Published in final edited form as:

Am J Ophthalmol. 2010 September ; 150(3): 338–345. doi:10.1016/j.ajo.2010.04.009.

1-year outcomes after retinal detachment surgery among Medicare beneficiaries

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Abstract

Purpose—To determine longitudinal rates of second retinal detachment operation and postoperative adverse outcomes after retinal detachment surgery in a nationally representative sample of older Americans.

Design—Retrospective, longitudinal cohort analysis.

Methods—9,216 Medicare beneficiaries were identified from the Medicare 5% sample who were diagnosed with rhegmatogenous retinal detachment and underwent primary pars plana vitrectomy (PPV), scleral buckle, pneumatic retinopexy, or laser photocoagulation or cryotherapy alone. Rhegmatogenous retinal detachment, PPV, scleral buckle, pneumatic retinopexy, or laser photocoagulation/cryotherapy was ascertained from International Classification of Diseases and Current Procedural Terminology procedure codes. Rates of second retinal detachment operation and postoperative adverse outcomes were analyzed by cumulative incidence and logistic regression to control for prior adverse outcome measures and demographic factors.

Results—At 1-year follow-up, the rate of receipt of a second retinal detachment operation for beneficiaries who had undergone primary pneumatic retinopexy was much higher (40.6%, $p < 0.0001$) relative to the scleral buckle (19.2%) group. After controlling for demographic variables and ocular comorbidities, pneumatic retinopexy individuals were nearly 3 times more likely to receive a second retinal detachment surgery than scleral buckle individuals. No significant differences exist in risk of second retinal detachment surgery for the PPV compared to the scleral buckle group. Individuals receiving PPV were 2 times more likely to suffer adverse outcomes than were persons undergoing scleral buckle. Results were robust in sensitivity analysis.

Conclusions—Rates of second operation were much higher after pneumatic retinopexy than PPV or scleral buckle, and rates of adverse outcomes were higher in PPV, even after controlling for risk factors and demographic variables.

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Introduction

The incidence of rhegmatogenous retinal detachment (RD), the most common type of retinal detachment, varies between 12.9 to 17.9 per 100,000 persons per year.^{1, 2} The 5 primary interventions currently used to repair RRD are scleral buckle,¹ pars plana vitrectomy (PPV),² pneumatic retinopexy, combined PPV/scleral buckle, and laser and/or cryotherapy alone for simple, limited detachments.^{3–5} While scleral buckle is still considered to be the “gold standard” for repair of rhegmatogenous RD, PPV and pneumatic retinopexy have become increasingly popular in the last 2 or 3 decades, particularly with advances in wide-angle viewing systems, perfluorocarbon liquids, vitrectomy machines, endolaser, and intraocular gas tamponade.⁶ The purported advantages of primary PPV are improved internal search for retinal breaks, elimination of vitreous traction, and removal of the vitreous as a stimulant for proliferative vitreoretinopathy, while scleral buckling relieves circumferential traction at the vitreous base and avoids post-vitrectomy cataract progression and glaucoma.^{7, 8} Unlike scleral buckling and PPV which must be performed in the operating room, pneumatic retinopexy involves creation of retinopexy around retinal breaks with laser or cryotherapy followed by intraocular gas injection and can be performed in the clinic. Pneumatic retinopexy is considered to be most successful for primary retinal reattachment in phakic patients with limited superior retinal breaks who can cooperate with post-procedure head positioning.⁹

As surgical practices evolve over time, it is helpful to have additional information about surgical outcomes and adverse events associated with each type of retinal detachment repair. The choice of initial surgical intervention is the most important predictor of primary anatomic success and final visual outcome.¹⁰ The vast majority of studies examining the success of retinal detachment repair have been single center case series. There have been 4 prospective randomized controlled trials comparing primary PPV vs. scleral buckle,^{6, 7, 11, 12} and 1 randomized trial examining pneumatic retinopexy vs. scleral buckle.¹³ This study adds to existing evidence on success of different types of retinal detachment repair by examining data from a nationally representative longitudinal database spanning 17 years with 1 year of follow-up on each Medicare beneficiary. The 17-year span allowed us to examine cohort effects and test the efficacy of these procedures comparing the most recent with earlier periods. This represents the largest reported sample of American patients undergoing retinal detachment repair, and offers the advantage of reducing surgeon- and center-specific factors.

