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ORIGINAL PAPER

# The outcomes of subtotal vitrectomy in macular surgeries: a single surgeon case series

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**Abstract**
*Purpose* To investigate the outcomes of subtotal vitrectomy in epiretinal membrane (ERM) and idiopathic macular hole (IMH) surgeries.
*Methods* The patients who underwent vitrectomy for primary ERM and IMH were included. After the truncation of posterior hyaloid, cortical vitreous was incompletely removed and anterior vitreous was left in place. The main outcome measure was the complications of the surgical technique during the postoperative 12 months of follow-up.
*Results* Fifty-two eyes were included. Thirty-seven eyes had ERM, and 15 had IMH. During the 12 months of follow-up period, 33% of the phakic patients showed progression in the lens opacities and required cataract surgery. Other postoperative complications were listed as follows: transient intraocular pressure increase in 3 (5.9%), endophthalmitis in 1 (2.0%), and retinal detachment in 1 patient (2.0%).
*Conclusion* Subtotal vitrectomy seems as an effective and safe surgical technique in the treatment of macular diseases.

**Keywords** Complication · Epiretinal membrane · Macular hole · Vitrectomy

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## Introduction

Epiretinal membrane (ERM), idiopathic macular hole (IMH), and vitreomacular traction syndrome are three entities which form the group of vitreomacular surface disorders [1]. Vitrectomy and ERM peeling is required in ERM patients when they suffer from visual decrease and metamorphopsia [2–4]. Stage 2–4 MH patients also require vitrectomy with or without internal limiting membrane peeling [5, 6]. Usually complete vitrectomy is performed when the risk for subsequent proliferative vitreoretinopathy development is high (i.e., retinal detachment, tractional detachment, trauma patients with or without intraocular foreign body cases) [7–10]. However, subtotal rather than total or complete vitrectomy may be an option in the surgical approach of some selected patients with macular diseases. In this study, we aimed to evaluate the functional and anatomical outcomes, and the complications of subtotal vitrectomy in ERM and IMH patients during a follow-up time of 12 months.

## Methods

In this interventional retrospective case series, we reviewed the records of the ERM and IMH patients who underwent 23-gauge vitrectomy in Beyoglu Eye Hospital between January and June 2016 and were operated by a single experienced surgeon (A.O.). A written informed consent was obtained from all

patients before the treatment and the study adhered to the tenets of the Declaration of Helsinki.

The patients who had undergone vitrectomy for primary ERM or idiopathic IMH and who had completed a minimum follow-up period of 12 months were included. Eyes with ERMs secondary to diabetic retinopathy, other retinal vascular diseases, uveitis, and eyes with traumatic MH were not included. Data collected from the patients included age, gender, macular disease, visual acuity (VA), central retinal thickness (CRT), stage of IMH, complications, and functional and anatomical outcomes of the surgeries. All patients underwent a standardized examination including measurement of BCVA via a projection chart in decimals at 4 meters, slit-lamp biomicroscopy, measurement of IOP via applanation tonometry, and biomicroscopic fundus examination. Optical coherence tomography (OCT) imaging (Spectralis; Heidelberg Engineering, Heidelberg, Germany) was performed before treatment. All examinations were repeated at postoperative day 1, week 1, month 1, month 3, month 6, and month 12. Optical coherence tomography was used for detecting ERM and IMH. Central retinal thickness, defined as the mean thickness of the neurosensory retina in a central 1-mm-diameter area, was computed using OCT mapping software generated by the device. The IMH hole was classified according to Gass classification [11].

## Surgical technique

All surgeries were performed by a single surgeon (A.O.). All patients underwent 23-gauge transconjunctival vitrectomy with the Constellation system (Alcon Surgical, Ft. Worth, TX) and a wide-field viewing system was used. The phakic patients with a significant cataract underwent a combined phacoemulsification and vitrectomy procedure, whereas the patients without significant lens opacity did not undergo phacoemulsification.

