



Published in final edited form as:

Ophthalmology. 2010 June ; 117(6): 1087–1093.e3. doi:10.1016/j.ophtha.2009.10.040.

Vitrectomy Outcomes in Eyes with Diabetic Macular Edema and Vitreomacular Traction

Diabetic Retinopathy Clinical Research Network*

Abstract

Purpose—To evaluate vitrectomy for diabetic macular edema (DME) in eyes with at least moderate vision loss and vitreomacular traction.

Design—Prospective cohort study

Participants—The primary cohort included 87 eyes with DME and vitreomacular traction based on investigator’s evaluation, visual acuity 20/63–20/400, optical coherence tomography (OCT) central subfield >300 microns and no concomitant cataract extraction at the time of vitrectomy.

Methods—Surgery was performed according to the investigator’s usual routine. Follow-up visits were performed after 3 months, 6 months (primary endpoint) and 1 year.

Main Outcome Measures—Visual acuity, OCT retinal thickening and surgical complications.

Results—At baseline, median visual acuity in the 87 eyes was 20/100 and median OCT thickness was 491 microns. During vitrectomy, additional procedures included epiretinal membrane peeling in 61%, internal limiting membrane peeling in 54%, panretinal photocoagulation in 40% and injection of corticosteroids at the close of the procedure in 64%. At 6 months, median OCT central subfield thickness decreased by 160 microns, with 43% having central subfield thickness <250 microns and 68% having at least a 50% reduction in thickening. Visual acuity improved by 10 or more letters in 38% (95% confidence interval 28% – 49%) and deteriorated by 10 or more letters in 22% (95% confidence interval 13% – 31%). Postoperative surgical complications through 6 months included vitreous hemorrhage (5 eyes), elevated intraocular pressure requiring treatment (7 eyes), retinal detachment (3 eyes) and endophthalmitis (1 eye). Little changes in results were noted between 6 months and one year.

Conclusion—Following vitrectomy performed for DME and vitreomacular traction, retinal thickening was reduced in most eyes. Between 28% and 49% of eyes with characteristics similar

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An address for reprints will not be provided.

Conflicts of interest statement: A complete list of all DRCCR.net investigator financial disclosures can be found at www.drccr.net.

Dr. Neil M. Bressler Financial relationships: Grants to investigators at The Johns Hopkins University are negotiated and administered by the institution which receives the grants, typically through the office of Research Administration. Individual investigators who participate in the sponsored project(s) are not directly compensated by the sponsor, but may receive salary or other support from the institution to support their effort on the project(s).

Dr. Neil Bressler is Principal Investigator for the following: Allergan, Bausch & Lomb, Bristol-Meyers Squibb, Carl Zeiss Meditec, EMMES Corporation, Genentech, Lumenis, Notal Vision, Novartis, Othera, QLT, Regeneron, Steba Biotech.

Dr. Susan Bressler (spouse) is Co-Investigator for the following: Genentech, Inc. Dr. Susan Bressler has been or is presently Consultant for the following: AstraZeneca, Genentech, Notal Vision, Pfizer.

But we do not believe that any of these constitutes a financial conflict of interest for this manuscript.

to those included in this study are likely to have improvement of visual acuity, while between 13% and 31% are likely to have worsening. The surgical complication rate is low and similar to what has been reported for this procedure. These data provide estimates of surgical outcomes and serve as a reference for future studies that might consider vitrectomy for DME in eyes with at least moderate vision loss and vitreomacular traction.

Introduction

Diabetic macular edema (DME) is a disorder of major and increasing public health importance throughout the world.¹⁻⁴ The only proven effective therapy for DME at this time is focal/grid laser photocoagulation as performed in the Early Treatment Diabetic Retinopathy Study (ETDRS).⁵⁻⁷ However, even with photocoagulation, some eyes have persistent edema and visual loss. The Diabetic Retinopathy Clinical Research Network (DRCR.net) has shown that although approximately one-third of eyes treated with focal/grid photocoagulation improved by 10 or more letters at 2 years, approximately 20% lost 10 or more letters and approximately 50% still had evidence of central edema at 2 years.⁸ Other pharmacotherapeutic interventions are under investigation to determine if certain drugs, either alone, or in combination with focal/grid laser result in superior visual acuity outcomes compared with laser alone.

The vitreous has been implicated as a cause of macular edema in people with diabetes via several mechanical and physiologic mechanisms, all of which are postulated to lead to increased vascular permeability.⁹⁻³⁴ Suggested mechanisms include the following: (1) destabilization of the vitreous by abnormal glycation and crosslinking of vitreal collagen, leading to traction on the macula, (2) accumulation and concentration of factors causing vasopermeability in the premacular vitreous gel and (3) accumulation of chemoattractant factors in the vitreous, leading to cellular migration to the posterior hyaloid, contraction and macular traction.^{9, 10, 12, 14-16, 19, 23, 24, 27, 28, 30} The observation that release of mechanical traction on the macula with subsequent reduction in DME, either by spontaneous posterior vitreous detachment or with vitrectomy, lends support to this line of reasoning.^{11, 13, 14, 17, 20, 21, 25, 32} Furthermore, the evidence that vitrectomy produces improved retinal oxygenation,^{28, 29} taken together with the evidence that increased oxygenation can reduce DME,³⁵ suggests an additional physiologic advantage, potentially conferred by vitrectomy.

A prospective observational protocol was developed by the DRCR.net to evaluate visual and anatomic outcomes following vitrectomy performed without concomitant cataract surgery in eyes with DME. A primary cohort was defined that included eyes that not only had vitreomacular traction based on clinical examination by their surgeon, but also had at least moderately impaired visual acuity and definite thickening within the central subfield on optical coherence tomography (OCT). This report describes the visual acuity and OCT outcomes in this primary cohort.

Methods

The study was conducted by the DRCR.net at 50 clinical sites in the United States. The protocol and HIPAA-compliant informed consent forms were approved by multiple institutional review boards. Each subject gave written informed consent to participate in the study. The study is listed on www.clinicaltrials.gov, under identifier NCT00709319 and the protocol is available on the DRCR.net website (www.drcr.net Accessed September 2, 2009). This paper reports data collected through the 6-month primary outcome phase of the protocol with additional safety data collected through the final follow-up at 1 year. A future report will evaluate factors associated with the outcome of vitrectomy in 241 eyes with DME, including the 87 eyes in the primary cohort described in this report.