Methods

Data

For this retrospective, longitudinal cohort analysis, Medicare 5% inpatient, outpatient, Part-B, and durable medical equipment claims files were used to identify a nationally representative sample of Medicare beneficiaries aged 67+ years undergoing retinal repair surgery and related adverse outcomes during 1991–2007. The 5% sample is created by selecting records with 05, 20, 45, 70 or 95 in positions 8 and 9 of the Health Insurance Claim number. In any given year, there are approximately 1.5 million individuals in the 5% sample. The data contained information on beneficiaries' demographic characteristics, diagnostic (International Classification of Diseases, 9th Revision, Clinical Modification, ICD-9-CM), and procedural codes (Current Procedural Terminology, CPT-4; Healthcare Common Procedure Coding System, HCPCS) submitted with claims. Data were linked by a unique identifier, permitting construction of longitudinal, person-specific data from January 1, 1991 through December 31, 2007.

Sample Selection

We identified all individuals undergoing a pars plana vitrectomy (PPV; CPT-4: 67108, 67036), scleral buckle (67107), pneumatic retinopexy (67110), and retinal repair surgery (laser photocoagulation, diathermy, or cryotherapy: laser/cryotherapy) (67101, 67105) between 1993 and 2007. Individuals who were coded under CPT code 67108 underwent a PPV “with or without” scleral buckle, and would have been categorized in our study as PPV.

We employed a 2-year look-back period to ensure that the individual had a previous diagnosis of rhegmatogenous retinal detachment (ICD-9-CM: 361.0x) to account for eye-related comorbidities, and to ensure that the surgery was the first retinal repair procedure an individual had undergone. We excluded all individuals receiving a first study surgical procedure before age 67 or after age 95, individuals receiving a code for the following vitrectomy procedures on the same day as their first retinal detachment procedure (67039, 67040, 67041, 67042, 67043) as these codes are generally associated with treatment of diabetic retinopathy, macular holes, and epiretinal membranes, persons diagnosed with proliferative diabetic retinopathy (PDR: ICD-9-CM: 362.02), tractional retinal detachment (361.81), chorioretinitis (363.0x, 363.1x, 363.2x), ruptured globe (871.0, 871.1, 871.2), presence of an intraocular foreign body (360.5x, 360.6x, 871.5, 871.6), or Stickler’s disease (756.0), and beneficiaries who entered a Medicare risk plan or who lived outside of the U.S. for 12+ months during the look-back period. We also excluded individuals undergoing a PPV and SB procedure (n=80) on the same day because we lacked statistical power to analyze this group.

Individuals were classified into 4 mutually exclusive categories based on their initial retinal detachment procedure: PPV, scleral buckle, pneumatic retinopexy, and laser/cryotherapy alone. Any persons undergoing either laser/cryotherapy or pneumatic retinopexy who also had another retinal repair the same day were classified by the more complex procedure (e.g., PPV or scleral buckle). Overall, our sample was slightly older (0.5 years older), and had a higher percentage of males and Whites than the Medicare 5% sample from which our sample was drawn.

We followed individuals for 1 year after the initial retinal repair procedure or until censored. Individuals were censored if they died during follow-up, received another retinal repair procedure, or if they received *any* intraocular procedure, ensuring complications occurring after the receipt of a second procedure were not misattributed to the initial retinal repair procedure.