First, core vitrectomy was performed, and if posterior vitreous detachment was not present, it was induced (Fig. 1) and then a limited posterior vitrectomy (Fig. 2) was performed. Anterior vitreous was totally left in place, and vitreous base shaving was not performed with or without indentation. Trypan blue-assisted (0,06%, VisionBlue, DORC, Netherlands) peeling of ERM was performed in all ERM surgeries, after ERM peeling, the ILM was stained with brilliant blue G (Fluoron Gmbh, NEU-Ulm, Germany), and ILM was also peeled if it was obviously or suspiciously disrupted. Brilliant blue G-assisted ILM peeling was performed in all IMH cases. At least 2-disk-diameter ERM and/or ILM was peeled in all cases (Fig. 3). After membrane peeling, peripheral retina was examined with indentation to find out any previous or new retinal breaks, and barrier laser photocoagulation was performed when required. Tamponade choice was not based on any specific rules in ERM surgeries; however, 10% perfluoropropane (C3F8) was used in all IMH cases. Strict positioning was not suggested in ERM patients, in

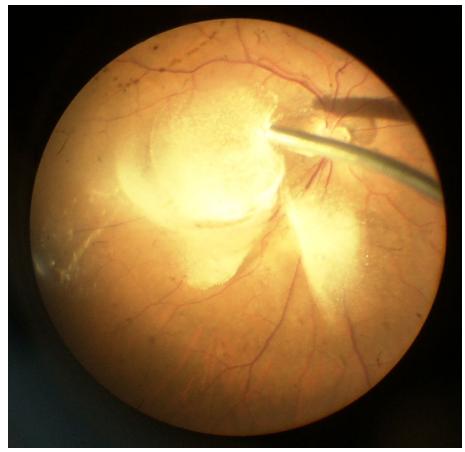

**Fig. 1** Triamcinolone-assisted posterior vitreous detachment in an idiopathic macular hole patient

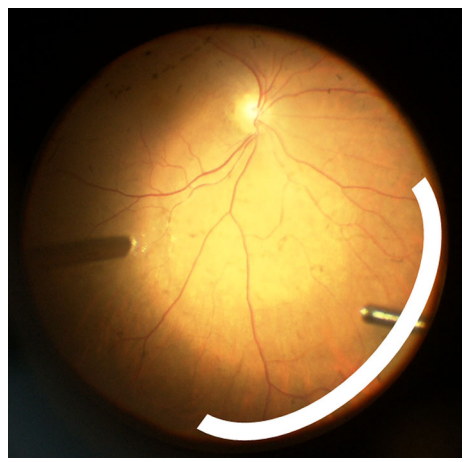

**Fig. 2** The anterior border of truncated posterior hyaloid (white crescent) (the border is posterior to the equator)

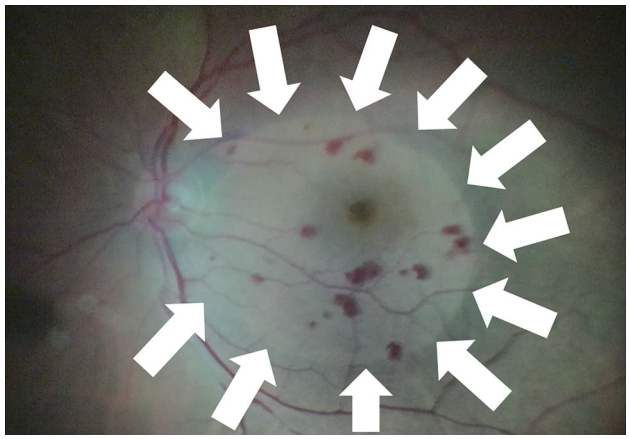

**Fig. 3** The borders of the peeled internal limiting membrane in an idiopathic macular hole patient (white arrows)

contrast, at least 5 days of prone position was suggested for IMH patients.

Primary outcome measure of the study was the per- and postoperative complications during the 12 months of follow-up period. Secondary outcome measures were the change in BCVA in ERM and IMH subgroups, change in CRT in ERM subgroup, and MH closure rate in IMH subgroup.

### Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software (version 21.0). The continuous variables were expressed as mean ± standard deviation (SD). The categorical variables were expressed as number (*n*) and percentages (%). Visual acuity was converted to the logarithm of the minimum angle of resolution (LogMAR) for statistical analysis. Categorical variables were presented as numbers and percentages, while numerical variables were expressed as the mean and standard deviation. First the data were analyzed in terms of normality using Kolmogorov–Smirnov test. As the distribution of the data was found to be normal, the visual acuity and the CRT values between baseline and the other time points were assessed with repeated measures test. Categorical variables were compared using Chi-square test. A $p$ value 0.05 was considered statistically significant.

## Results

The inclusion criteria were met by 52 eyes of 52 patients. The overall mean age was 69.6 ± 5.9 years (range 7–72 years). Twenty-one patients (40.4%) were female, and 31 (59.6%) were male. The mean follow-up time after surgery was 12.0 ± 0.2 months (range 12–13 months). Thirty-seven eyes (71.2%) were diagnosed as ERM and 15 (28.8%) as IMH. A total of 37 patients (71.2%) were phakic, and 15 (28.8%) were pseudophakic preoperatively. Thirteen out of the 37 phakic patients (35.1%) underwent combined phacoemulsification and vitrectomy procedure.

