# Phenotype and Outcomes of Phakic Versus Pseudophakic Primary Rhegmatogenous Retinal Detachments: Cataract or Cataract Surgery Related?

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• PURPOSE: To compare phakic and pseudophakic primary rhegmatogenous retinal detachments (RD) and, within phakic RD, eyes with and without cataract.
• DESIGN: Retrospective comparative clinical study.
• METHODS: SETTING: Online database of prospectively collected data. STUDY POPULATION: Patients aged ≥50 years who had undergone RD repair. PROCEDURE: Data included baseline demographic and clinical features, surgical details, and anatomical and functional outcomes. Univariate analysis was performed to compare pseudophakic with phakic RD, and phakic RD with and without cataract. Age and sex dependency of variables was analyzed and the association of preoperative variables with final visual acuity was assessed using multivariate analysis. MAIN OUTCOME MEASURES: Preoperative features, intraoperative management, postoperative outcomes, association of preoperative features with postoperative outcomes.
• RESULTS: Of 4,231 eyes, 1,212 were pseudophakic and 3,019 phakic, among which 310 had cataract. Pseudophakic RD showed significant differences compared with phakic RD, including older age, higher prevalence of male sex, foveal detachment, grade C proliferative vitreoretinopathy (PVR), inferior retinal breaks, inferior retinal involvement, and greater RD extent. Despite the more advanced features of pseudophakic RD, pseudophakia was a positive factor for visual outcome. Contralateral RD was more frequent in pseudophakic than phakic RD eyes ($P < .0001$). Within phakic RD, phakic RD with cataract exhibited several similarities with pseudophakic RD, including greater age, more frequent foveal detachment, PVR, and greater RD extent.
• CONCLUSIONS: The presenting features differed significantly between pseudophakic and phakic RD, with greater occurrence of inferior retinal breaks and inferior retinal involvement in particular. Phakic RD with cataract shared several features in common with pseudophakic RD. (Am J Ophthalmol 2021;222:318–327. © 2021 Elsevier Inc. All rights reserved.)

RHEGMATOGENOUS RETINAL DETACHMENT (RD) has an annual incidence ranging from 0.01% to 0.02% in the general population.[1] Cataract surgery is a widely recognized risk factor for RD,[2–4] particularly in cases with intraoperative complications, such as posterior capsule rupture.[5,6] Indeed, the incidence of pseudophakic RD has been reported as being 0.36% to 2.9% within the first 10 years after phacoemulsification, representing an approximate 4 times increased risk compared to the fellow nonoperated eye when age and sex matched.[7] As cataract surgery is one of the most commonly performed surgical procedures, it is not surprising that pseudophakic RD represents a significant proportion of RD, accounting for some 22%-37% of cases in developed countries, and likely to increase as the population ages and the number of cataract operations increases.[1,8,9]

A variety of hypotheses have been proposed for the association of RD with cataract surgery, including vitreous traction during surgery, changes in vitreous composition with a higher incidence of posterior vitreous detachment following surgery, and shared genetic predispositions.[3,10,11] These mechanistic hypotheses might suggest that there would be differences in the clinical features between pseudophakic RD and phakic RD and there is some, albeit limited data to suggest that this may be the case.[12–14] Interestingly, there have also been differences described in the size of retinal breaks, presence of proliferative vitreoretinopathy (PVR), and frequency of foveal involvement in phakic RD, depending on the presence of cataract.[13] An accurate characterization of pseudophakic RD compared to phakic RD, with and without visually

AJO.com Supplemental Material available at AJO.com.

Accepted for publication Sep 21, 2020.

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0002-9394/$36.00
https://doi.org/10.1016/j.ajo.2020.09.036

