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Full-thickness macular holes treated with vitrectomy and tissue glue

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Abstract

In the surgical treatment of full-thickness macular holes good results have been published with the combination of vitrectomy, gas and application of Transforming Growth Factor β 2. Other authors report a 73% success rate in closing a full-thickness macular hole after vitrectomy and gas tamponade alone. We used, in addition to vitrectomy and gas tamponade, a tissue glue to stimulate adhesion of the elevated cuff of neurosensory retina surrounding a full-thickness macular hole and to close to hole itself. A total of 15 eyes of 13 patients (3 men, 10 women), with stage 3 and 4 macular holes were operated. All of the 13 uncomplicated cases showed complete closure of the macular hole. In one case (8%) the visual acuity decreased one line in spite of a funduscopically closed hole, and in two cases (16%) visual acuity remained the same despite closure. Increased visual acuity was seen in ten cases (76%), eight of which improved more than two lines.

Introduction

Several techniques have been proposed for the treatment of full-thickness macular holes. Vitrectomy with removal of all premacular cortical vitreous and gas tamponade [1] has been published as a means to close a macular hole. Our own results with this technique, however, were unsatisfactory (unpublished data). In addition to pars plana vitrectomy with removal of premacular cortical vitreous, transforming growth factor (TGF β 2) has been advocated [2, 3]. Others have used autologous serum to this purpose [4].

In an attempt to permanently close full-thickness macular holes, we used a tissue glue (Tissucol Duo 500, Immuno AG, Vienna, Austria) which is a biological two component fibrin sealant prepared from pooled human plasma. The main active components are fibrinogen, fibronectin, factor 8, plasminogen and thrombin. Applied on tissue this gives a temporary solidified sealant which is completely absorbed in approximately one week. Since the glue only can be applied on a macula devoid of vitreous, complete removal of all posterior cortical vitreous is essential. Specially in younger patients this can be difficult to achieve. In two cases proliferative vitreoretinopathy (PVR) occurred with traction retinal detachment, which was treated accordingly. Whether this is a direct result of the use of the intraocular glue and/or the amount of glue has not been clearly established.

Patients and methods

All patients had a complete ophthalmologic examination, including best corrected Snellen distance visual acuity, slit-lamp biomicroscopy, applanation tonometry and slit-lamp biomicroscopic evaluation with the Golmann contact lens.

Our surgical technique consists of a pars plana vitrectomy with meticulous removal of all premacular cortical vitreous. With either a flute needle and/or vitreous pick, a posterior vitreous detachment was created. Any epiretinal membranes, if present, were removed. A gas-fluid exchange was performed, followed by the swift application of a drop of the tissue glue on the posterior pole. The air was exchanged for a 16% C3F8 mixture. The application of a drop of the glue, approximately 50 μl, with a blunt 20 gauge needle, has to be quick in order to prevent the glue from sticking to the needle. Tissucol is a biological two component

