

## Original Article

# Visual and anatomic outcomes of vitreoretinal surgery: results at the Boston VA and a review of the literature

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## Abstract

**Introduction**—The veteran population presents unique challenges in the management of vitreoretinal disorders. We compiled the surgical outcomes for the most common visually significant vitreoretinal diagnoses. Those results were then compared to visual and anatomic outcomes established in the literature.

**Materials and Methods**—Medical records over a three-year time period, from January 2005 through December 2007, were reviewed for 208 persons who underwent vitreoretinal surgery for vitreous hemorrhage, retained lens fragment, rhegmatogenous and tractional retinal detachment, macular hole, and macular pucker at the Jamaica Plain Campus of the Veterans Affairs Boston Healthcare System in Boston, MA. A comprehensive search of the literature was conducted on Medline. Data from several large case series and meta-analyses were compared to results obtained at the VA Boston.

**Results**—A total of 208 veterans underwent vitreoretinal surgery from January 2005 to December 2007. After excluding those with rare diagnoses and lack of adequate follow-up data, the outcomes of 181 vitreoretinal procedures were included in this study.

**Discussion**—Overall, veterans at a regional referral center in Boston demonstrate postoperative visual and anatomic outcomes comparable to outcomes reported in the ophthalmic literature.

## Introduction

The Veterans Affairs Boston Healthcare System is the regional referral center for medical and surgical management of vitreo-retinal diseases for all veterans in the New England area. Patients are drawn from areas as far as northern Maine, Vermont, New Hampshire, and Rhode Island. Serving a largely senior veteran population, many of whom travel long distances for their care, veterans can present special social and diagnostic challenges in managing core eye diseases. Many veterans, being from remote areas, may go several years without a screening eye examination.<sup>1</sup> Difficulty in accessing care may result in more complicated medical and surgical eye diseases such as cataracts, diabetic retinopathy, hypertensive retinopathy, and age-related macular degeneration. In a diabetic veteran population, the prevalence of vitreo-retinal disorders and preventable blindness can be as high as 9.5% and 2.7%, respectively.<sup>2</sup> Alternatively, prevalence of vision-threatening retinop-

athy in the general US adult diabetic population is 8.2%.<sup>3</sup> These advanced ophthalmic disease entities, combined with advanced systemic co-morbidities, can potentially affect surgical outcomes.

Some of the commonly managed diagnoses requiring surgical intervention at the Veterans Administration Hospital in Boston include non-clearing vitreous hemorrhage from diabetes, retained lens fragments, tractional and rhegmatogenous retinal detachment, macular hole, and epiretinal membranes. In this series we examined the visual outcomes of veterans undergoing vitreo-retinal surgery for these disorders. We then performed a comprehensive search in Medline, looking at detailed outcome data from numerous case series, review articles, and meta-analyses for each diagnosis. As expected, there is variability in the literature regarding visual and anatomic outcomes from vitreo-retinal surgery. This can

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be due to a number of factors, which include but are not limited to, the stage of disease at the time of diagnosis, the status of the macula, co-existing ocular or systemic disease, preoperative vision, and the presence and frequency of postoperative complications. There are copious and detailed data in the literature describing the results of vitreo-retinal surgery for at least four of the six of the aforementioned diagnoses, many of which are included in this article. However, we acknowledge that a comprehensive review and meta-analyses of all of the data for every common vitreo-retinal diagnosis is simply not possible to present in a single manuscript. For the purposes of this article, we have favored data from selected meta-analyses and review articles offering anatomic and visual outcomes of surgery for the more common vitreo-retinal disorders as a frame of reference. Articles were excluded if they were non-English and the corresponding abstract failed to provide the needed information. The data obtained from the literature were then compared to the visual and anatomic outcomes of veterans undergoing vitreo-retinal surgery at the Boston VA. Hence, this review will serve two purposes: 1) to offer a general overview of the literature describing surgical outcomes for common vitreo-retinal disorders, and 2) to help provide a standard of comparison for the outcomes of veterans in the New England area receiving surgical vitreo-retinal care in the Veterans Administration system.