Adverse Events

Adverse events were identified using ICD-9-CM, CPT, and HCPCS Codes. Complications were classified into 2 groups—adverse outcomes (endophthalmitis (ICD-9-CM: 361.0), hypotony (360.30, 360.31, 360.32, 360.33), phthisis (360.40, 360.41, 360.42), moderate vision loss (369.6, 369.6x, 369.7, 369.7x, 369.8, 369.9), severe vision loss (369.4, 369.1, 369.1x, 369.2, 369.2x, 369.3), blindness/low vision aids (369.0, 369.0x; CPT-4: 92392; HCPCS: V2600, V2610, V2615)) and additional surgical procedures—receipt of another PPV, scleral buckle, pneumatic retinopexy, laser/cryotherapy, or recurrent retinal repair (CPT-4: 67112).

Severity

Using the look-back period, we created a continuous variable for severity of the rhegmatogenous retinal detachment, with least severe set to 1 (ICD-9-CM: 361.0, 361.00, 361.01; Table 1), moderately severe set to 2 (361.02, 361.03, 361.04), and most severe receiving a 3 (361.05, 361.06, 361.07) (Table 1). Persons receiving more than 1

rhegmatogenous retinal detachment diagnosis in multiple severity categories were coded with the most severe diagnosis they received during the look-back period.

Additional Covariates

To account for other eye comorbidities present at the time of surgery, we included covariates for prior diagnosis of: cataract (ICD-9-CM: 366.0); myopia (360.21, 367.1); lattice degeneration (362.63); proliferative vitreoretinopathy (PVR: 362.2x); visual impairment (see *Adverse Events*); and a severe complication (see *Adverse Events*), receipt of a prior intraocular procedure, and receipt of a cataract extraction surgery (CPT-4: 66830-66984, ICD-9-CM: V45.61, including a diagnosis of pseudophakia (V43.1) or aphakia (379.31)).

Cohort Variables

We created 3 separate variables identifying the time period in which the procedures were performed to examine whether or not complication rates or additional operation rates changed over time. Individuals undergoing a retinal repair procedure from 1993–1997 were Cohort 1. Cohort 2 was composed of those receiving a procedure from 1998–2002, and Cohort 3 was defined as persons receiving a procedure from 2003–2006. Sample sizes by cohort were 3,554, 3,192, and 2,550 for Cohort 1, 2, and 3, respectively.

Analysis

Using the 5 mutually exclusive categories described above, we performed student T-tests to examine whether or not statistically significant differences existed at baseline, using scleral buckle as the comparison group, and subsequently considering second retinal detachment operation/adverse outcome rates among the procedure groups. We then used logit analysis to determine whether or not second operation and adverse outcome rates differed by procedure type, adjusting for baseline characteristics and comorbid eye conditions.

We performed a sensitivity analysis, assigning individuals with only 1 diagnosis of an adverse event a 1, individuals with 2+ diagnoses of adverse events a 2, and all others a 0. We performed ordered logit analysis to determine whether or not requiring 2 diagnoses of an adverse outcome affected our results. Because of the small number of adverse events with 2+ diagnoses of adverse events ($n=77$), we did not perform a simple logit analysis. The Duke University Institutional Review Board approved this study.

Results

In the 5% random sample of Medicare beneficiaries from 1991 to 2007, 9,216 beneficiaries were identified with a diagnosis of rhegmatogenous retinal detachment who also satisfied the study's eligibility criteria. Compared to the scleral buckle group (1.972), the severity of retinal detachment was significantly lower for the pneumatic retinopexy (1.785, $p<0.0001$) and the laser/cryotherapy groups (1.597, $p<0.0001$), and slightly higher for the PPV group (2.016, $p=0.048$; Table 2). Individuals undergoing PPV were more likely to have received a prior diagnosis of PVR (2.3% vs. 0.6%; $p<0.0001$) than scleral buckle patients. In terms of lens status, patients undergoing laser/cryotherapy were more likely to have cataract (44.9%, $p=0.021$) than patients undergoing scleral buckle (41.2%). The PPV group (53.5%, $p<0.0001$) was more likely to have undergone cataract surgery in the previous two years, while the pneumatic retinopexy group (39.7%, $p=0.001$) was less likely to have undergone cataract surgery in the previous two years than the scleral buckle group (45.2%). Persons undergoing pneumatic retinopexy had the lowest rate of lattice degeneration of any group (1.1%, $p=0.04$). Persons undergoing PPV were significantly more likely to have received prior intraocular procedures (14.7% vs. 6.2%; $p<0.0001$), and severe complications (3.2% vs. 0.6%; $p<0.0001$) than were patients undergoing scleral buckle. Medicare beneficiaries

