstrated absence of ILL in 6 (60%).

Peripheral retinal breaks were identified intraoperatively in 2 eyes, and were treated by cryotherapy and intraocular fluid/air exchange. No posterior retinal breaks or bleeding from the retinal surface occurred in this series. A whitening of the retina, outside the fovea, occurred in 4 eyes due to mechanical trauma during the early stages of developing the technique. This resulted in retinal

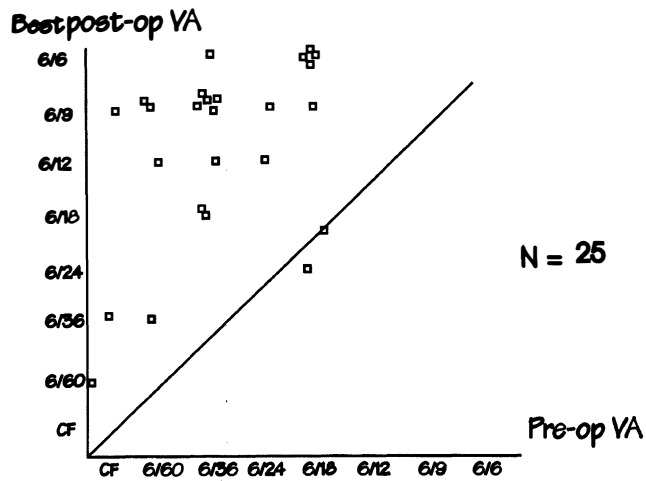
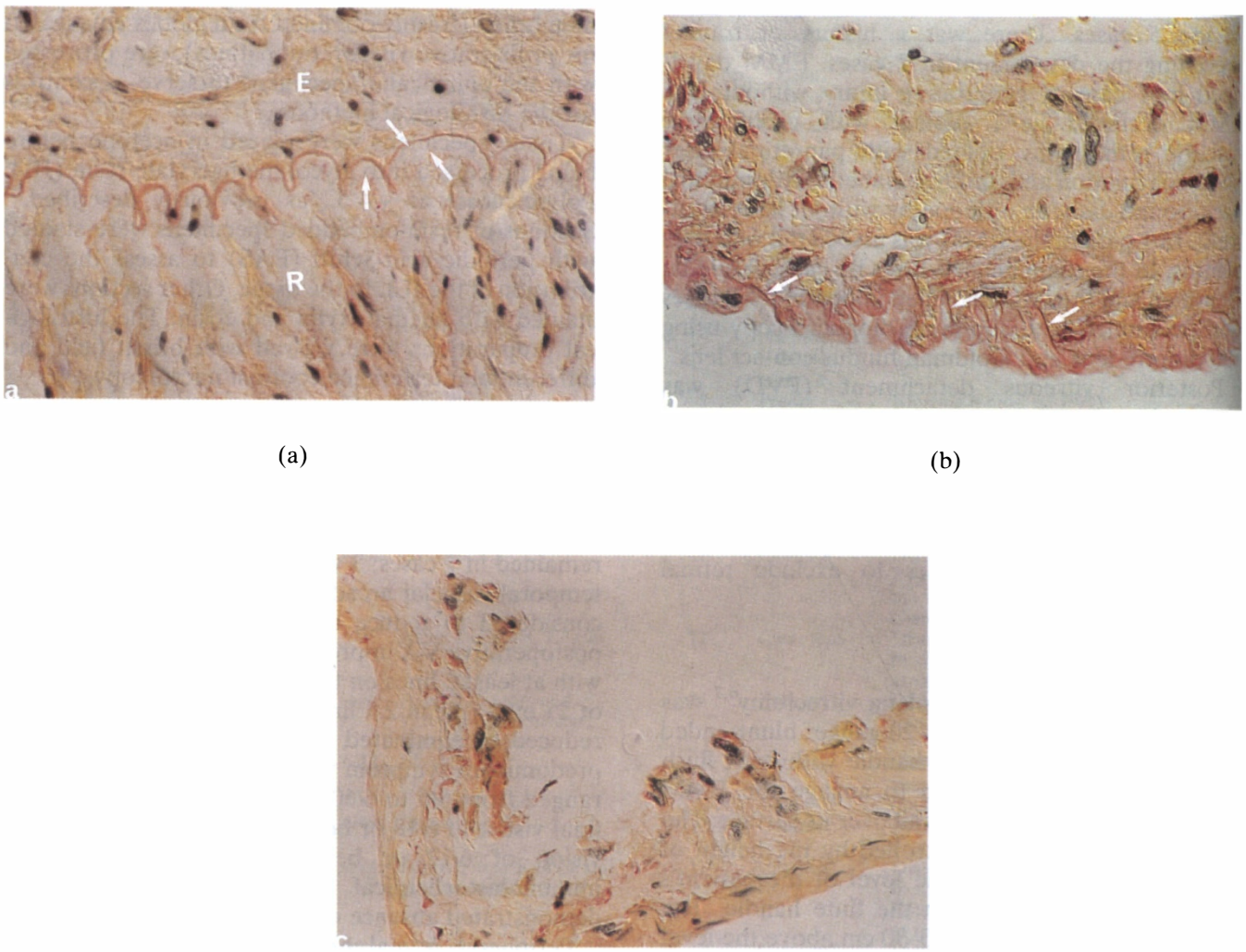