Study Population

Eligible participants had to be at least 18 years old with type 1 or type 2 diabetes. Data were collected on 241 individuals who had a vitrectomy as treatment for DME. The current study included a predefined subset of eyes that met the following criteria for the primary analysis: (1) vitreomacular traction as the indication for vitrectomy based on investigator assessment, (2) best corrected visual acuity 20/63 to 20/400 (E-ETDRS letter score between 19 and 63), (3) retinal central subfield thickness >300 microns on Stratus OCT and (4) cataract extraction not performed in conjunction with vitrectomy. Major exclusion criteria included: (1) a history of macular photocoagulation, intravitreal corticosteroids or other treatment for DME within 3.5 months prior to enrollment, (2) peripheral scatter photocoagulation within 4 months prior to enrollment, (3) prior pars plana vitrectomy, (4) other major ocular surgery (including cataract extraction, scleral buckle or other intraocular surgery) within 6 months prior to enrollment or anticipated within the 6 months following enrollment or (5) YAG capsulotomy performed within 2 months prior to enrollment. Only one eye per participant could be enrolled.

Intervention

A standard pars plana vitrectomy was performed according to the investigator's usual routine. General guidelines included: (1) three pars plana sclerotomies, (2) removal of the vitreous gel with peeling of the posterior hyaloid, if attached and removal of the peripheral vitreous leaving only a small residual vitreous skirt, (3) engagement and peeling of epiretinal membranes judged visually significant, (4) examination of the peripheral retina at the close of the procedure and treatment of peripheral breaks with laser or cryotherapy. Additional collected information included gauge of vitrectomy instrumentation and other maneuvers performed, such as removal of the internal limiting membrane, use of agents to improve visualization of membranes, use of corticosteroids at the close of the procedure and use of concomitant laser.

Follow-Up Visits

Follow-up visits were performed at 3 months, 6 months and 12 months within pre-specified time windows. At each visit, an interval history was elicited, which included medical and surgical treatment of the study eye. At baseline and at each follow-up visit, best-corrected visual acuity was measured at 3 meters by a certified tester using an electronic procedure based on the ETDRS method (E-ETDRS).³⁶ OCT images were obtained through a dilated pupil by a certified operator using the Zeiss Stratus OCT (OCT3). OCT scans were 6 mm length and included the 6 radial line pattern (fast macular scan option with OCT3 (Carl Zeiss Meditec, Dublin, CA)) for quantitative measures and the cross hair pattern (6–12 to 9–3 o'clock) for qualitative assessment of retinal morphology. Seven-field fundus photographs were obtained at baseline, 6 months and 12 months.

OCT images and fundus photographs were sent to the DRCR.net Reading Center at the University of Wisconsin-Madison for grading. Fourteen percent of the 87 baseline scans and 27% of the 155 follow-up scans were judged by the Reading Center to have inaccurate automated central subfield thickness measurements. In these cases, center point thickness was measured manually and the resultant value used to impute a value for the central subfield thickness (based on a correlation of the two measures of 0.99) as previously published.⁷ Grading of fundus photographs for proliferative diabetic retinopathy (PDR) included both active neovascularization and prior panretinal photocoagulation (PRP) even without active neovascularization.

Additional Treatment for DME

By protocol, injectable medications, focal laser or other treatments for DME were to be deferred until completion of the 6-month visit. Between 6 and 12 months, treatment of DME was at investigator discretion.

Statistical Methods

A sample size was planned to be approximately 100 eyes that met all the criteria for the primary cohort. This was a convenience sample based on the expected number of subjects to be enrolled in a given time period. However, based on actual recruitment, the 100 subject goal was not reached.

The main outcomes were best corrected visual acuity and OCT-measured central subfield thickness at 6 months. The visual acuity letter score was used for analyses; but approximate Snellen equivalents are presented to facilitate interpretation. Signed rank tests were performed on changes in central subfield thickness from baseline to follow-up visits. Missed visits were excluded from the analysis. SAS version 9.1 (Cary, NC) was used for all analyses.

Results

Between 2005 and 2008, 87 subjects who met the primary cohort criteria for this study were enrolled at 35 sites. The baseline characteristics are presented in Table 1. The presence of vitreomacular traction, as identified by the investigator, was a requirement for inclusion in this cohort. However, epiretinal membranes (ERM) were only identified as “probably” or “definitely present” by the investigator in 71% of study eyes. Presumably the vitreomacular traction was not associated with a clinically apparent ERM in the other 29%. In 27 eyes (31%), the surgeon listed “unresponsive to other therapies” as an additional indication for the vitrectomy. Surgery characteristics are presented in Table 2. Visit completion was 95% at the 3-month visit, 93% at the 6-month visit, and 90% at the 12-month visit. Four subjects died (2 before and 2 after the 6-month visit) and four subjects dropped out of the study (2 before and 2 after the 6-month visit).

Visual Acuity

Median visual acuity was approximately 20/100 at baseline, 3 months, and 6 months. At 3 months, 22% of eyes had experienced an improvement of 10 or more letters from baseline (Figure 1). Conversely, 23% of the eyes had worsened 10 or more letters from baseline. At 6 months 38% of eyes were improved by 10 or more letters (95% confidence interval 28% to 49%) and 22% had worsened by 10 or more letters (95% confidence interval 13% to 31%). Among the 18 eyes that improved by 10 or more letters from baseline to 3 months, none had additional improvement of at least 10 or more letters from 3 to 6 months. One phakic eye lost 16 letters from 3 to 6 months. Among the 19 eyes that lost 10 or more letters from baseline to 3 months, 3 eyes (16%) lost an additional 10 or more letters from 3 to 6 months. All 3 of these eyes still were phakic at 6 months. Also, among the eyes that lost 10 or more letters from baseline to 3 months, 9 (47%) gained 10 or more letters from 3 to 6 months, including 3 eyes that had cataract surgery between 3 months and 6 months after vitrectomy.