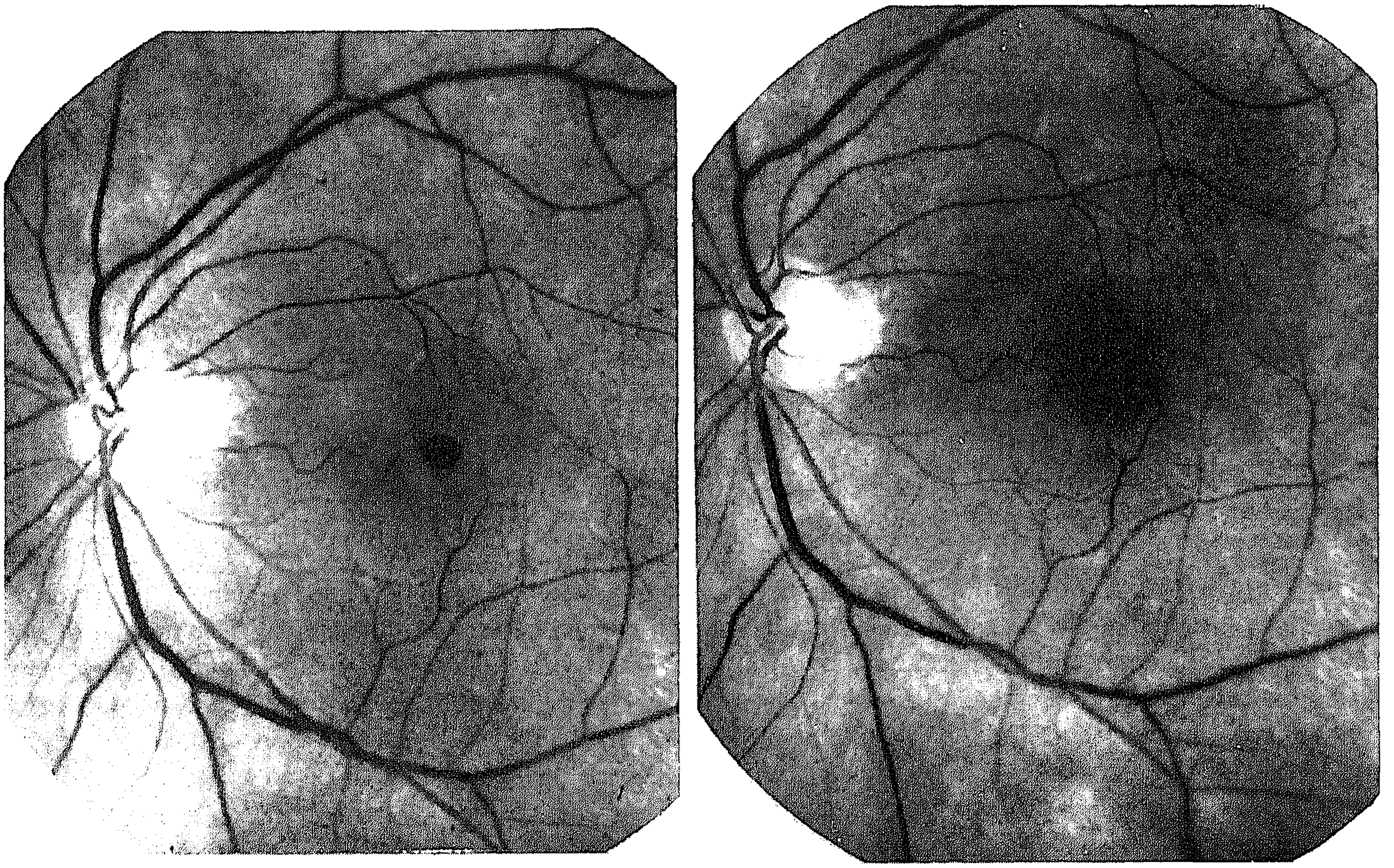

Fig. 1. Fundus photography on the first postoperative day demonstrates a gas-filled vitreous cavity with a mass of white tissue glue present over the posterior pole and macula.

sealant, the components come deep frozen, in preloaded syringes, and have to be defrosted prior to use. We defrost the Tissucol 30 minutes before use and warm it up to 37° C. The components are mixed in the needle during application.

This results in a viscous solution that quickly sets to form an elastic white mass, which firmly adheres to tissue. This process simulates the key features of the physiological coagulation process and is used to seal or glue tissue and to support wound healing. In the course of wound healing the solidified sealant is completely absorbed. Since the solidified sealant reaches its ultimate strength after about 2 hours, we positioned the patient strictly supine until the next day. After that we instruct the patient to keep a face down position for one week. The duration of the white mass of tissue glue was five to ten days, the disappearance showed gradual thinning combined with the appearance of irregularities at the edge of the mass.

Results

A total of 15 eyes of 13 patients (3 men, 10 women), with stage 3 and 4 macular holes were operated. The ages ranged from 35 to 81 years, mean 64 years. The duration of preoperative visual complaints ranged from 1 to 36 months, mean 7.5 months. Preoperative visual acuity ranged from 20/60 to 5/200 (mean: 20/100). Fifteen eyes had a follow up of three month or more, postoperative visual acuity ranged from 20/30 to 5/200 (mean 20/60). In our first series of 15 eyes two cases developed of proliferative vitreoretinopathy in the first postoperative week.

All of the 13 uncomplicated cases showed a complete closure of the macular hole. In one case (8%) the visual acuity decreased one line in spite of a funduscopically closed hole, in two cases (16%) visual acuity remained the same despite closure, an increase of visual acuity was seen in ten cases (76%), eight of which increased more than two lines.