Fig. 1. *A plot of the preoperative visual acuity (VA) against the best postoperative VA in 25 cases.*



(a) (b)

(c)

Fig. 2. *Tissue specimens were processed in glycol methacrylate resin (JB4) and sections of resin-embedded specimens were stained with periodic acid–Schiff to assess the contribution of the internal limiting lamina (ILL) to the tissue. The histological preparations were viewed with bright field and differential interference contrast microscopy. ILL are shown as red (arrowed), cell nuclei blue and other tissue components yellow. E, ERM; R, retina. (b) and (c) Typical specimens showing fibrocellular layers of the epimacular membrane closely applied to grossly folded ILL (arrows).*

pigment epithelial (RPE) changes postoperatively. Postoperative complications included rhegmatogenous retinal detachment (RRD) in 1 eye (4%) and progressive cataract development in 17 eyes (70.8%). The most important postoperative complication was progressive nuclear sclerotic changes in 17 of the 24 phakic eyes during the follow-up period. In 8 eyes the preoperative cataract progressed and in 9 eyes nuclear sclerotic changes developed *de novo* and progressed. In 7 eyes the VA dropped by 1 to 4 lines from the best postoperative VA due to the progressive cataract changes. In the remaining 10 eyes, the final VA failed to improve better than 6/12 or better than the preoperative visual acuity level. However, there was significant reduction or elimination of distortion in all these cases.

There was a variation in the time interval taken for the vision to reach the best attainable improvement among individual patients. Some patients showed immediate postoperative improvement of vision to 6/9 or better within the first 1–4 weeks after surgery. The vision then either became stable or deteriorated due to development of progressive lens opacities. In other patients the vision improved gradually over a few months. In the eye with penetrating injury and intraocular foreign body (IOFB), lens removal with phacoemulsification was carried out at the same time as vitrectomy and the EMM was found following removal of the vitreous haemorrhage. In this eye, RRD occurred postoperatively, probably due to a peripheral retinal break which might be related to the original injury or to the vitrectomy. This eye was successfully treated with encircling band, intraocular C_3F_8 gas and indirect argon laser treatment. No case of postoperative recurrence of the ERM was detected in this series during the follow-up period.

Table II. Histology of 10 excised membranes

Membrane no.	Diagnosis	ILL	Comments
1	PVD	Yes	F/C
2	PVR	No	F/C
3	PVR	No	F/C
4	Idiopathic	No	F/C
5	Trauma	Yes	F/C
6	Diabetes	Yes	F/C
7	Tumour[a]	No	F/C
8	Idiopathic	No	F/C
9	Idiopathic	No	F/C
10	Idiopathic	Yes	ILL + SERM

ILL, inner limiting lamina; F/C, fibrocellular; PVR, proliferative vitreoretinopathy; SERM, simple epiretinal membrane.
[a]Following local resection of melanoma.

Histology

PAS staining of the retinal fragments delineated the ILL red, cell nuclei blue and other tissue components yellow (Fig. 2a). The vitreous surface of the ILL was smooth while the retinal surface appeared irregular (Table II; Fig. 2a). Portions of grossly folded ILL were identified in 4 of the 10 EMM (Table II; Fig. 2b,c). The membranes generally consisted of fibrocellular layers which, in the specimens with ILL, were closely applied to the vitreous surface of the ILL (Fig. 2b). One specimen was devoid of a fibrous component and consisted of isolated cells on the vitreous surface of a strip of ILL.

DISCUSSION

Vitreoretinal surgery for treatment of epiretinal membranes traditionally involved using a membrane pick[2,6,7,11] and/or bent 23-gauge needle.[12] The effectiveness of conventional sharp dissection depended on the presence of an obvious edge and the degree of adherence[4,7] of the ERM to the underlying retina. Such instrumentation is associated with fragmentation of the epimacular membrane into strips, particularly friable thin membranes leading to incomplete removal[4] and injury to the underlying retina giving rise to foci of re-proliferation.[13] Surgery was not usually advised in cases with vision better than 6/18[14] or before the membranes mature.[4] In recent years, the removal of posterior vitreous cortex for treatment of impending macular holes has been successfully achieved using a tapered extrusion needle[1] or a cannulated extrusion needle.[2] We have adapted this technique to remove the ERM in 25 consecutive cases.