Retinal Thickness

Median retinal central subfield thickness at baseline was 491 microns (interquartile range 356 to 586 microns). At both 3 and 6 months there was a median 160 micron decrease from baseline in the central subfield thickness ($P<0.001$, Figure 2). At 3 months, 82% and 68% had a decrease in thickness from baseline of 50 and 100 microns or more, respectively while only 3 (4%) eyes experienced an increase in thickness of at least 50 microns. At 6 months,

the reduction in thickness from baseline of 50 and 100 microns or more were seen in 82% and 66% of the eyes, respectively, while 68% decreased in thickening by at least 50%. Reduction of central subfield thickness to less than 250 microns occurred in 33 eyes (43%). Eyes with greater central subfield thickness at baseline tended to have greater reduction in thickness after surgery ($P<0.001$). Results for OCT-measured retinal volume were similar to the central subfield results (data not shown).

From baseline to 3 months, 55 (81%) of 68 eyes with OCT measurements at baseline, 3 months and 6 months had a reduction in OCT central subfield of 50 microns or more, 10 (15%) changed by less than 50 microns and 3 (4%) worsened 50 microns or more. Among the 55 eyes that improved at least 50 microns from baseline to 3 months, 8 (15%) improved at least 50 more microns from 3 months to 6 months, 36 (65%) changed less than 50 microns and 11 (20%) worsened 50 microns or more. Among 10 eyes that changed less than 50 microns from baseline to 3 months, 8 changed less than 50 microns from 3 months to 6 months and 2 worsened 50 or more microns. Among 3 eyes that worsened 50 or more microns from baseline to 3 months, 2 improved 50 or more microns between 3 months and 6 months and 1 changed less than 50 microns.

The correlation between changes in OCT central subfield thickness from baseline to 6 months and changes in visual acuity during this time was -0.31 (Figure 3). Except for cases with very large decreases in central subfield thickness (>350 microns), a given decrease in OCT was associated with a wide range of changes in visual acuity.

Postoperative Complications and Treatments

Of the 87 subjects, 16 (18%) experienced postoperative complications in the first 6 months (Table 3). Of greatest importance, 4 eyes developed a vitreous hemorrhage, 2 eyes developed a retinal detachment, 1 eye developed endophthalmitis and 1 eye developed vitreous hemorrhage and retinal detachment; 4 of these 8 eyes lost 10 or more letters from baseline to 6 months. One additional eye had a retinal detachment after the first 6 months.

Twenty eight (78%) of 36 eyes that were phakic at the time of vitrectomy (by definition, the cohort did not include eyes that had cataract surgery at the time of vitrectomy) and completed 6 month visit developed lens changes by 6 months based on investigator assessment, including 5 eyes that had cataract surgery by 6 months (Table 4). Cataract surgery was performed in 12 eyes between 6 and 12 months, for a total of 17 (46%) of the 37 eyes that were phakic prior to vitrectomy having cataract surgery within 12 months following vitrectomy.

Postoperatively, no eye had PRP performed, 4 eyes had macular laser performed, 2 eyes had intravitreal injections of corticosteroid and 2 eyes received injections of anti vascular endothelial growth factor within the first 6 months.

12-month Outcomes

Between 6 months and 12 months, 20 (26%) of 78 study eyes that completed 12 month visit received some form of treatment for DME and 58 (74%) did not, including 10 eyes that received laser (including 1 eye listed below that also received intravitreal corticosteroids), 8 eyes that received intravitreal corticosteroids (including 1 eye that also received laser listed above and 1 eye that also received peribulbar steroids listed below), 2 eyes that received peribulbar steroids (including 1 eye noted above that also received intravitreal corticosteroids and 1 eye that listed below that also received intravitreal bevacizumab), and 3 eyes that received intravitreal bevacizumab (including 1 eye noted above that also received peribulbar steroids).

At one year, median visual acuity was approximately 20/80 (interquartile range 20/50 to 20/160), with 30 (38%) of the 78 eyes having improved 10 or more letters from the preoperative visual acuity and 20 (26%) having worsened 10 or more letters. Of the 29 eyes that had improved by 10 or more letters from baseline at 6 months, 22 still had 10 more letter improvement from baseline to 1 year and only 1 worsened 10 or more letters from baseline to 1 year. Of the 17 eyes that lost 10 or more letters from baseline at 6 months, 12 still had lost 10 or more letters from baseline at 1 year and only 1 had improved 10 or more letters from baseline to 1 year.

Median OCT central subfield thickness at 12 months was 256 microns (interquartile range 205 to 340 microns), with the median change from the preoperative OCT measurement being a decrease in thickness of 153 microns (interquartile range 286 to 61 microns). In 33 (47%) of the 70 eyes with a 12-month OCT, central subfield thickness was <250 microns.

Discussion

In this prospective study of 87 eyes undergoing vitrectomy for DME associated with at least moderate visual loss and investigator-determined vitreomacular traction, the median change in visual acuity at 6 months was an improvement of 3 letters, with visual acuity improving 10 or more letters from baseline to 6 months in 38% (95% confidence interval 28% to 49%) and worsening 10 or more letters in 22% (95% confidence interval 13% to 31%). Reduction in OCT central subfield thickness to <250 microns occurred in almost half, and most eyes had a reduction of thickening of at least 50%. As one might expect, eyes with greater retinal thickness at baseline tended to have greater reduction in retinal thickness following surgery likely reflecting, at least in part, a floor effect on the amount of thickness reduction that can occur when the macula is only mildly thickened. Little changes in results were noted between 6 months and one year even though additional procedures to treat DME were performed in 20 subjects and cataract surgery in 12 subjects.

With respect to safety, the surgical complication rate, including vitreous hemorrhage, retinal detachment or other serious adverse events, was similar to what has been reported for this procedure.^{9, 10, 12–19, 22–27, 30–34, 37} Most phakic eyes developed lens changes by 6 months after vitrectomy, which may account for some decrease in visual acuity between 3 and 6 months.