undergoing the 5 different primary procedures were not significantly different in terms of gender. Persons undergoing pars plana vitrectomy and scleral buckle were slightly older on average than were those undergoing pneumatic retinopexy and laser/cryotherapy. Those undergoing PPV had a greater likelihood of receiving Medicaid coverage compared to those undergoing scleral buckle (7.7% vs. 5.2%; $p<0.0001$).

Complication rates were divided into additional retinal detachment operation and adverse outcomes. The latter was subdivided into severe complications (endophthalmitis, hypotony, and phthisis) and visual impairment (moderate vision loss, severe vision loss, and blindness). Compared to scleral buckle (19.2%), rates of second retinal detachment operation were highest for pneumatic retinopexy (40.6%; $p<0.001$), slightly higher for PPV (21.2%; $p=0.044$), and lower for laser/cryotherapy (17.2%; $p=0.043$). If a second operation was performed, it was most likely to be PPV for all therapeutic categories except laser/cryotherapy. Rates of adverse outcomes overall (3.5%; $p=0.0001$) and severe complications (1.2%; $p=0.0001$) were highest for PPV (Table 3). The only cases of hypotony occurred in the PPV group. Rates of visual impairment were also highest for the PPV group (2.6%; $p=0.002$), whether it was moderate or severe vision loss or blindness (Table 3).

Logit analysis of second retinal detachment surgery was performed to control for demographic factors and pre-existing eye comorbidities. Even after controlling for these factors, the odds ratio (OR) for rate of second retinal detachment surgery was 2.804 for the pneumatic retinopexy group (95% Confidence Interval (CI): 2.410,3.262; Table 4) compared to the scleral buckle group. Risk of additional retinal detachment repair did not differ significantly between scleral buckle, PPV, and laser/cryotherapy. Previous diagnosis of PVR was associated with a 94% increased risk of receiving an additional procedure (95% CI: 1.293,2.922). Blacks were 34% less likely to undergo a second retinal detachment operation (95% CI: 0.474,0.931). Compared to the most recent cohort of individuals (2003–2006), persons from cohort 1 (1993–1997) were 13% less likely to have an additional retinal detachment surgery (95% CI:0.762,0.988).

For adverse outcomes, individuals receiving a PPV were 2 times more likely to experience an adverse outcome (OR: 2.019; 95% CI: 1.412,2.889) compared to the scleral buckle group. The pneumatic retinopexy group was 60% less likely to experience an adverse outcome (OR: 0.403; 95% CI: 0.181,0.898) compared to the scleral buckle group. Among eye comorbidities, previous intraocular procedures nearly doubled the risk of an adverse outcome (OR: 1.895; 95% CI: 1.281,2.802). Older individuals (OR: 1.051; 95% CI: 1.027,1.075) also had an increased risk of developing an adverse outcome. Comparing the most recent cohort of patients (2003–2006) to the 2 previous cohorts (1993–1997 and 1998–2002), there were no statistically significant differences by cohort in the rate of adverse outcomes.

In sensitivity analysis, only 77 individuals received 2+ diagnoses of an adverse outcome. Using ordered logit analysis did not materially affect our results (Table 4). Individuals undergoing PPV were still twice as likely to develop a severe complication as compared to the scleral buckle group (OR: 2.007; 95% CI: 1.404,2.871), and individuals undergoing pneumatic retinopexy were less than half as likely to have an adverse outcome (OR: 0.403; 95% CI: 0.181,0.897).