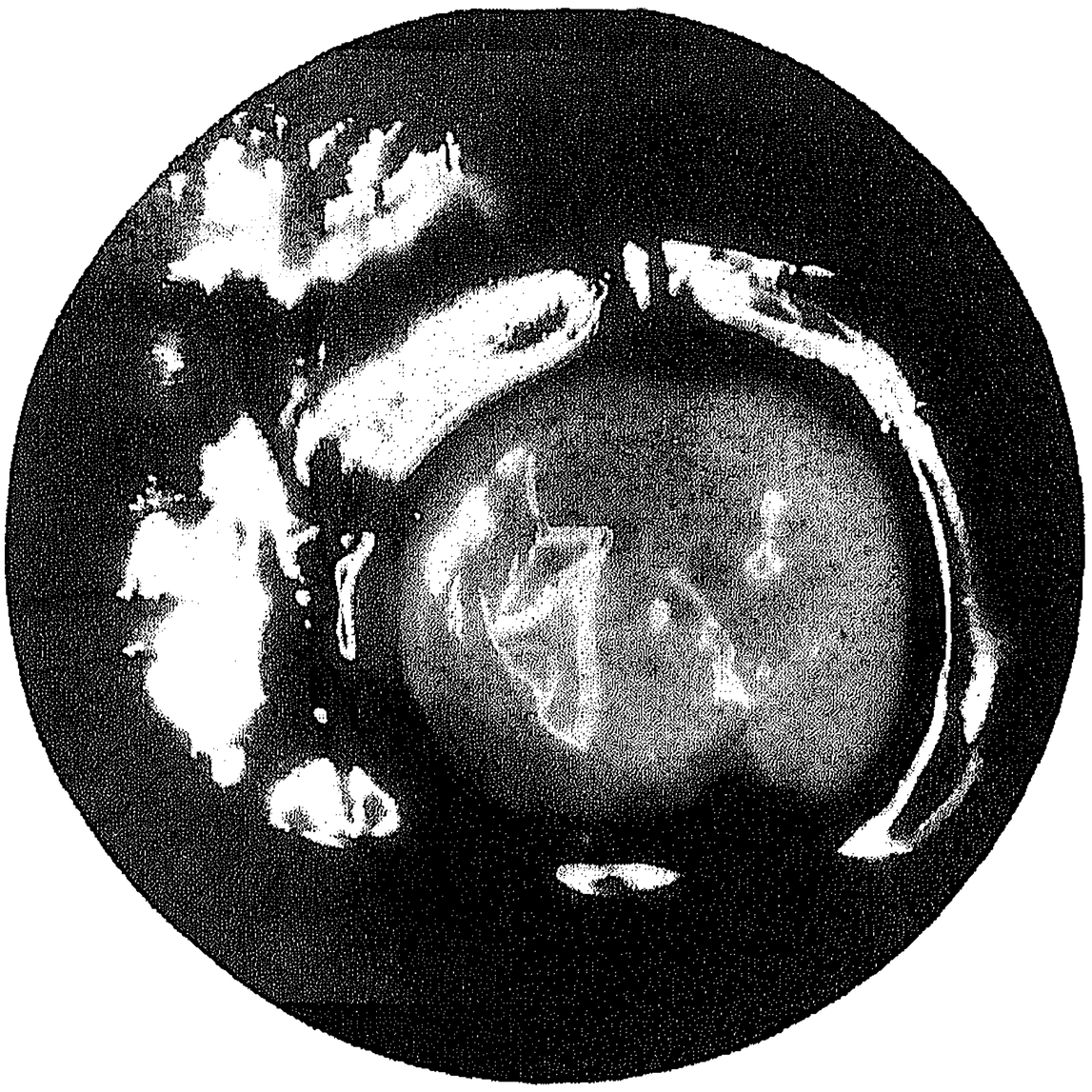

Fig. 2. On the left is a preoperative fundus photograph of full-thickness macular hole with a surrounding cuff of subretinal fluid. Two months postoperatively (on the right), the macular hole is closed and the previous cuff of subretinal fluid is completely reabsorbed.

Discussion

Tissucol is prepared from pooled human plasma. To minimize the risk of viral infection only plasma units are used which are non-reactive in tests for HBs-antigen as well as for HIV-1-, HIV-2-. Autologous serum, autologous plasma and platelets have been reported as an adjunct in macular hole surgery; however, these techniques all require handling with blood and therefore bear a risk of bacterial infection. Macular holes appear most frequently in women in the sixth decade.

In most cases it is a unilateral disease [5]. Full-thickness macular holes usually result in a reduction of visual acuity to a level between 20/200 and 20/80 [6]. In our series we found bilateral macular hole in 28% of cases. Spontaneous resolution of early stages of macular hole has been reported [7], but this has not been seen in holes of longer duration. Separation of the posterior vitreous with release of vitreoretinal traction is thought to prevent the progression of early stages of macular hole. Nevertheless it is thought that a posterior vitreous detachment can prevent the progression from an impending to a full-thickness macular hole. According to Wendel et al., vitrectomy with relief of all tangential traction and retinal tamponade with intraocular gas can provide meaningful improvement of visual acuity [8].