The surgical techniques recorded appear to mirror recent vitreoretinal surgical practice trends in North America,³⁸ characterized by the increased use of smaller gauge vitrectomy systems, injection of triamcinolone acetate and other agents to aid in intraoperative visualization of membranes and widespread use of epiretinal and internal limiting membrane peeling in the treatment of patients with macular disorders. However, the relative benefits or risks of these preferences on visual acuity outcomes remain unknown.

There are several strengths to this study, including the prospective collection of visual acuity and anatomic outcomes following vitrectomy for DME in the presence of vitreoretinal traction. This is also the first large surgical series to have OCT measurements at baseline and during follow-up. Other strengths of this study include uniform entry criteria and greater than 90% follow-up through 6 months. Although this study did not mandate standardizing the precise surgical maneuvers used, data regarding the details of surgery were acquired in a standardized fashion.

A potential study weakness is that the assessment of the presence or absence of vitreomacular traction was made by the individual investigators based on their clinical judgment, without standardized criteria and without central reading center assessment or independent confirmation. However, the lack of centralized assessment may have more

generalizability when applying these results to clinical practice, where there generally is no independent confirmation of vitreomacular traction.

The lack of a concurrent control group also is a study weakness. Our study was designed as a prospective cohort investigation rather than as a randomized trial of vitrectomy versus laser or observation because of a lack of equipoise on the part of the participating surgeons, who were uncomfortable randomizing eyes with traction and decreased vision to a non-vitrectomy trial arm.

The study protocol to defer macular photocoagulation until after 6 months may also have affected the visual acuity and retinal thickness outcomes. In addition, approximately two-thirds of these cases had PDR. It is possible that the visual outcome for cases with this degree of vascular compromise or retinal ischemia associated with PDR is worse than DME treatments in the absence of PDR. Also, many of these eyes may have had limited potential for improvement and a relatively high chance of losing vision due to complications of PDR or associated capillary non-perfusion in the macula. Even though approximately 40% of the study eyes received PRP intraoperatively, which in the setting of pre-existing DME might have exacerbated the macular edema; very few eyes had an increase in edema. Among the eyes that received PRP, the average change in OCT from baseline to 6 months appeared similar to the average change in eyes that did not receive PRP. An additional consideration may be that eyes in the study had relatively poor visual acuity (median 20/100) and a relatively thickened macula (median central subfield thickness 491 microns) at the time of vitrectomy. Perhaps earlier intervention in these compromised eyes would have improved visual results.

There are few reports in the literature with which to compare these DRCR.net results. Hikichi et al reported a series of 53 consecutive non-diabetic eyes followed with vitreomacular traction in the pre-OCT era,³⁹ 64% of which lost 2 or more lines of vision over the course of follow-up. In the absence of a spontaneous peripheral vascular disease in this series, 87% lost vision at the final visit. Since the report by Smiddy et al in 1988 describing successful surgery for non-diabetic eyes with macular traction and visual decrease,⁴⁰ many surgeons have elected to operate rather than to follow patients with evident vitreomacular traction and significant visual impairment. The report by Lewis et al in 1992 and subsequent series extended this surgical indication to include diabetic patients with evidence of tangential hyaloidal traction.¹⁷ This study did not examine the impact of vitrectomy for DME when traction was not identified by the investigator. Reports in the literature on vitrectomy for such eyes, in the absence of traction, include mixed visual acuity results. While some studies suggested positive outcomes,^{9, 14, 16, 30, 33} recent studies have shown anatomical but not visual improvement after surgery.^{10, 19, 24}

In summary, this report adds prospective visual acuity and OCT data to our understanding of the effect of vitrectomy on DME in eyes with visual acuity 20/63 to 20/400 in the presence of vitreomacular traction and central subfield thickening confirmed on OCT, when cataract surgery is not performed at vitrectomy. Vitrectomy performed for this indication with the techniques reported herein usually resulted in a reduction in macular thickening. Visual acuity results were less consistent with some eyes improving (estimated between 28% to 49%) and some eyes worsening (estimated between 13% to 31%). Whether vitrectomy provides an improvement over other therapies or over the natural history of DME in this setting requires further investigation.

Acknowledgments

Supported through a cooperative agreement from the National Eye Institute and the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Department of Health and Human Services EY14231, EY14269, EY14229

References

1. Aiello LP, Bursell SE, Clermont A, et al. Vascular endothelial growth factor-induced retinal permeability is mediated by protein kinase C in vivo and suppressed by an orally effective beta-isoform-selective inhibitor. *Diabetes* 1997;46:1473–80. [PubMed: 9287049]
2. Klein R, Klein BE, Moss SE, Cruickshanks KJ. The Wisconsin epidemiologic study of diabetic retinopathy. XV. The long-term incidence of macular edema. *Ophthalmology* 1995;102:7–16. [PubMed: 7831044]
3. Moss SE, Klein R, Klein BE. Ten-year incidence of visual loss in a diabetic population. *Ophthalmology* 1994;101:1061–70. [PubMed: 8008348]
4. Moss S, Klein R, Klein B. The 14-year incidence of visual loss in a diabetic population. *Ophthalmology* 1998;105:998–1003. [PubMed: 9627648]
5. Diabetic Retinopathy Clinical Research Network. A randomized trial comparing intravitreal triamcinolone acetonide and focal/grid photocoagulation for diabetic macular edema. *Ophthalmology* 2008;115:1447–9. 1449, e1–10. [PubMed: 18662829]
6. Early Treatment Diabetic Retinopathy Study Research Group. Photocoagulation for diabetic macular edema. Early Treatment Diabetic Retinopathy Study report number 1. *Arch Ophthalmol* 1985;103:1796–806. [PubMed: 2866759]
7. Fong DS, Strauber SF, et al. Writing Committee for the Diabetic Retinopathy Clinical Research Network. Comparison of the modified Early Treatment Diabetic Retinopathy Study and mild macular grid laser photocoagulation strategies for diabetic macular edema. *Arch Ophthalmol* 2007;125:469–80. [PubMed: 17420366]
8. Ip MS, Bressler SB, Antoszyk AN, et al. A randomized trial comparing intravitreal triamcinolone and laser photocoagulation for diabetic macular edema: Baseline features. *Retina* 2008;28:919–30. [PubMed: 18698292]
9. Dillinger P, Mester U. Vitrectomy with removal of the internal limiting membrane in chronic diabetic macular oedema. *Graefes Arch Clin Exp Ophthalmol* 2004;42:630–7. [PubMed: 15221304]
10. Figueroa MS, Contreras I, Noval S. Surgical and anatomical outcomes of pars plana vitrectomy of diffuse nontractional diabetic macular edema. *Retina* 2008;28:420–6. [PubMed: 18327133]
11. Foos RY, Kreiger AE, Forsythe AB, Zakka KA. Posterior vitreous detachment in diabetic subjects. *Ophthalmology* 1980;87:122–8. [PubMed: 7383541]
12. Gandorfer A, Messmer EM, Ulbig MW, Kampik A. Resolution of diabetic macular edema after surgical removal of the posterior hyaloid and the inner limiting membrane. *Retina* 2000;20:126–33. [PubMed: 10783944]
13. Harbour JW, Smiddy WE, Flynn HW Jr, Rubsamen PE. Vitrectomy for diabetic macular edema associated with a thickened and taut posterior hyaloid membrane. *Am J Ophthalmol* 1996;121:405–13. [PubMed: 8604734]
14. Ikeda T, Sato K, Katano T, Hayashi Y. Vitrectomy for cystoid macular edema with attached posterior hyaloid membrane in patients with diabetes. *Br J Ophthalmol* 1999;83:12–4. [PubMed: 10209427]
15. Kuhn F, Kiss G, Mester V, et al. Vitrectomy with internal limiting membrane removal for clinically significant macular oedema. *Graefes Arch Clin Exp Ophthalmol* 2004;42:402–8. [PubMed: 14986010]
16. La Heij EC, Hendrikse F, Kessels AGH, Derhaag PJFM. Vitrectomy results in diabetic macular oedema without evident vitreomacular traction. *Graefes Arch Clin Exp Ophthalmol* 2001;39:264–70. [PubMed: 11450490]