## Materials and Methods

### Data Collection

The electronic medical records were reviewed for all patients undergoing vitreo-retinal surgery at the Veterans Affairs Boston Healthcare System between January 2005 and December 2007. As this was, in part, a review article based on data gathered in a retrospective chart review, Institutional Review Board approval was obtained but informed consent was waived. Data were recorded in an ongoing fashion in order to track visual and anatomic outcomes for surgeons. For each case, the Snellen visual acuity was recorded pre-operatively and post-operatively at day one, month one, month three and month six after surgery. Complications occurring during this period were also recorded. In addition, each patient's significant co-morbidities and ocular history were also recorded. Each case was followed to the absolute post operative period. The absolute post-operative period is defined as the time period to obtain the final visual acuity, and this time period differed for each patient. The best corrected visual acuity or the best visual acuity with correction was recorded at each post-operative month.

### Data Analysis

The most common preoperative diagnoses for our veterans were diabetic vitreous hemorrhage, retained lens fragment, rhegmatogenous and tractional retinal detachment, macular hole, and epiretinal membranes. The diagnoses of epiretinal membrane and vitreo-macular traction were combined to form one group. For each case, the preoperative visual acuity was compared with the best visual acuity during the absolute postoperative period to obtain the number of lines of improvement in vision. Both the pre-operative and post-operative visual acuities were converted to logMAR equivalents based on the method described by J. Holladay.<sup>4</sup> For each diagnostic group, the mean, median, and standard deviation were calculated for the number of lines of improvement, pre-operative logMAR equivalent, post-operative logMAR equivalent, and post-operative month during which the best visual acuity was recorded. The mean logMAR equivalent for each diagnostic group was subsequently converted back into Snellen visual acuity. Cases in which the pre-operative or post-operative visual acuity was recorded as light perception (LP) or no light perception (NLP) were excluded from the visual outcome data because LP and NLP cannot be converted to logMAR equivalents. However, these cases were subsequently included in the stratification of visual outcomes shown in Table 3, and they were also included in Table 4 (complications) to aide in giving a more accurate assessment of outcomes. Other exclusionary criteria were: lack of recorded manifest refraction during the absolute post-operative period, lack of recorded visual acuity with correction in the absolute post-operative period, and having insufficient follow up in the post-operative period due to either death or missed appointments.

## Results

A total of 208 veterans underwent vitreo-retinal surgery from January 2005 to December 2007 at the Veterans Affairs Boston Healthcare System. Sixteen (7.7 percent) subjects were excluded because they had relatively rare disorders. An additional 31 patients (15 percent) were excluded because of being lost to follow up or having an incalculable preoperative or postoperative visual acuity (9 and 6 percent, respectively). As a result, 172 operations of 161 eyes were included when calculating visual outcomes in terms of fractionated snellen acuities and lines of improvement. While reporting stratified, non-fractionated snellen visual outcomes and major complications, the 9 procedures with incalculable pre-operative or post-operative vision (LP or NLP) were subsequently included (see Table 4), for a sum of 181 vitreo-retinal procedures.

**Table 3.** Visual outcomes stratified by visual acuity for each diagnostic group of veterans

Diagnostic Group	n	20/40 or better	20/40 to 20/200	Worse than 20/200	LP or worse*
VH	43	22 (52%)	9 (21%)	9 (21%)	3 (7%)
Retained lens fragments	24	14 (58%)	7 (29%)	2 (8%)	1 (4%)
Retinal Detachment	52	18 (35%)	17 (33%)	13 (25%)	4 (7.5%)
Tractional RD	9	2 (22%)	2 (22%)	4 (44%)	1 (11%)
Macular Hole	20	5 (25%)	7 (35%)	8 (40%)	0
VMT/ERM/Macular Pucker	33	9 (27%)	15 (45%)	9 (27%)	0
<b>Total*</b>	181	70 (39)	57 (32%)	45 (25%)	9 (5%)

\* Total "n" includes those patients LP and/or NLP vision

VH=Vitreous Hemorrhage, RD=Retinal Detachment, VMT=Vitreomacular Traction, ERM=Epiretinal Membrane

**Table 4.** Major complication rates from vitreo-retinal surgery at the Veterans Affairs Boston Healthcare System

Diagnostic Group	n*	Post -op Vitreous Hemorrhage	Post-op RD or retinal hole	Hypotony	CME	Failure or Recurrence
Vitreous Hemorrhage	43	8 (18.6%)	3 (7%)	0	0	8 (18.6%)
Retained Lens	24	0	2 (8%)	0	0	0
Retinal Detachment	52	0	8 (16%)	2 (4%)	0	8 (16%)
Tractional RD	9	0	1 (12.5%)	1 (12.5%)	0	1 (12.5%)
Macular Hole	20	0	1 (5%)	0	0	2 (10%)
VMT/ERM	33	0	4 (13%)	1 (3%)	3 (9.0%)	1 (3%)
<b>Total*</b>	181	8 (4.5%)	19 (10.5%)	2 (1.0%)	3 (1.5%)	12 (6.5%)

Total "n" includes those patients with LP and/or NLP vision.