With aspiration delamination, we emphasise the importance of loosening the adhesion over a wide area in a gradual fashion. Indeed, when we produced a local separation between the ERM and underlying retina in one area, we purposely stopped and moved away to work upon another area. The process usually took 20 minutes or more. We have been impressed with the ability of this technique of aspiration delamination to remove ERMs over a wide area in an 'en bloc' fashion. Furthermore, membrane peeling could be safely done in a centripetal fashion instead of 'inside-out' peeling.[7] We found that even strongly adherent ERMs could be successfully and safely removed without the need to find an edge or the use of sharp instruments near the retina. The technique was particularly useful for thin friable membranes with ill-defined edges. We were surprised how many ERMs extended beyond what was visible as a discrete lamina. It made us realise that previously we were probably leaving behind thin ERMs when using conventional techniques.

We opted to use passive aspiration with a 20-gauge metal needle attached to a back flushing handle. We appreciated that active aspiration could take advantage of the linear suction provided by vitrectomy machines. We preferred the fine finger-tip control of the back flush flute needle which could instantaneously release the cortical vitreous or ERM when we felt that the traction from the suction was excessive at any one area. Passive aspiration also guards against the excessively low pressures which could be generated by active suction. We tried using a 20-gauge silicone-tipped extrusion cannula (the Grizzard subretinal fluid cannula from Visitec) and found it to be less effective. The lumen of the silicone tip was smaller than a metal 20-gauge needle and might account for the less effective suction for the same perfusion pressure. It did, however, have the advantage of being flexible and less likely to cause damage should it touch the retina accidentally. Perhaps a combination of using active aspiration combined with a soft-tip cannula might be a good alternative to our technique, but we did not have sufficient experience to report on this.

We speculate that aspiration delamination might cause less damage to inner layers than sharp dissection using picks and needles. There are several potential cleavage planes in the dissection of ERMs. These include: (1) a plane within the membranes themselves (i.e. between cellular and fibrous layers in the tissue),[15] (2) between the ERM and the ILL, and (3) the line of attachment between the Mueller cell pedicles and ILL. Separation between the Mueller cells and ILL could occur if oedema accumulates in the retinal extracellular spaces. Indeed, microcystic changes which may have represented sub-ILL oedema were observed in one of our histological controls (Fig. 2a). However, the control was from a globe with long-standing (over 1 year) traction RD. Where RD or distortion is of a relatively short duration, we speculate that gentle aspiration usually induces separation at the cleavage plane between the ERM and the ILL (perhaps by causing focal fluid accumulation at the interface between the ERM and the ILL). With sharp instruments, the needle tip might engage the ILL during the initial edge

dissection and cause the dissection to continue in a deeper plane. The ILL might also have greater tensile strength and therefore more readily engage the needle tip, whereas immature ERMs might be more friable and allow the needle to 'cheese-wire' or cut through the lamina. Smiddy *et al.*[8] examined the ultrastructure of 101 cases of idiopathic ERM removed with conventional techniques and found that ILL was present in 76.2%. Histopathological and immunohistochemical examination of our 10 ERMs removed using aspiration delamination showed ILL to be present in 4 (40%). The number of aspirated ERMs examined histologically was too small to substantiate or refute our concept. To clarify the relationship between the 'en bloc' technique and damage to the inner retina we are undertaking a histological evaluation of a larger series of ERMs.

The postoperative anatomical and visual results in this series compare favourably with previous studies.[3,8,14,16] Serious intraoperative and postoperative complications were infrequent. There was no case of recurrence of clinically detectable or visually significant ERM from re-proliferation in this series over the follow-up period. The reported incidence of epiretinal tissue re-growth ranged from 3% to 31% in other series, varying with the aetiology of ERMs and being more common in the retinal vascular cases.[4,11,16] The most significant postoperative complication was progressive lens opacification in 17 (70.8%) of 24 phakic eyes. Previously reported incidence ranged from 12.5%[6] to 68.4%.[10]

CONCLUSIONS

We are encouraged by the visual, anatomical and histopathological outcome of this technique of 'en bloc dissection of epiretinal membranes' with a back flush blunt flute needle. It is an effective technique for more complete removal of EMMs and may be particularly applicable to those of an immature or diaphanous nature. We believe that aspiration delamination may be less injurious to the underlying retinal layers and that the histological evaluation of a larger number of cases may offer independent confirmation of this assertion.

Our research is funded by the Guide Dogs for the Blind Association, the Foundation for the Prevention of Blindness, the Research and Development Fund of the University of Liverpool and the British Council. We would like to thank Miss Gillian Rycroft and the medical illustration department, Royal Liverpool University Hospital, for the preparation of the colour illustrations.

Key words: Aspiration delamination, Internal limiting membrane, Macular pucker, Vitrectomy.

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