17. Lewis H, Abrams GW, Blumenkranz MS, Campo RV. Vitrectomy for diabetic macular traction and edema associated with posterior hyaloidal traction. *Ophthalmology* 1992;99:753–9. [PubMed: 1594222]
18. Micelli Ferrari T, Cardascia N, Durante G, et al. Pars plana vitrectomy in diabetic macular edema. *Documenta Ophthalmologica* 1999;97:471–4. [PubMed: 10896366]
19. Mochizuki Y, Hata Y, Enaida H, et al. Evaluating adjunctive surgical procedures during vitrectomy for diabetic macular edema. *Retina* 2006;26:143–8. [PubMed: 16467668]
20. Nasrallah FP, Jalkh AE, Van Coppenolle F, et al. The role of the vitreous in diabetic macular edema. *Ophthalmology* 1988;95:1335–9. [PubMed: 3226682]
21. Nasrallah FP, Van De Velde F, Jalkh AE, et al. Importance of the vitreous in young diabetics with macular edema. *Ophthalmology* 1989;96:1511–6. [PubMed: 2587046]
22. Otani T, Kishi S. Tomographic assessment of vitreous surgery for diabetic macular edema. *Am J Ophthalmol* 2000;129:487–94. [PubMed: 10764858]
23. Otani T, Kishi S. A Controlled study of vitrectomy for diabetic macular edema. *Am J Ophthalmol* 2002;134:214–9. [PubMed: 12140028]
24. Patel JI, Hykin PG, Schadt M, et al. Pars plana vitrectomy with and without peeling of the inner limiting membrane for diabetic macular edema. *Retina* 2006;26:5–13. [PubMed: 16395132]
25. Pendergast SD, Hassan TS, Williams GA, et al. Vitrectomy for diffuse diabetic macular edema associated with a taut premacular posterior hyaloid. *Am J Ophthalmol* 2000;130:178–86. [PubMed: 11004291]
26. Radetzky S, Walter P, Fauser S, et al. Visual outcome of patients with macular edema after pars plana vitrectomy and indocyanine green assisted peeling of the internal limiting membrane. *Graefes Arch Clin Exp Ophthalmol* 2004;42:273–8. [PubMed: 15042375]
27. Sato Y, Lee Z, Shimada H. Vitrectomy for diabetic cystoid macular edema. *Jpn J Ophthalmol* 2002;46:315–22. [PubMed: 12063043]
28. Stefansson E, Landers MBI, Wolbarsht ML. Increased retinal oxygen supply following pan-retinal photocoagulation and vitrectomy and lensectomy. *Tr Am Ophth Soc* 1981;79:307–34. [PubMed: 7200671]
29. Stefansson E, Novack RL, Hatchell D. Vitrectomy prevents retinal hypoxia in branch retinal vein occlusion. *Invest Ophthalmol Vis Sci* 1990;31:284–9. [PubMed: 2303330]
30. Tachi N, Ogino N. Vitrectomy for diffuse macular edema in cases of diabetic retinopathy. *Am J Ophthalmol* 1996;122:258–60. [PubMed: 8694095]
31. Takagi H, Otani A, Kiryu J, Ogura Y. New surgical approach for removing massive foveal hard exudates in diabetic macular edema. *Ophthalmology* 1999;106:249–57. [PubMed: 9951473]
32. Yamamoto T, Akabane N, Takeuchi S. Vitrectomy for diabetic macular edema: The role of posterior vitreous detachment and epimacular membrane. *Am J Ophthalmol* 2001;132:369–77. [PubMed: 11530050]
33. Yamamoto T, Hitani K, Tsukahara I, et al. Early postoperative retinal thickness changes and complications after vitrectomy for diabetic macular edema. *Am J Ophthalmol* 2003;135:14–9. [PubMed: 12504691]
34. Yang CM. Surgical treatment for severe diabetic macular edema with massive hard exudates. *Retina* 2000;20:121–5. [PubMed: 10783943]
35. Nguyen QD, Shah SM, Van Anden E, et al. Supplemental oxygen improves diabetic macular edema: A pilot study. *Invest Ophthalmol Vis Sci* 2004;45:617–24. [PubMed: 14744906]
36. Beck RW, Moke PS, Turpin AH, et al. A computerized method of visual acuity testing: adaptation of the early treatment of diabetic retinopathy study testing protocol. *Am J Ophthalmol* 2003;135:194–205. [PubMed: 12566024]
37. Kumagai K, Furukawa M, Ogino N, et al. Long-term follow-up of vitrectomy for diffuse nontraction diabetic macular edema. *Retina* 2009;29:464–72. [PubMed: 19289987]
38. American Society of Retina Specialist. PAT Survey. 2008
39. Hikichi T, Yoshida A, Trempe CL. Course of vitreomacular traction syndrome. *Am J Ophthalmol* 1995;119:55–61. [PubMed: 7825690]