The mean BCVA at baseline, month 1, month 3, month 6, and month 12 in ERM group was 0.65 ± 0.33 LogMAR (range 0,15–1.30), 0.74 ± 0.32 LogMAR (range 0.05–1.5), 0.67 ± 0.38 LogMAR (range 0.0–1.8), 0.55 ± 0.30 LogMAR (range 0.0–1.3), and 0.56 ± 0.36 LogMAR (range 0.0–1.3) ($p > 0.05$, for all) (Fig. 4). Mean CRT at baseline, month 1, month 3, month 6, and month 12 in ERM group was 472 ± 104 micrometers (range 242–729), 420 ± 75 micrometers (range 273–675), 386 ± 73 micrometers (range 196–645), 383 ± 76 micrometers (range 247–694), and 378 ± 66 micrometers (range 247–560) ($p < 0.0001$, for all) (Fig. 5). Only ERM was peeled in 11 patients (29.7%), and both ERM and ILM were peeled in 26 patients (70.3%). A tamponade balanced salt solution was used in 20 patients (54.1%), air in 12 patients (32.4%), 20% sulfur hexafluoride in three patients (8.1%), and 10% perfluoropropane in two patients (5.4%). The posterior vitreous was found to be detached in 32 of the 37

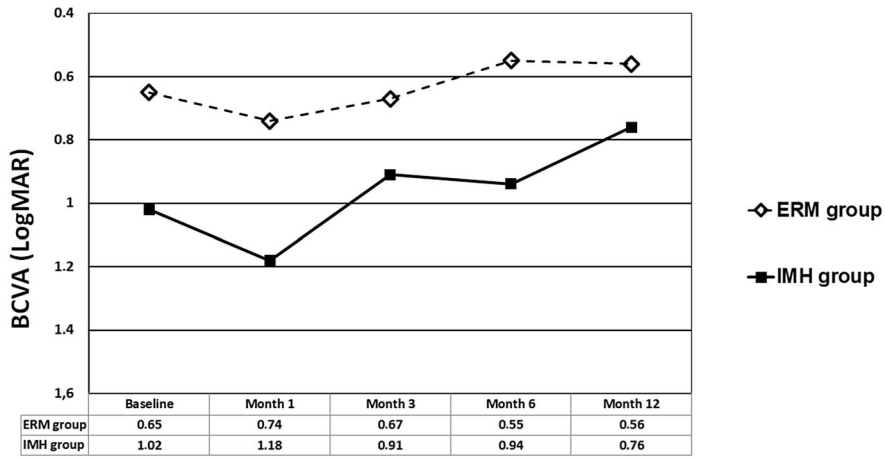


**Fig. 4** The change in mean BCVA in ERM and IMH groups. *BCVA* best corrected visual acuity, *LogMAR* logarithm of the minimum angle of resolution, *ERM* epiretinal membrane, *IMH* idiopathic macular hole

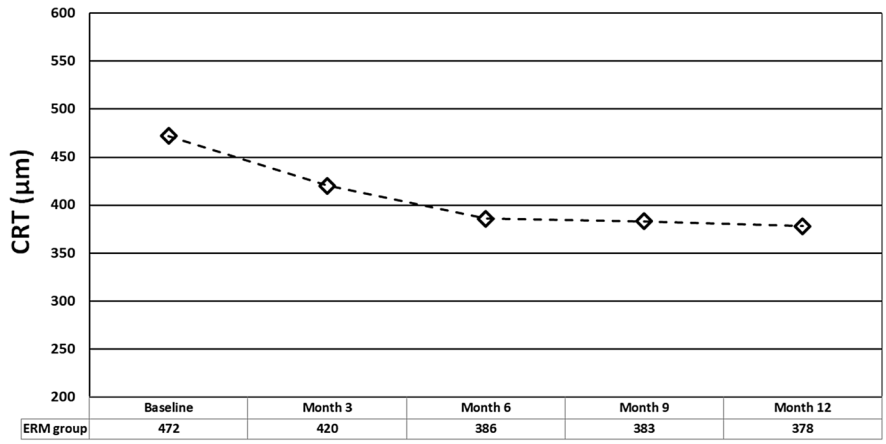


**Fig. 5** The change in mean CRT in ERM group. *CRT* central retinal thickness, *ERM* epiretinal membrane

patients (86.4%) and was attached in five patients (13.6%).