RD = Retinal Detachment, CME = Cystoid Macular Edema, VMT=Vitreomacular Traction, ERM=Epiretinal Membrane

**Table 1.** Patient demographics for veterans undergoing vitreo-retinal surgery between January 2005 and December 2007 at the Veterans Affairs Boston Healthcare System

Diagnostic Group	Age		Gender	
	Mean	Median	Male	Female
Vitreous Hemorrhage	66	64	100%	
Retained Lens Fragment	73	72	96%	4%
Retinal Detachment	67	65	100%	
Tractional Retinal Detachment	66	61	100%	
Macular Hole	71	72	100%	
VMT/ERM/Macular Pucker	72	73	100%	
<b>Total</b>	69	68.5	99%	< 1%

VMT=Vitreomacular Traction, ERM=Epiretinal Membrane

Table 1 describes the demographic characteristics of the patients, including mean and median age for each group of patients. As this study was conducted at a Veterans Administration Hospital, over 95 percent of all patients are male. Tables 2, 3, and 4 summarize the results and major complications for each study group. The visual outcomes are outlined in detail within each of the tables. Table 2 describes mean pre-operative and post-operative vision, as well as the mean and median lines improved for each diagnosis. Table 3 stratifies the final visual outcomes, and includes those patients with incalculable vision (LP and NLP). Table 4 describes the major post-

operative complication rates. Table 5 conveys results of sample case series from original articles and meta-analyses describing the outcomes of vitreo-retinal surgery for each diagnosis.

## Discussion

### Vitreous Hemorrhage

The most common underlying diagnosis for vitreous hemorrhage is proliferative diabetic retinopathy.<sup>5</sup> All patients who underwent surgery for vitreous hemorrhage

**Table 2.** Visual outcomes for each diagnostic group of veterans who underwent vitreo-retinal surgery at the Veterans Affairs Boston Healthcare System

Diagnostic Group	n	Mean Pre-operative Vision	Mean Final Post-operative Vision	Mean Lines of Improvement	Median Lines of Improvement
VH	40	20/1948	20/107	6.6	6
Retained lens fragments	23	20/270	20/50	5.13	6
Retinal Detachment	48	20/935	20/132	2.94	3
Tractional RD	8	20/873	20/372	1.75	2
Macular Hole	20	20/289	20/148	1.8	1.5
VMT/ERM/Macular Pucker	33	20/132	20/76	1.88	2
Total*	172				

\*Total "n" excludes those patients LP and/or NLP vision.

VH = Vitreous Hemorrhage, RD = Retinal Detachment, VMT=Vitreomacular Traction, ERM=Epi-retinal Membrane

**Table 5.** Visual Outcomes from sample articles from a review of the literature

	n	Literature Source	20/40 or better	20/40 to 20/200	Worse than 20/200	Failure or Recurrence Rate
VH	226	CS (6)	60%	26%	14%	N/A
Retained lens fragments	343	CS (12)	190 (56%)	81 (24%)	67 (20%)	Minimal
Macular Hole	>227	MA (36)	27%-71%	48%-85%	NA	2%-10%
VMT/ERM	125	CS (42)	49 (39%)	52 (42%)	24 (19%)	0

VH = Vitreous Hemorrhage, CS = Case Series, MA = Meta-analysis, NA = no information regarding this outcome was provided, VMT = Vitreomacular Traction, ERM = Epi-retinal Membrane

in this case series had underlying diabetic retinopathy. There is a paucity of data in the literature describing the outcomes of vitrectomy for diabetic vitreous hemorrhage. Only one case series was found which looked solely at vitreous hemorrhage outcomes in a similar fashion to our case series, and it showed a wide range of results, from better than 20/50 to worse than 20/400.<sup>6</sup> The variability in visual outcomes is likely due to the presence of co-existing diabetic eye disease, such as neovascularization leading to a retinal detachment. Table 5 includes a breakdown of visual outcomes from the case series (Cooper et al.) of patients who underwent vitrectomy for non-clearing vitreous hemorrhage. These results show outcomes that are similar to our series of patients.<sup>6</sup>

