examination the lining looked irregular and there were small white particles which appeared to be floating away from the sleeve. There was no sign of any irregularities 'downstream' from the tip, either in the irrigation fluid and tubing or in the phacoemulsification handpiece.

We concluded that these particles had originated from the phacoemulsification tip sleeve which had had a manufacturing defect. The inert nature of the retained particle would be in keeping with the presumption that it was a silicone fragment. The sleeve and fluid from the phacoemulsification cassette were sent to the manufacturer for analysis but were lost in transit.

We would recommend the routine inspection of the sleeve to look for any manufacturing abnormalities.

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Sir,

Plasmin-assisted vitrectomy eliminates cortical vitreous remnants

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Plasmin, a non-specific serine protease mediating fibrinolysis, has properties to hydrolize a variety of glycoproteins, including laminin and fibronectin.[1] By degrading the links between these components of the vitreoretinal interface and the inner limiting membrane (ILM), therapeutic posterior vitreous detachment (PVD) has become possible.[2,3] In controlled experiments in postmortem porcine eyes, enzymatic action alone is sufficient to induce PVD.[2] However, there are remnants of cortical vitreous remaining adherent to the ILM depending on the dose and exposure time of plasmin.[2]

Enzymatic vitrectomy is envisaged to augment or even replace conventional vitrectomy by proposed means of less surgical risks, less surgeon time, lower costs, and a transition to office-based vitreoretinal procedures. However, there are few data concerning the effect of plasmin at the vitreoretinal interface of human eyes.[4] Especially the impact of plasmin as an enzymatic adjunct to vitrectomy has not been studied and published as yet. Therefore, we compared the ultrastructure of the vitreoretinal interface of human postmortem eyes, which had undergone conventional vitrectomy or plasmin-assisted vitrectomy.

Methods and results

Five human postmortem eyes were injected with one unit (1U) of plasmin (Sigma®, Germany) into the center of the vitreous cavity. The fellow eyes received calcium and magnesium free phosphate buffered saline and served as controls. Eyes were obtained from the local eye bank 6–14 h after death. Due to the lack of blood testing, the corneas were not excised. The donors' age ranged from 55 to 69 years. After 30 min of incubation time at 37°C, all eyes underwent a standard three port pars plana vitrectomy. Induction of PVD was initiated by suction with the vitrectomy probe at the posterior pole and then extended peripherally. The vitreous base was not excised. No attempt of peeling of the posterior hyaloid was made. The globes were placed in a solution of 4% paraformaldehyde, and the vitreoretinal interface was investigated by two observers independently using scanning electron microscopy.

Intraoperatively, all plasmin-treated eyes and three control eyes showed an attached vitreous. In two

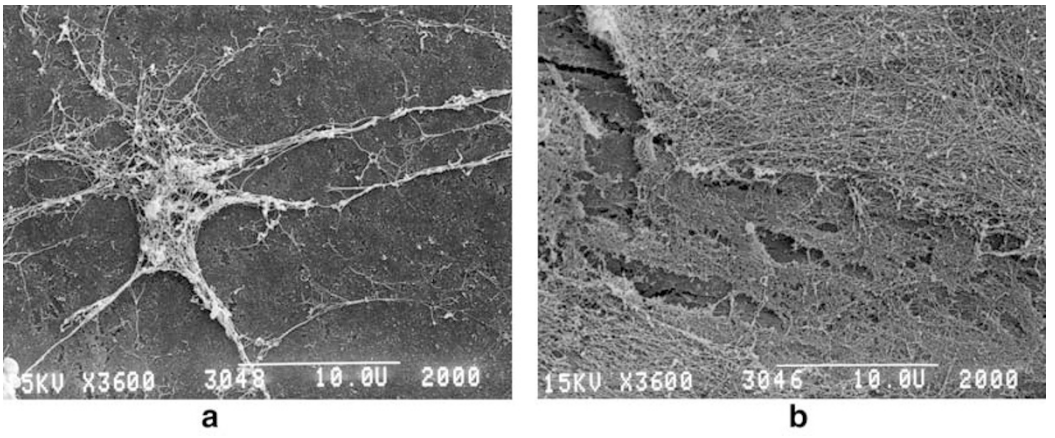

Figure 1 In eyes which had undergone conventional vitrectomy, there were networks of collagen fibrils covering most parts of the ILM.

control eyes, the vitreous was detached spontaneously. However, all control eyes revealed remnants of cortical vitreous at the posterior pole and at the equator (Figure 1). Regarding the networks of collagen fibrils which covered most parts of the ILM, there was no difference in eyes which had undergone spontaneous PVD compared to eyes in which PVD was induced surgically postmortem.

In contrast, plasmin-treated eyes showed only sparse collagen fibrils or a smooth retinal surface (Figure 2). At the vitreous base, there was no vitreoretinal separation.

Comment

This limited series in postmortem human eyes demonstrates the efficacy of plasmin as an enzymatic adjunct to vitrectomy. By eliminating remnants of cortical vitreous, which remain adherent to the ILM following conventional vitrectomy, plasmin-assisted vitrectomy creates a smooth retinal surface consistent with a bare ILM.