Discussion

This study demonstrates that rates of second retinal detachment operation within the first year after retinal detachment repair were highest for pneumatic retinopexy and also slightly higher for PPV than for the scleral buckle group. Even after controlling for demographic

factors and pre-existing ocular comorbidities, rates of second operation were still significantly higher for pneumatic retinopexy compared to scleral buckle. Although the rates of second retinal detachment surgery were not significantly different between PPV and scleral buckle using logit analysis, rates of severe complications and visual impairment following PPV were still substantially higher compared to scleral buckle.

While multiple surgical treatments are available for retinal detachment repair, studies comparing pars plana vitrectomy and scleral buckling have not clearly demonstrated the superiority of either technique.^{7, 10, 13} Pneumatic retinopexy generally has a lower single operation success rate, but this is offset by the convenience, cost-effectiveness, and lower morbidity of an office-based procedure. Rates of primary anatomic success for scleral buckle reported in a review of retrospective case series have ranged from 75% to 91% for 4940 eyes, and 82% in a recent retrospective case series of 227 eyes.^{14, 15} In retrospective case series, PPV has been shown to have primary anatomic success rates ranging from 71% to 93%.^{16, 17} For pneumatic retinopexy, reviews of subsequent case series reveal a range of single operation success rates of 53–100%.^{9, 16, 18, 19}

Rates of additional retinal detachment surgeries were appreciably higher for pneumatic retinopexy, consistent with the results of previously published studies. The high second operation rate of 40.6% may also be due to the large proportion of patients who have undergone cataract surgery in this elderly population. Pneumatic retinopexy tends to be less successful in pseudophakic or aphakic patients, although cataract surgery within the previous two years was accounted for in the logit analysis.²⁰

Using cost data from the pneumatic retinopexy vs. scleral buckle from a randomized clinical trial, Tornambe calculated that the cost of pneumatic retinopexy was approximately 59% that of scleral buckle (assuming a 82% single operation success rate for scleral buckle and a 68% single operation success rate for pneumatic retinopexy), including the cost of all subsequent operations.²⁰ Final re-attachment rates have been shown to be comparable between pneumatic retinopexy and scleral buckle, and final post-operative visual acuity does not appear to be affected by multiple re-operations after pneumatic retinopexy.²¹ Moreover, the higher rate of second retinal detachment surgery may be offset by the fact that individuals undergoing pneumatic retinopexy had lower rates of adverse outcomes compared to the scleral buckle group.

In this study, the rate of second retinal detachment operation for PPV was slightly higher than that for scleral buckle, although the risk of second operation was not significantly higher for PPV after controlling for demographic variables and ocular comorbidities. This is consistent with findings in previous studies which have shown comparable rates of single operation success between PPV and scleral buckle. Interestingly, the rate of adverse outcome was substantially higher for PPV than for any of the other primary retinal detachment repair procedures. Since clinical information available from Medicare claims data is limited, the higher rate of adverse outcomes with PPV could still be the result of more advanced disease and case selection. Within the severe complication categories of endophthalmitis, hypotony, and phthisis, individuals undergoing PPV suffered higher rates of hypotony and phthisis, perhaps reflecting that PPV is an invasive intraocular procedure, whereas a standard scleral buckle without intraocular gas injection or drainage of subretinal fluid does not penetrate the globe. The advent of transconjunctival sutureless vitrectomy using 25-gauge or 23-gauge incisions may cause higher rates of hypotony. The higher rate of poor vision after PPV may also reflect the influence of other factors such as poor pre-operative vision which may not have been coded as visual impairment. Poor pre-operative vision has been associated with poor post-operative vision.¹⁶ While the rates of severe

complication and visual impairment were higher for PPV, the absolute values were still quite low.