40. Smiddy WE, Michels RG, Glaser BM, deBustros S. Vitrectomy for macular traction caused by incomplete vitreous separation. *Arch Ophthalmol* 1988;106:624–8. [PubMed: 3358728]

Appendix

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Sites are listed in order by number of subjects enrolled into the study. The number of subjects enrolled is noted in parenthesis preceded by the site location and the site name. Personnel are listed as (I) for Investigator, (C) for Coordinator, (V) for Visual Acuity Tester and (P) for Photographer.

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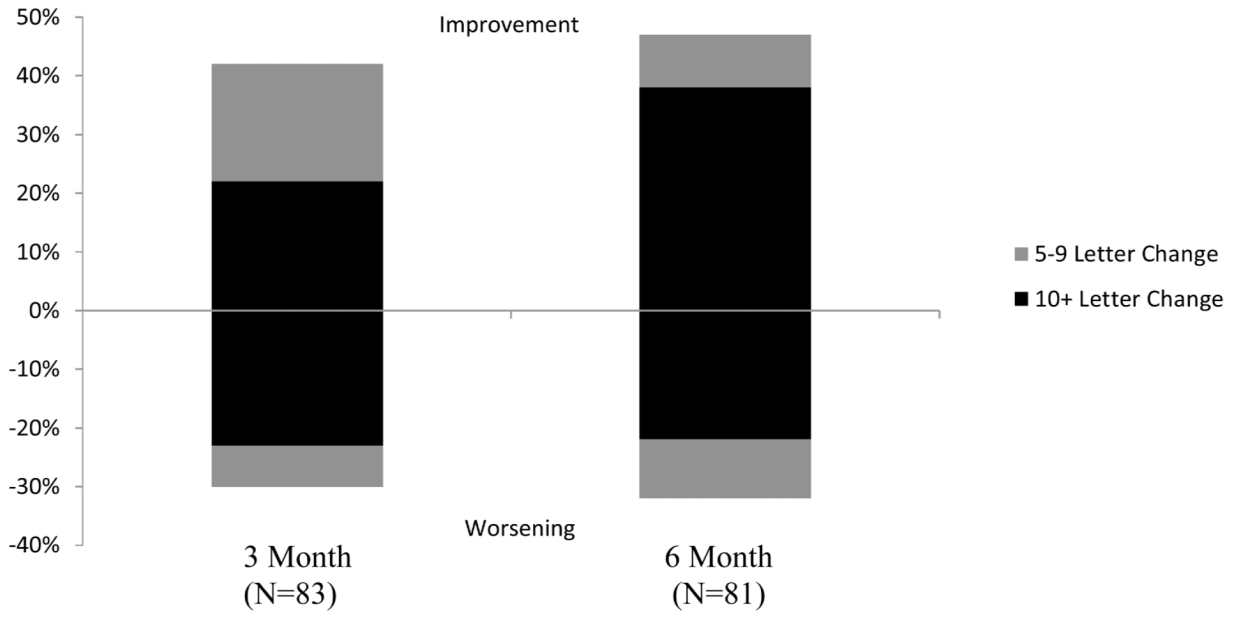