### Retained Lens Fragments

Most patients with retained lens fragments do well following vitrectomy, with the majority of patients having a final visual acuity of 20/40 or better.<sup>7-11</sup> Analysis of retrospectively reviewed, large non-comparative case series show that significant predictors of good final visual acuity include good preoperative vision, presence of an intraocular lens, and an uncomplicated intraoperative and post-operative course.<sup>12</sup> Our case series is consistent

with that reported in the literature, with 58 percent achieving a final vision of 20/40 or better.

### Retinal Detachments

In general, visual outcome analyses for retinal detachment repair are often difficult to track and compare. This is because several factors impact the overall visual outcome of surgery for a retinal detachment. The most important preoperative predictor is the status of the macula. Other factors include lens status, presence of symptoms, signs of chronicity, and presence of proliferative vitreo-retinopathy. To further complicate the scenario, the type of procedure selected by the surgeon (i.e. primary vitrectomy, pneumatic retinopexy, scleral buckle, or combination procedure), and the rationale that is used in determining the ideal approach, affects the overall outcome. All of the aforementioned factors, in addition to other unknown factors, may prevent a thorough exploration and control for heterogeneity between the studies. As a result, we were unable to convey (in Table 5) visual outcomes for retinal detachment repair from the literature in the same manner as the other diagnoses.

Instead, we offer data from the literature looking at outcomes for retinal detachment repair in a dual fashion - visual and anatomic outcomes. The literature has shown

**Table 6.** Visual outcomes for the retinal detachment diagnostic group of veterans receiving vitreo-retinal surgery at the Veterans Affairs Boston Healthcare System

	Macula-on		Macula-off	
	Mean Pre-operative	Mean Post-operative	Mean Pre-operative	Mean Post-operative
PPV (n=23)*	20/97	20/38	20/4184	20/321
SB (n=16)	20/33	20/46	20/1121	20/106

PPV= pars plana vitrectomy, SB=Scleral Buckle

\*Patients who underwent combined procedure (SB/PPV) were small in number (n=6) and excluded from this table.

that the visual outcomes for retinal detachment repair range between 20/50 and 20/200.<sup>13–16</sup> In pseudophakic patients, reports have cited that repair with primary vitrectomy has yielded a single operation anatomic success rates between 50–95 percent.<sup>17–24</sup> Patients undergoing pneumatic retinopexy have anatomic success rate between 68–73 percent after a single procedure.<sup>25–27</sup> Patients undergoing scleral buckling for retinal detachment have a success rate of 80–86 percent after a single procedure.<sup>28–31</sup> Approximately 52 patients in this case series underwent surgical repair for rhegmatogenous retinal detachment at the VA Boston. All of the patients underwent either primary vitrectomy, scleral buckle, or combination of scleral buckle and vitrectomy. Eighty-four percent of patients achieved anatomic success after a single operation, leaving a 16 percent re-detachment rate. About 35 percent of patients achieved a final vision of 20/40 or better. Table 6 shows a breakdown of the preoperative and postoperative vision based on status of the macula and the type of procedure. Overall, these data suggest that anatomic and visual outcomes from repair of retinal detachments at the Boston VA seem to fall within the standards reported in the literature.

### Tractional Retinal Detachment

The surgical treatment of tractional retinal detachment is an individual matter that is influenced by the preoperative findings on examination, patient characteristics, use of a wide variety of available tools and techniques for surgery, and the experience and ability of the retinal surgeon. The nature of tractional retinal detachments, in the setting of advanced diabetic retinopathy, unsurprisingly will often lead to poor visual outcomes. Our series looked at 9 patients who underwent vitrectomy for tractional retinal detachment. Visual outcomes were modest, but due to a small number of cases, it is difficult to compare these outcomes to those reported in the literature.