An advantage of studying data from a 17-year time period is the ability to compare rates of second operation and adverse outcomes between patients who had primary retinal detachment repair at different points over these years. Surprisingly, individuals from Cohort 1 (1993–1997) had a lower likelihood of second retinal detachment surgery. It is possible that more severe or previously inoperable recurrent retinal detachments are now being treated surgically, although we controlled for severity of retinal detachments and presence of PVR for in the logit analysis. Moreover, the rate of adverse outcomes was not significantly different between the 3 cohorts, suggesting that innovations in vitrectomy machines, perfluorocarbon liquids, intraocular gas tamponade, wide-angle viewing systems, and longer surgeon experience with PPV and pneumatic retinopexy do not appear to have changed the rate of adverse outcomes.

Our study has several strengths. First, we used a large, nationally representative sample of Medicare 5% inpatient, outpatient, Part-B, and durable medical equipment claims files. Because of the large sample, we can show significant differences even when the underlying differences are small. This represents the largest group of U.S. patients with rhegmatogenous retinal detachments studied to date, and no other studies have used Medicare claims data to examine patterns in this particular patient population. This study complements the previously published literature which consists primarily of retrospective single-center case series, as well as a few multi-center prospective, randomized trials. Because of the diverse background of the sites at which these retinal repair procedures were performed, our second retinal detachment operation and adverse outcome rates are generalizable to the care and outcomes U.S. elderly receive as a whole.²² These results are likely to be relevant for elderly, primarily Caucasian populations with high rates of pseudophakia worldwide. While it is necessary to consider the racial composition of European nations in determining the applicability of our results, for the most part, there were no differences between Blacks or Hispanics and Whites, an exception being that Blacks were less likely to undergo a second retinal operation than were Whites. Moreover, because of the 17-year time period we used to identify sample persons, we could examine secular trends in rates of additional surgeries and adverse outcomes of these 5 procedures.

We acknowledge several limitations. Since CPT code 67108 can be used for PPV “with or without” scleral buckle, we cannot exclude the possibility that some individuals in the PPV category also underwent scleral buckle. A deficiency of insurance claims is that the data are collected for billing purposes and do not contain detailed clinical information, e.g., the exact pre- and post-operative visual acuity and whether or not the retinal detachments involved the macula. Unmeasured clinical variation may bias our results, since more severe retinal detachments may undergo more aggressive therapy with a higher likelihood of complications. For visual acuity outcomes, this study only captures those patients with vision loss severe enough to be coded as moderate vision loss, severe vision loss, or blindness. This study also assumes accurate diagnosis and coding by the physicians involved. Since the specific causes of different diagnoses were not recorded, some adverse outcomes recorded may be due to other ocular comorbidities. To minimize this effect, individuals were censored if they received any other intraocular procedure during the 1 year follow-up. Finally, rates of second operation are not directly comparable with single operation success rates measured in other studies. Presumably, a second operation would be reserved for persons who failed primary retinal detachment repair, but there may also be patients who choose not to undergo additional surgery even if they have persistent or recurrent retinal detachments after primary repair. If so, rates of additional operation may overestimate the rate of single operation success for each of these procedures. Furthermore,

the rates of second operations may not fully reflect “reoperation” since they may indicate procedures in the other eye.

Rates of second retinal detachment operation varied greatly, with the highest rates of additional surgeries for individuals undergoing pneumatic retinopexy, and with comparable risk of second operation for pars plana vitrectomy and scleral buckle. Individuals undergoing pars plana vitrectomy were much more likely to suffer an adverse outcome following retinal repair.

Acknowledgments

Acknowledgments/Disclosure

- a. *Funding/Support*: Partial support for this research came from the National Institute on Aging grant 2R37-AG-17473-05A1 and Alcon Research Award. The sponsors had no role in the design or conduct of this study.
- b. *Financial Disclosures*: Dr. Paul Lee has served as a consultant for Allergan, Pfizer, and Genentech, and he has received financial support from Alcon, the National Institute of Health, and the Washington University Award.
- c. *Contributions to Authors in each of these areas*: Design of the study (SD, FS, DG, PL); Conduct of the study (SD, FS, DG, PL); Collection, management, analysis and interpretation of the data (SD, FS, DG, PL, PM); Preparation, review, or approval of the manuscript (SD, FS, DG, PL, PM).
- d. *Statement about Conformity with Author Information*: The Duke University Institutional Review Board approved this study.
- e. *Other Acknowledgments*: none.