Figure 1.
Distribution of Change in Visual Acuity from Baseline

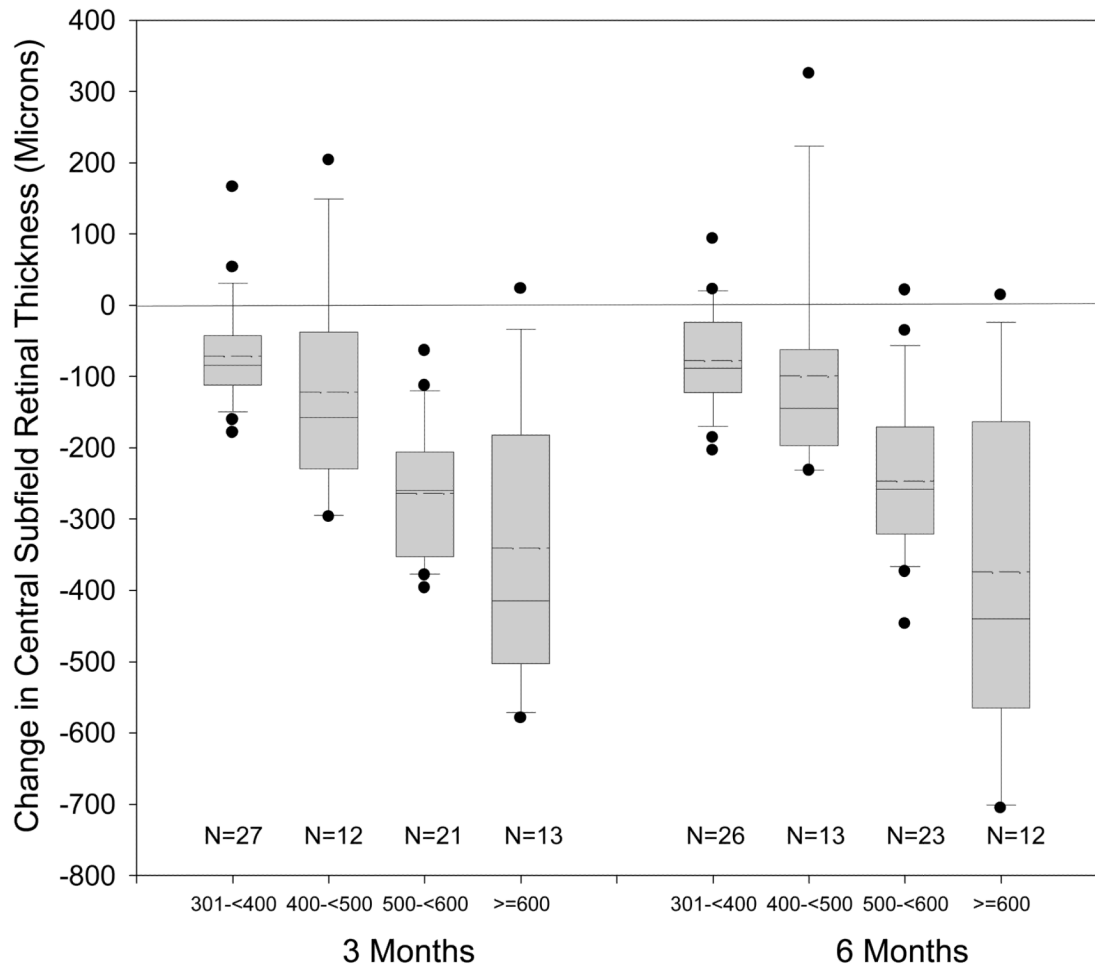


Figure 2. Distribution of Change in optical coherence tomography (OCT) Central Subfield Thickness in Categories According to Baseline Thickness
Box-whisker plot demonstrating mean (dashed horizontal line), median (solid horizontal line), 25 – 75th percentiles (extremes of the box), 10–90th percentiles (whiskers) and 5–95th percentiles (solid circles) of change in optical coherence tomography (OCT) central subfield.

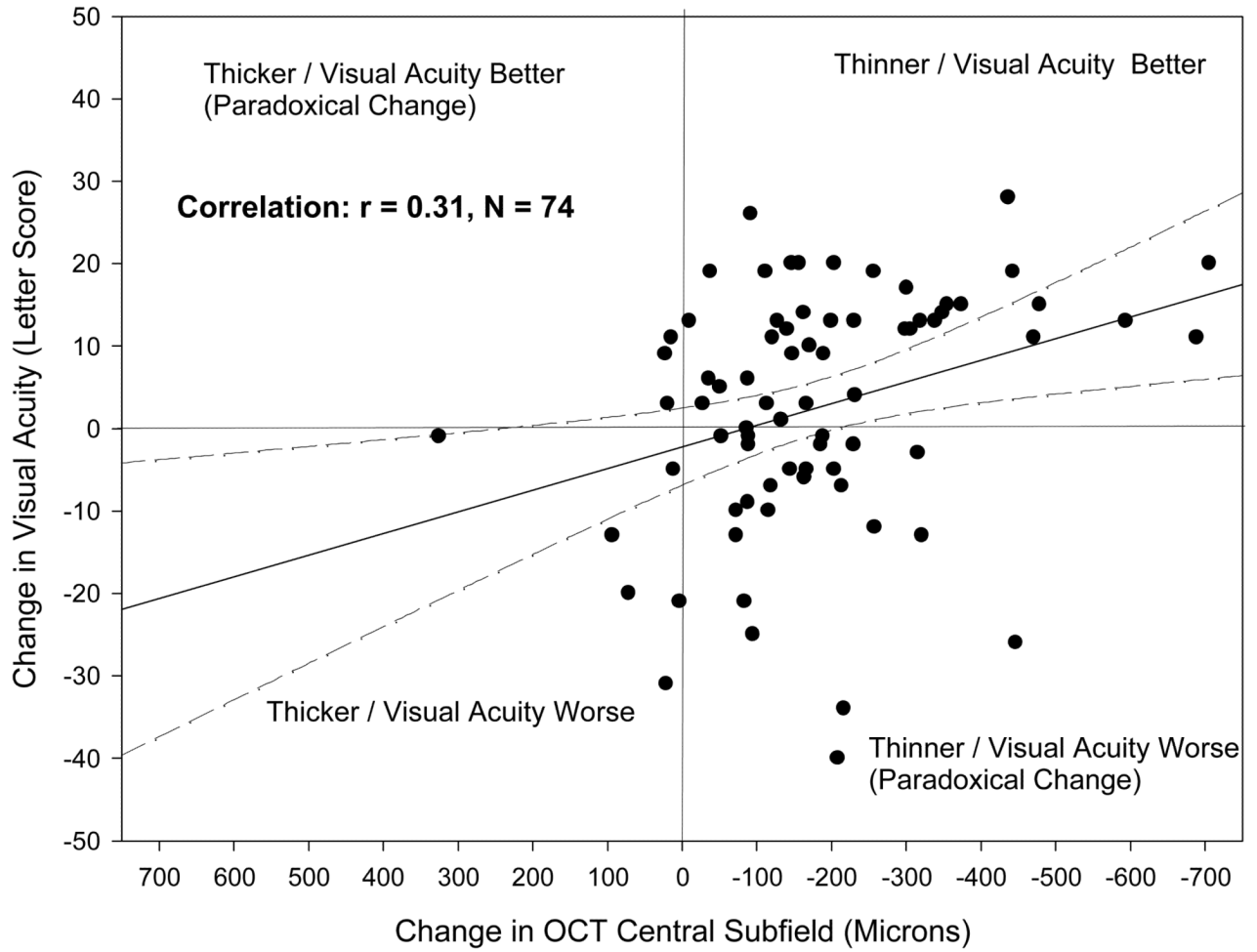


Figure 3.

Comparison of Change in Optical Coherence Tomography (OCT) Central Subfield and Change in Visual Acuity from Baseline to 6 Months. The solid line represents the regression line and the dotted lines represent the 95% confidence interval for the mean.