### Macular Holes

Surgical repair for full thickness macular holes (Stages 2, 3 and 4) has been well studied. Stage 1 macular holes are typically treated with observation, although reports

of surgical intervention for stage 1b have yielded good anatomic and visual results.<sup>32</sup> Patients with macular holes who elect surgical intervention typically complain of distortion and difficulty reading. While anatomic success and relief of distortion is often achieved following surgery, the degree of improvement in visual acuity on the Snellen chart is often less proportionate and incongruous with anatomic results. This variability in visual outcomes can be due to preoperative staging, length of symptoms, lens status of the patient, use of adjuvants such as indocyanine green to assist in intraoperative peeling, and type of procedure selected by the surgeon. Following prompt surgical intervention for treatment of a stage 3 or 4 macular hole, vision can improve to better than 20/40 in 22–49 percent of patients.<sup>33–35</sup> Other meta-analyses have shown improvement to 20/40 or better in 27–72 percent (Table 5).<sup>36</sup> Anatomic success, seen as closure or flattening of the edges, is achieved in 80 percent of cases.<sup>31–34</sup> Length of post-operative recovery is variable. Optical coherence tomography demonstrates that the significant improvement in macular configuration can take up to six months.<sup>37</sup> Patients at the Boston VA (n=20) who underwent repair of their macular hole showed an anatomic closure rate of 90 percent. Twenty-five percent of these patients achieved a final visual acuity of 20/40 or better (Table 3).

### Epiretinal Membranes/Vitreomacular Traction Syndrome

It has been reported that epiretinal membranes frequently occur in conjunction with vitreo-macular traction.<sup>38</sup> However, the exact nature of this relationship is yet to be determined. As such, we combined the diagnoses of vitreomacular traction and macular pucker. Patients who develop epiretinal membranes will often complain of visual distortion similar in degree to those with macular holes. Surgical repair often does not require intraoperative infusion of gas nor postoperative prone positioning, as it does with macular holes. As with other vitreo-retinal disorders, final postoperative vision in patients undergoing vitrectomy for macular pucker is dependent on a number of factors, such as preoperative

vision, duration of symptoms, presence of macular edema, and intraoperative and postoperative courses. Anatomic success is often conveyed as the presence or absence of the membrane, any associated macular edema, or development of recurrence. This is determined by clinical examination and confirmed by optical coherence tomography (OCT). In the case of epiretinal membranes, visual outcomes can be as good as 20/40.<sup>39-41</sup> One report looked at visual outcomes for 125 patients who underwent surgery for macular pucker and showed that 39 percent had a final vision of 20/40 or better (Table 5).<sup>42</sup>

Thirty-three patients underwent surgery at the Boston VA for removal of symptomatic epiretinal membrane. Of those, 9 patients (27 percent) had a final vision of 20/40 or better, 15 (45 percent) had a final vision between 20/40 and 20/200, and the remainder had vision worse than 20/200.

The Veterans Affairs Boston Healthcare System is the only VA facility in New England that provides surgical vitreo-retinal care. As such, it draws veterans from a large geographic area to provide care for advanced surgical vitreo-retinal disorders that significantly affect vision. Veterans who live in remote areas of New England will often have difficulty keeping appointments and maintaining ongoing care of chronic disorders. This can lead to potentially challenging diagnostic and therapeutic scenarios. It should be noted that geographical diversity of population, multitude of vitreo-retinal surgeons, the type of procedure selected by the operating surgeon, the perceived complexity of the diagnosis, variations in intra-operative course, co-morbidities, and other unknown factors impact the eventual outcome and prognosis for vision. However, these issues pertaining to diversity is consistent with actual clinical practice. Moreover, it gives insight to improving the care of patients.

There are limitations present in this case series. The first include the retrospective nature of the study and the inherent bias associated with it. In addition, the exclusion of patients whose preoperative or final postoperative visual acuity was LP or NLP (due to difficulty in converting the fractionated visual acuities to LogMar equivalents for analysis of mean visual acuities), should be recognized as potentially skewing the data favorably. Moreover, the outcomes reported from the literature serve as a historical cohort and frame of reference for comparison, and the authors acknowledge that this is not as meaningful as performing a meta-analysis for all 6 diagnoses studied in this article. Finally, the patient population at the VA is different in terms of demographic

characteristics (mostly male patients), making extrapolation of data to females more difficult.

Surgical intervention for each vitreo-retinal diagnosis at the Boston VA appears to demonstrate postoperative improvement in both mean and median visions (Table 2). Overall, this review offers some reassurance that surgical outcomes for veterans undergoing vitreo-retinal surgery for common diagnoses were generally consistent with visual and anatomic outcomes and standards of care established in the literature.

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