It is of note that no attempt of peeling of the cortical hyaloid was made in any eye. The surgical procedure consisted of induction of PVD using the suction forces of the vitrectomy probe over the posterior pole. Maybe the remnants of cortical vitreous could have been removed by meticulous peeling as well. However, every surgical technique approaching the vitreoretinal interface by mechanical means can be technically difficult, and carries the risk of iatrogenic retinal damage.

Regarding the ability of plasmin to create a smooth retinal surface free of cortical vitreous remnants, tractional forces at the vitreoretinal interface may be relieved more safely and effectively compared to conventional vitrectomy. Today, the most complete release of vitreomacular traction seems to be possible by removing all epiretinal tissue including the ILM. ILM peeling has been shown to enhance the closure rate of

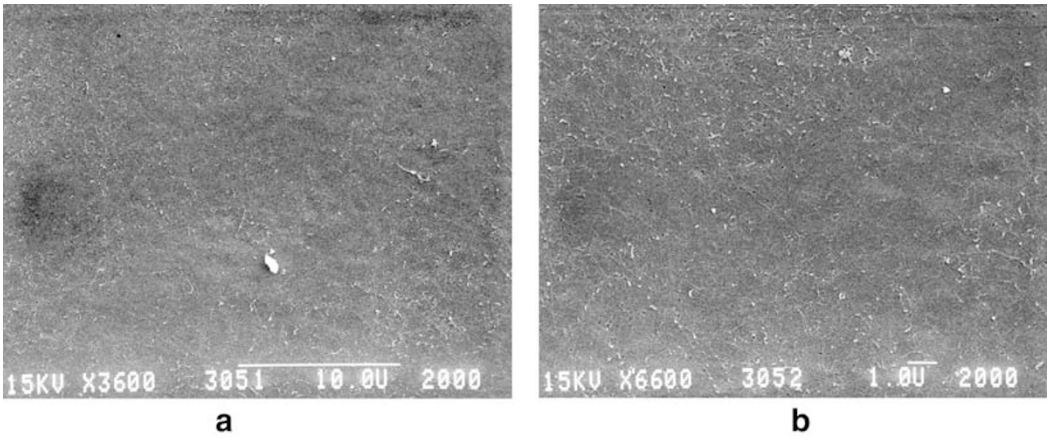

Figure 2 In plasmin-treated eyes, vitrectomy created a smooth retinal surface consistent with a bare ILM.

macular hole surgery and to promote resolution of diffuse diabetic macular edema.[5,6] However, manual peeling of the ILM is technically difficult, and has even been implicated in visual field loss.[7] Staining of the ILM using indocyanine green (ICG) results in better visibility of the membrane, and ICG-assisted peeling has been proposed for an easier and safe removal of the ILM.[8,9] For unknown reasons, however, ICG-assisted peeling of the ILM may cause retinal damage under certain yet undetermined circumstances.[10] Plasmin-assisted vitrectomy may hold the promise of relieving tractional forces without approaching the ILM and the retina.

Indeed, plasmin-assisted vitreous surgery has been proposed as an office-based procedure for idiopathic stage 3 macular holes.[11] Injection of autologous plasmin before vitrectomy was reported to cause PVD and facilitate surgical repair of the hole.[11] Moreover, the procedure has shown promise in the more challenging cases of macular holes caused by ocular trauma.[12] One may speculate whether plasmin could in some cases obviate ILM peeling for complete release of vitreoretinal traction.

In our series we used plasmin as an enzymatic adjunct to vitrectomy. One unit of plasmin applied 30 min before vitrectomy resulted in a smooth retinal surface. Recent studies in postmortem porcine and human eyes demonstrated that enzymatic action alone was sufficient to induce PVD.[2,4] Two units of plasmin created a smooth retinal surface without any additional surgical technique.[2,4] It cannot be concluded from these studies, whether plasmin-assisted vitrectomy presents any advantages compared to plasmin injection alone concerning the cleaving effect and surgical risks.

However, plasmin-induced vitreoretinal separation is limited to the posterior pole and to the equator. At the vitreous base, the cortical hyaloid remains firmly attached, indicating that plasmin does not cleave the vitreoretinal junction by secondary activation of collagenases.[2,4] Therefore, one important disadvantage of plasmin injection without vitrectomy may be the risk of inducing retinal breaks at the posterior margin of the vitreous base. Plasmin assisted vitrectomy enables the surgeon to excise the vitreous base, to examine the peripheral retina for retinal break formation, and to treat retinal breaks immediately.

Further studies are now required to investigate the short- and long-term complications of the different surgical techniques. Before plasmin-assisted vitrectomy may be regarded as a viable alternative or adjunct to vitrectomy, central questions of efficacy and safety need to be addressed. Nevertheless, plasmin-assisted vitrectomy holds the promise of creating a raft of new therapeutic strategies for a variety of vitreoretinal diseases.

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