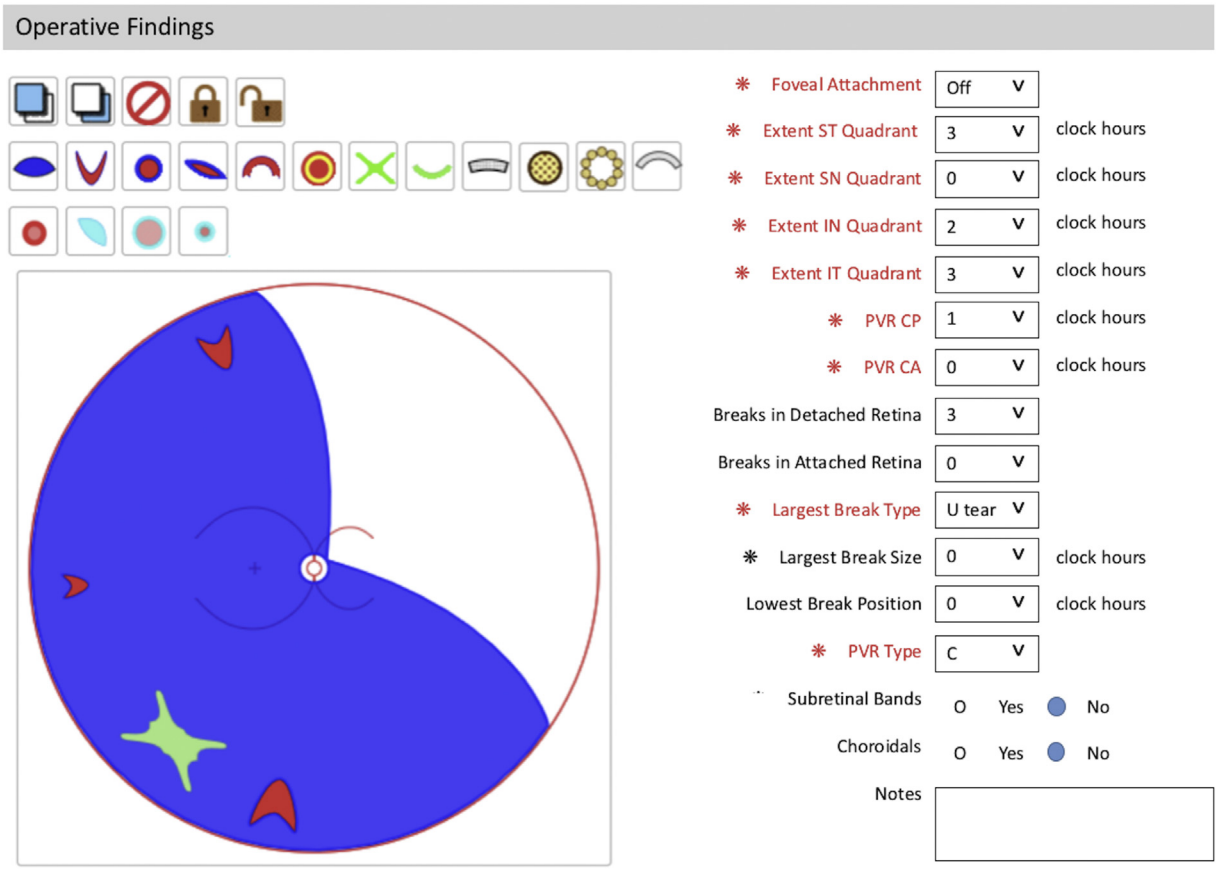


**FIGURE. Drawing tool of Britain & Eire Association of Vitreoretinal Surgeons database. Example drawing of a foveal-involving retinal detachment with 3 retinal tears and proliferative vitreoretinopathy grade C represented by an inferotemporal star fold. As each icon is linked to a diagnostic code, the values are directly uploaded in the side boxes for the collection of data.**

significant cataract, could provide insight into their pathogenesis, as well as assisting in surgical approach and analysis of outcomes.

The aim of this study was to analyze the differences in clinical characteristics between phakic RD, with and without cataract, and pseudophakic RD in a large cohort of prospectively evaluated patients.