Table 1

Baseline Characteristics (N=87)

Gender: Women - n (%)	39 (45%)
Age (yrs) - Median (25th, 75th percentile)	66 (60, 72)
Race - n (%)	
White	69 (79%)
African-American	7 (8%)
Hispanic	5 (6%)
Other	6 (7%)
Diabetes Type - n (%)	
Type 1	14 (16%)
Type 2	73 (84%)
Duration of Diabetes (years) -	
Median (25 th , 75 th percentile)	20 (12, 25)
HbA1c (%) -	
Median (25 th , 75 th percentile)	7.1 (6.7, 7.9)
Prior treatment for DME* - n (%)	51 (59%)
Macular photocoagulation	38 (44%)
Intravitreal corticosteroid	26 (30%)
Peribulbar corticosteroid	3 (3%)
Other	4 (5%)
E-ETDRS Visual Acuity letter score (Snellen equivalent)	
Median	52 (20/100)
75 th , 25 th percentile	41, 58 (20/80, 20/160)
63 to 54 (20/63 to 20/80)	37 (43%)
53 to 44 (20/100 to 20/125)	25 (29%)
43 to 19 (20/160 to 20/400)	25 (29%)
Central Subfield Thickness[‡] (microns) -	
Median (25 th , 75 th percentile)	491 (356, 586)
301 to <400	28 (34%)
400 to <500	15 (18%)
500 to <600	24 (29%)
≥600	16 (19%)
Retinal Volume (mm³) -	
Median (25 th , 75 th percentile)	9.2 (8.5, 11.8)
Retinopathy Severity[‡] - n (%)	
Microaneurysms only	1 (1%)
Mild/Moderate NPDR	6 (8%)
Moderate Severe NPDR	14 (18%)
Severe NPDR	4 (5%)
PDR	51 (67%)

Prior Scatter Photocoagulation - n (%)	39 (45%)
Lens Status - n (%)	
Phakic	37 (43%)
Pseudophakic/Aphakic	50 (57%)
Epiretinal Membranes Present^{//} - n (%)	
No	21 (24%)
Probable	19 (22%)
Definite	43 (49%)
Cannot determine	4 (5%)
Status of vitreous^{//} - n (%)	
Attached	49 (56%)
Partially attached	28 (32%)
Detached	5 (6%)
Uncertain	5 (6%)
Reasons for Vitrectomy* - n (%)	
Vitreomacular interface abnormality	87 (100%)
Unresponsive to other therapies	27 (31%)

* Same subjects could be listed for multiple reasons

[†] Missing for 4 eyes

[‡] Missing for 11 eyes

^{//} From investigator's observations at enrollment

ETDRS= Early Treatment Diabetic Retinopathy Study, DME=Diabetic macular edema, NPDR = nonproliferative diabetic retinopathy, PDR = proliferative diabetic retinopathy

Table 2

Surgery Characteristics (N=87)

Vitreotomy System - n (%)	
19/20 gauge	35 (40%)
25 gauge	43 (49%)
23 gauge	9 (10%)
Epiretinal Membrane Peeled - n (%)	
	53 (61%)
Internal Limiting Membrane Removed - n (%)	
	47 (54%)
Agents Used to Improve Visualization* - n (%)	
	52 (60%)
Triamcinolone acetonide	30 (34%)
Indocyanine Green	24 (27%)
Trypan Blue	2 (2%)
Laser Used[†] - n (%)	
	48 (55%)
Focal to break(s)	14 (16%)
Panretinal photocoagulation, no prior PRP	19 (22%)
Panretinal photocoagulation, prior PRP	16 (18%)
Focal/grid to DME	4 (5%)
With endoprobe	21 (24%)
With laser indirect ophthalmoscope	7 (8%)
Other ^{**}	4 (5%)
Peripheral Cryotherapy Given - n (%)	
No	80 (92%)
Yes, not treated for breaks	6 (7%)
Yes, treated for breaks	1 (1%)
Corticosteroids Used at Close* - n (%)	
	56 (64%)
Intravitreal	37 (43%)
Peribulbar	4 (5%)
Subtenon's	13 (15%)
Subconjunctival	18 (21%)
Lens Removed - n (%)	
	0
Posterior Capsulotomy Performed - n (%)	
	7 (8%)
Epiretinal Membrane Present	
No	31 (36%)
Probable	13 (15%)
Definite	43 (49%)
Status of Vitreous	
Attached	59 (68%)
Partially attached	22 (25%)
Detached	5 (6%)
Uncertain	1 (1%)
Complications from Vitrectomy - n (%)	
Anesthesia complications	0

Surgical complications 6 (7%)

* Same subjects could be listed for multiple categories

† Laser technique was not recorded on the study data form in all cases

** Includes scatter over peripheral schisis (N=1), barrier laser (N=3).

PRP= Panretinal photocoagulation

Table 3

Postoperative Complications (0 to 6 months, N=87)*

Postoperative complications - N (%)	16 (18%)
Vitreous hemorrhage	5 (6%)
Development of additional vitreomacular interface abnormalities	2 (2%)
Elevated IOP requiring treatment	7 (8%)
Retinal detachment	3 (3%)
Retinal tear	0
Endophthalmitis	1 (1%)
Macular ischemia	0
Double vision	2 (2%)
Lamella hole	1 (1%)
Choroidal effusion	1 (1%)
Other	2 (2%)

* Same subject could have more than one complication

IOP=Intraocular pressure

Table 4

Investigator assessment of lens changes from baseline to 6 months in eyes phakic at baseline* (N=36**)

Baseline	6 Month			Cataract Extraction
	Absent	Present <standard	Present >=standard	
Nuclear Sclerosis (N=36)				
Absent	1 (3%)	1 (3%)	0	1 (3%)
Present < standard	0	13 (36%)	8 (22%)	4 (11%)
Present >= standard	0	2 (6%)	6 (17%)	0
Posterior Subcapsular Cataract (N=36)				
Absent	15 (42%)	6 (17%)	3 (8%)	4 (11%)
Present < standard	1 (3%)	4 (11%)	1 (3%)	1 (3%)
Present >= standard	0	0	1 (3%)	0
Cortical Cataract (N=36)				
Absent	12 (33%)	6 (17%)	0	3 (8%)
Present < standard	4 (11%)	7 (19%)	2 (6%)	2 (6%)
Present >= standard	0	0	0	0
Highest grade among all 3 types of lens opacity				
Absent	1 (3%)	0	0	1 (3%)
Present < standard	0	14 (39%)	8 (22%)	4 (11%)
Present >= standard	0	2 (6%)	6 (17%)	0

* Bold cells represent cataract progression. By definition of the cohort, no eyes had cataract extraction at the time of vitrectomy.

** One eye that was phakic at baseline did not complete 6 month visit.