The mean BCVA at baseline, month 1, month 3, month 6, and month 12 in IMH group was 1.02 ± 0.37 LogMAR (range 0,5–1.80), 1.18 ± 0.59 LogMAR (range 0.7–3.0), 0.91 ± 0.32 LogMAR (range 0.5–1.5), 0.94 ± 0.37 LogMAR (range 0.4–1.5), and 0.76 ± 0.45 LogMAR (range 0.2–1.5) ($p > 0.05$, for all) (Fig. 4). Four out of the 15 patients (26.7%) had stage 2 IMH, seven (46.7%) had stage 3 IMH, and four (26.7%) had stage 4 IMH preoperatively. Three out of the 15 patients (20%) showed ERM with IMH, and both ERM and ILM were peeled in these patients, and only ILM was peeled in the remaining 12 patients (80%). A tamponade 10% perfluoropropane was used in all of the patients, and patients were told to remain face-down position at least for 5 days postoperatively. Seven (46.7%) patients showed type 1 IMH closure, four (26.7%) showed type 2 IMH closure, and IMH was not successfully closed in four patients (26.7%) after the first surgery. Two patients showed stage 3 IMH, and two showed stage 4 IMH preoperatively in the group of patients in whom MH closure was not obtained successfully. Re-operation was scheduled for four patients in whom IMH was not closed, two of them accepted, and successful closure of the MH was achieved finally in 13 out of the 15 patients (86.6%).

A total of 37 patients (71.2%) were phakic, and 15 (28.8%) were pseudophakic preoperatively. Thirteen out of the 37 phakic patients (35.1%) underwent phacoemulsification simultaneously with the vitrectomy. Eight of the remaining 24 phakic (33.3%) patients showed significant progression of lens opacity during the follow-up period of 12 months and required cataract surgery. Per-operatively retinal tears were detected in three out of the 52 (5.8%) patients and treated with laser photocoagulation. (All three were ERM patients.) All of the 3 breaks were already

detected preoperatively, no new breaks was observed during the induction PVD in the patients with attached posterior vitreous, and no new sclerotomy-related break was detected at the end of the surgery. In general, three patients (5.8%) showed transient intraocular pressure increase which was treated with topical antiglaucomatous agents. One patient (2.0%) showed retinal detachment, and one showed infectious endophthalmitis (2.0%) which were both treated successfully with vitrectomy.

## Discussion

We evaluated the outcomes and complications of subtotal vitrectomy and membrane peeling surgery in ERM and IMH patients in this study. Functional outcomes were arithmetically better than baseline at all time points; however, they did not reach statistically significant levels at any of the time points. In ERM cases, CRT was found to be significantly decreased during the 12 month follow-up period, and 86.6% of the MHs were found to be closed at month 12. Complications were acceptable, 33% of the phakic patients showed progression in lens opacity, one patient (2%) showed postoperative endophthalmitis, and only one patient (2%) showed retinal detachment during the follow-up period. The postoperative endophthalmitis case was one of the eight cases of an endophthalmitis outbreak in a 2-week period. The possible cause of the outbreak could not be proven. The case was not a culture-proven endophthalmitis and successfully treated with early vitrectomy and intravitreal antibiotic injection. No functional loss was detected in the patient.

We peeled both ERM and ILM in patients who showed any deficit in ILM with application of brilliant blue dyeing after ERM peeling and did not peel the ILM of the ERM patients with intact ILMs. In a meta-analysis by Liu et al. [12], eight studies reporting the outcomes of ERM or ERM + ILM peeling in idiopathic ERM patients were evaluated. A total of 418 eyes were included in the meta-analysis of which 218 were only ERM peeled eyes and 200 were ERM + ILM peeled eyes. The study mainly focused on the efficacy outcomes, while the complications of the surgeries were not analyzed in detail. The most common complication reported was postoperative cataract formation. The authors concluded that additional ILM peeling during ERM surgery did not show better vision improvement or lower recurrence rate. Their results showed that ERM + ILM peeling group showed better visual outcomes at postoperative month 12, whereas only ERM peeling group showed better visual outcomes at postoperative month 18.