Since our experiences with vitrectomy and gas tamponade alone were unsatisfactory in permanently closing full-thickness macular holes, perhaps in part due to incomplete removal of all tangential traction and possibly insufficient compliance with the postoperative face-down positioning, we decided to use a tissue glue. Because TGF beta 2 was not commercially available for clinical use, we decided to use Tissucol. Coleman and co-authors have reported positive results with biologic glue in the treatment of giant retinal tears and macular holes [9]. In their animal model tissue glue was injected underneath artificially detached retina. They found circumscribed chorioretinal adhesion at the injection site of retroretinal glue. Later they used tissue glue in five patients with a macular hole and two patients with giant tears.

We speculate that a similar chorioretinal adhesion may occur when tissue glue is placed on a macular hole instead of under the edge of the retina and in this manner stimulates both closure of the macular hole and adhesion of the cuff of subretinal fluid surrounding the hole.

During surgery it is essential to induce a posterior vitreous detachment before application of the tissue glue, since the glue has to stick to the macula. Especially in relatively young patients, creating a posterior vitreous detachment and removal of all posterior vitreous can be difficult. Either active suction with a silicone-tipped flute needle or peeling with a bent sharp needle was tried in every case to create a posterior vitreous detachment and remove all remaining vitreous. Three months postoperatively we could not detect any sign of a full thickness macular hole in any patient. The surrounding rim had disappeared and we could no longer identify remnants of the edge of the macular hole.

Generally, postoperative closure of macular holes, specially those with flattened and unidentifiable edges, will show a smaller scotoma and higher visual acuity than preoperatively. Most likely the glue will stimulate chorioretinal adhesion of the retina surrounding the hole. Although it is possible that tissue glue will result in the discrete macular epiretinal, or preretinal membrane at the site of the preexisting hole, we did not observe such occurrence in any of our patients. In early cases however, proliferative vitreoretinopathy did develop shortly after the operation. In later cases, we have not experienced this complication, which may have been related to the completeness of the vitrecto-

my or experience with tissue glue application. Since any manipulation of the vitreous can induce PVR, vitrectomy, application of a glue and gas tamponade are definite risk factors. We feel that the amount of applied glue is related to this risk, so we have reduced the amount of glue and improved the application methods, and in doing so, shortened operation time.

Since there was great heterogeneity in the presented group of macular holes regarding the type of hole, duration of symptoms, myopia, size of the hole and intraoperative difficulties with respect to complete removal of all vitreous and inducing a posterior vitreous detachment, the importance of these respective parameters has to be further studied. The first results indicate that adding tissue glue to the surgical procedure can enhance the anatomical and functional outcome of surgery significantly.

Longer follow up is needed to determine the final place of tissue glue in the treatment of full thickness macular holes.

References

1. Kelly NE, Wendel RT. Vitreous surgery for idiopathic macular holes. Results of a pilot study. Arch Ophthalmol 1991; 109: 654–9.
2. Glaser BM, Michels RG, Kuppermann BD, Sjaarda RN, Pena RA. Transforming growth factor beta 2 for the treatment of full thickness macular holes. Ophthalmology 1992; 99: 1162–73.
3. Lansing MB, Glaser BM, Liss H, Hanham A, Thompson JT, Sjaarda RN, Gordon AJ. The effect of pars plana vitrectomy and transforming growth factor beta 2 without epiretinal membrane peeling on full thickness macular holes. Ophthalmology 1993; 100: 868–72.
4. Liggett PE, Alfaro DV, Horio B, Chaudhry N, Mieler WF. Autologous serum as a tissue adhesive in the treatment of idiopathic macular holes. Proceedings of the AAO Annual Meeting; 1993 Nov 14–18; Chicago. Chicago: American Academy of Ophthalmology, 1993.
5. Morgan CM, Schatz H. Idiopathic macular holes. Am J Ophthalmol 1985; 99: 437–44.
6. Johnson RN, Gass JDM. Idiopathic macular holes: observations, stages of formation, and implications for surgical intervention. Ophthalmology 1988; 95: 917–24.
7. Wiznia RA. Reversibility of the early stages of idiopathic macular holes. Am J Ophthalmol 1989; 107: 241–5.
8. Wendel RT, Patel AC, Kelly NE, Salzano TC, Wells JW, Novack GD. Vitreous surgery for macular holes. Ophthalmology 1993; 100: 1671–6.
9. Coleman DJ, Lucas BC, Fleischman JA, Dennis PH, Chang S, Iwamoto T, Nalbandian RM. A biologic tissue adhesive for vitreoretinal surgery. Retina 1988; 8: 250–6.