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Table 1

Severity of retinal detachment among Medicare beneficiaries

ICD-9-CM code	Definition
1 (least severe)	
361.0	Retinal detachment with retinal defect
361.00	Retinal detachment with retinal defect, unspecified
361.01	Recent detachment, partial, with single defect
2 (moderate severity)	
361.02	Recent detachment, partial, with multiple defects
361.03	Recent detachment, partial, with giant tear
361.04	Recent detachment, partial, with retinal dialysis Dialysis (juvenile) of retina (with detachment)
3 (most severe)	
361.05	Recent detachment, total or subtotal
361.06	Old detachment, partial Delimited old retinal detachment
361.07	Old detachment, total or subtotal

Table 2
Baseline Characteristics of Medicare Beneficiaries with Rhegmatogenous Retinal Detachment

	Scleral Buckle	Pars Plana Vitrectomy	Pneumatic Retinopexy	Laser or Cryotherapy	Full sample
	Mean	P value	Mean	P value	Mean
Severity (rates unless otherwise noted)					
Severity of RD (1–3)	1.972	0.048	1.785	<0.0001	1.907
Proliferative vitreoretinopathy	0.006	<0.0001	0.002	0.017	0.012
RD risk factors (rates)					
Cataract	0.412	0.392	0.405	0.021	0.409
Cataract surgery	0.452	<0.0001	0.397	0.001	0.451
Myopia	0.026	0.033	0.026	0.027	0.029
Lattice degeneration	0.019	0.023	0.011	0.040	0.024
Prior intraocular procedure	0.062	<0.0001	0.088	0.006	0.094
Prior severe complication	0.006	<0.0001	0.003	0.003	0.015
Prior visual impairment	0.047	0.057	0.041	0.033	0.048
Demographic characteristics (rates unless otherwise noted)					
Male	0.516	0.511	0.546	0.522	0.519
Black	0.018	0.041	0.011	0.043	0.030
Other race	0.015	0.003	0.021	0.040	0.023
Age (years)	75.062	<0.0001	74.438	0.002	75.185
Medicaid	0.052	<0.0001	0.050	74.023	0.061
Observations	3248	3406	1151	1411	9216

Notes: Comparison group is Scleral Buckle. p-values present when p<0.05

Table 3

Complication rates following retinal repair procedures among Medicare beneficiaries*

Complications	Scleral Buckle	Pars Plana Vitrectomy	Pneumatic Retinopexy	Laser or Cryotherapy	Full Sample
Panel A. Main Analysis	Mean	Mean	Mean	Mean	Mean
Second operation	0.192	0.212	0.406	0.172	0.223
Pars Plana vitrectomy	0.128	0.174	0.241	0.068	0.150
Scleral buckle	0.034	0.009	0.105	0.043	0.035
Pneumatic retinopexy	0.016	0.014	0.058	0.010	0.020
Laser or Cryotherapy	0.030	0.024	0.109	0.094	0.048
Recurrent repair retinal detachment	0.022	0.022	0.014	0.004	0.018
Adverse outcomes	0.017	0.035	0.006	0.012	0.021
Severe complication	0.004	0.012	0.003	0.004	0.007
Endophthalmitis	0.002	0.003	0.003	0.003	0.003
Hypotony	0.000	0.002	0.000	0.000	0.001
Phthisis	0.001	0.009	0.000	0.001	0.004
Visual impairment	0.013	0.026	0.005	0.010	0.016
Moderate vision loss	0.009	0.014	0.005	0.007	0.010
Severe vision loss	0.003	0.009	0.000	0.003	0.004
Blindness or low vision aid	0.002	0.006	0.000	0.005	0.003
Observations	3248	3406	1151	1411	9216
Panel B. Sensitivity Analysis					
Adverse outcomes	0.007	0.014	0.004	0.005	0.009
Severe complication	0.002	0.006	0.002	0.003	0.004
Endophthalmitis	0.002	0.002	0.002	0.003	0.002
Hypotony	0.000	.001	0.000	0.000	0.0002
Phthisis	0.000	0.005	0.000	0.000	0.002
Visual impairment	0.005	0.008	0.002	0.002	0.005
Moderate vision loss	0.003	0.005	0.002	0.002	0.003
Severe vision loss	0.001	0.003	0.000	0.000	0.001
Blindness or low vision aid	0.002	0.002	0.000	0.025	0.001