The anatomical closure rate in IMHs is about 90% with vitrectomy combined with ILM peeling at present [13]. In a study by Yuksel et al. [6], 21 eyes of 20 patients with stage 3 or 4 IMH who underwent vitrectomy with brilliant blue assisted ILM peeling were evaluated. Primary and final IMH closure rate was reported to be 81, and 90% which was similar to our study. Also they reported that mean preoperative and postoperative BCVA were 0.86 and 0.64 LogMAR, respectively. The mean increase in BCVA was 2.2 LogMAR lines. In line with this, our postoperative improvement was 2.6 LogMAR lines. In another study by Kwok et al. [14], only the surgical outcomes of vitrectomy with indocyanine green assisted ILM peeling in stage 3 and 4 IMHs were evaluated, and the IMH closure rate was 87.8% after one surgery with a mean increase in BCVA by 3.2 lines after a mean follow-up 11 months. They also reported that 85% of the postoperative phakic eyes developed significant cataract, 1 of 41 eyes developed retinal detachment and 1 eye developed transient vitreous hemorrhage postoperatively. The anatomical MH closure rate of our series after the first surgery was relatively lower than the previous studies (73.7%, 11 of 15 eyes) which might be as a result that less vitreous material was removed and a smaller volume of gas was used to tamponade the MH with our surgical technique [6, 11, 13, 14].

Iatrogenic peripheral retinal tears are one of the most important complications of vitrectomy and when realized they have to be treated with laser photocoagulation [15]. Usually retinal tears occur at the time of inducing the posterior hyaloid detachment or peripheral vitreous shaving [15]. To avoid this, we did not perform any peripheral vitreous shaving with or without scleral indentation. Our complication rate was low and similar to that reported by Rahman and Stephenson [4] where iatrogenic retinal break occurred in only two eyes and one patient showed postoperative retinal detachment after ERM surgery. In another study, Won et al. [16] reported that none of the 24 patients showed post-vitrectomy retinal detachment after vitrectomy for ERM. Marie-Loise et al. [15]

studied the rate of retinal detachment occurrence after small gauge epiretinal detachment surgery. The postoperative retinal detachment rate after 25 gauge vitrectomy for ERM and cataract operation was compared in this interesting study. The patients who had a follow-up period of at least 12 months were included, and the patients were contacted by phone and questioned in regards to visual changes after the surgery. A total of 216 eyes of 212 ERM patients and 203 eyes of 157 cataract patients were included. The PVD was reported to be complete in 77.3% of the patients intraoperatively and PVD inducement was required in 22.6% of the ERM patients in the study. The occurrence rate of retinal break was 8.3% and these patients were treated with either laser photocoagulation or cryotherapy. The intraoperative PVD induction was not reported to be associated with retinal break; however, it was associated with occurrence of retinal detachment. The retinal detachment was reported in only two patients (0.92%) in ERM group and in two patients (0.98%) in cataract group. In line with this latter study, only one patient (2.0%) showed retinal detachment during the 12 month follow-up period in our study. The occurrence of retinal break was reported between 1.8 and 13.9% in previous reports [17–19]. The detection rate of a retinal tear was 5.8% in our study. This is in line with the findings of Marie-Loise et al. (8.3%).

Retinal breaks may be detected intraoperatively by a careful examination of peripheral retina with scleral indentation at the end of the surgery. They may be treated by endolaser photocoagulation [15]. Iatrogenic retinal breaks may occur during intraoperative induction of posterior vitreous detachment and vitreous base shaving [15, 19]. We only performed limited core vitrectomy and did not perform mild or extensive peripheral vitrectomy in any of the patients. Therefore, we did not cause any iatrogenic retinal breaks secondary to vitreous base shaving during the surgery. Another possible mechanism for the occurrence of retinal breaks during vitreoretinal surgery is sclerotomy-related breaks. In our study, none of the detected breaks were sclerotomy related. In a study by Scartozzi et al. [20], 347 consecutive eyes of 333 patients who underwent macular surgery via either 25- or 20-gauge vitrectomy were evaluated in regard to intraoperative sclerotomy-related retinal breaks. In this retrospective study, 3.1% of the 25-gauge operated patients and 6.4% of the 20-gauge operated patients showed sclerotomy-related retinal breaks.

The main limitation of this study was its retrospective design and relatively low patient number. The strong sides of the study were that this was a single center and surgeon series, with 12 month of follow-up period, and we evaluated both functional and anatomical outcomes of vitreoretinal surgery in macular diseases along with medium term complications.

In conclusion, limited core vitrectomy seems as an effective and safe surgical technique in ERM and IMH surgeries with low intra- and postoperative complications with acceptable functional and anatomical outcomes in both subgroups. Further studies comparing extensive and limited vitrectomy are necessary to better define which surgical technique would prove to be beneficial in terms of anatomical and functional outcomes and is less associated with surgical complications.

**Author contributions** AO, GE, BT, and HNT involved in design and conduct of the study and preparation and review of the study; AO, BT, and HNT contributed to data collection; and AO helped with statistical analysis.

**Compliance with ethical standards**

**Conflict of interest** None of the authors has any conflicts of interest or competing interests regarding the materials used in the research.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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