Complications	Scleral Buckle		Pars Plana Vitrectomy		Pneumatic Retinopexy		Laser or Cryotherapy		Full Sample
Panel A. Main Analysis	Mean		Mean	p value	Mean	p value	Mean	p value	Mean
Observations	3248		3406		1151		1411		9216

Notes:

* All rates are fractions. Comparison group is Scleral Buckle. p-values present when $p < 0.05$

Table 4

Logit analysis of rates of second retinal repair operation and adverse outcomes following rhegmatogenous retinal detachment in Medicare beneficiaries (odds ratios and 95% confidence intervals).

	Second retinal operation	Adverse outcomes	Adverse outcomes
Procedure Type			Sensitivity analysis
Pars Plana Vitrectomy (PPV)	1.084 (0.954,1.232)	2.019 (1.412,2.889)	2.007 (1.404,2.871)
Pneumatic retinopexy	2.804 (2.410,3.262)	0.403 (0.181,0.898)	0.403 (0.181,0.897)
Laser or Cryotherapy	0.878 (0.742,1.039)	0.77 (0.432,1.370)	0.769 (0.432,1.368)
Eye comorbidities			
Severity of retinal detachment	1.03 (0.973,1.090)	0.925 (0.783,1.092)	0.925 (0.783,1.093)
Cataract	1.002 (0.903,1.113)	1.249 (0.919,1.696)	1.245 (0.917,1.691)
Cataract surgery	1.097 (0.986,1.221)	1.221 (0.888,1.680)	1.225 (0.890,1.685)
Myopia	1.038 (0.773,1.394)	1.42 (0.654,3.084)	1.437 (0.665,3.108)
Lattice degeneration	1.057 (0.765,1.461)	0.487 (0.119,1.986)	0.487 (0.120,1.987)
Proliferative vitreoretinopathy	1.944 (1.293,2.922)	1.497 (0.590,3.796)	1.468 (0.575,3.749)
Prior intraocular procedure	0.986 (0.827,1.176)	1.895 (1.281,2.802)	1.891 (1.278,2.797)
Prior severe complication	1.142 (0.756,1.725)		
Prior visual impairment	0.912 (0.718,1.160)		
Demographic characteristics			
Male	1.107 (1.000,1.225)	0.972 (0.721,1.312)	0.969 (0.719,1.308)
Black	0.664 (0.474,0.931)	0.569 (0.205,1.578)	0.574 (0.208,1.584)
Other race	0.93 (0.658,1.314)	1.421 (0.618,3.271)	1.415 (0.615,3.254)
Age	0.989 (0.981,0.998)	1.051 (1.027,1.075)	1.051 (1.027,1.075)
Medicaid	1.107 (0.893,1.374)	1.425 (0.831,2.445)	1.443 (0.843,2.469)
Cohort			
1993–1997	0.867 (0.762,0.988)	1.242 (0.839,1.837)	1.228 (0.830,1.816)
1998–2002 (0.781,1.005)	0.886	1.208 (0.826,1.765)	1.203 (0.823,1.757)

Sensitivity analysis using ordered logit (Adverse outcomes=2 for multiple diagnoses, 1 for 1 diagnosis)