## METHODS

THE DATA FOR THIS ANALYSIS WERE EXTRACTED FROM THE Britain & Eire Association of Vitreoretinal Surgeons (BEAVRS) RD audit database in May 2018, including all RDs that had undergone surgery of any type (ie, vitrectomy, buckling, pneumatic retinopexy, or combinations thereof) from March 2011 to March 2018. The BEAVRS database is compliant with the UK national RD dataset (https://www.rcophth.ac.uk/standards-publications-research/audit-and-data/clinical-data-sets/retinal-detachment-data-set/). The database only includes primary rhegmatogenous RDs, and excludes RDs secondary to severe contusion, penetrating injury, vasoproliferative disorders, inflammatory eye disease, ocular dystrophies, and pediatric RD. Data are entered at the end of surgery and then again at the end of the postoperative follow-up (FU) with a stipulation that this is at least 2 months following surgery. The data collected include demographic and preoperative clinical findings such as age, sex, comorbidity, lens status including the presence of cataract, intraocular pressure, visual acuity (VA), duration of central vision loss, ocular co-pathology potentially interfering with the functional outcomes, presence and grade of vitreous hemorrhage (VH) (scored from 0, in absence of VH, to 4, in presence of VH completely obscuring the fundus),[15] anatomical findings of RD, and a history of a fellow-eye RD. Intraoperative and surgical details such as gauge of vitrectomy system, type of tamponade, type of scleral buckle if performed, modality of retinopexy, combination of cataract surgery, and any complications and postoperative outcomes including length of follow-up, anatomical success, and VA were recorded. With regard to the RDs, the anatomical findings recorded are the extent of RD (in clock hours); number, type, and location of retinal breaks; extent of the biggest retinal break (in clock hours); location of the lowest retinal break; foveal

**TABLE 1.** Demographic and Clinical Findings at Presentation in Pseudophakic and Phakic Eyes With Retinal Detachment (Phakic Group Further Divided as Phakic Eyes With and Without Cataract at Baseline)

| | Pseudophakic RD N = 1,212 | Phakic RD N = 3,019 | *P* Value | Phakic RD With Cataract N = 310 | Phakic RD Without Cataract N = 2,709 | *P* Value |
|---|---|---|---|---|---|---|
| Age, years; median (IQR) | 68 (61-75) | 62 (56-69) | <.001* | 69 (62-75) | 62 (56-68) | <.001* |
| Sex; % male | 68% | 60% | <.001* | 59% | 61% | .686 |
| Study eye; % right | 55% | 54% | .52 | 58% | 54% | .132 |
| Presenting VA, logMAR; median (IQR) | 1.00 (0.18-2.28) | 0.78 (0.18-1.98) | .001* | 1.98 (0.38-2.28) | 0.78 (0.18-1.98) | <.001* |
| Duration of visual loss, days; median, (IQR) | 6 (3-15) | 5 (3-11) | .017 | 6 (3-15) | 5 (2-11) | .095 |
| IOP, mm Hg; median (IQR) | 15 (12-16) | 15 (12-16) | .584 | 13 (11-16) | 15 (12-16) | .005 |
| Bilateral RD; % present | 8.92% | 5.81% | <.001* | 6.57% | 5.33% | .149 |

IOP = intraocular pressure; IQR = interquartile range; logMAR = logarithm of the minimum angle of resolution; RD = retinal detachment; VA = visual acuity.
*Significant result.

involvement; and the presence, extent, and grade of PVR, according to the revised Silicone Oil Study grading system.[16] Moreover, to facilitate the collection of data, a RD drawing tool is linked to the diagnostic grading of the above-mentioned details (Figure).

Primary anatomical success in the dataset is considered as complete retinal reattachment in the absence of tamponade and without any additional reattachment procedures.

Only patients aged more than 50 years were included in the analysis. The eyes were divided into 2 groups on the basis of lens status, namely phakic RD and pseudophakic RD. Moreover, a subgroup analysis of phakic RD was carried out, dividing between phakic RD with cataract and phakic RD without cataract.

To analyze for differences in the distribution of the RD, we derived a number of groups based on their location, including those localized to 1 quadrant or hemisphere only, as well as those with any involvement of the superior or inferior retina.

This study followed the UK's Data Protection Act and the Declaration of Helsinki. The database does not contain any data from which the identity of a patient might be established. Internal identification is via a unique random alphanumeric code. No institutional review board approval and/or informed consent were therefore needed according the UK guidelines, the database being considered instead a service evaluation.

• **STATISTICAL ANALYSIS:** Descriptive and statistical analysis was performed using SPSS version 24 (IBM Corp, Armonk, New York, USA). Patient demographics, preoperative features, surgical management, and postoperative outcomes were initially compared between phakic RD and pseudophakic RD. A subgroup analysis for the same variables was then performed between phakic RD with cataract and phakic RD without cataract.

All VA values were converted to logMAR values for analysis, considering count fingers, hand movements, perception of light, and no perception of light equivalent to 1.98, 2.28, 2.70, and 3.00, respectively.[17]

Two-sample independent *t* tests were used to compare continuous variables. Associations between noncontinuous variables were analyzed using the $\chi^2$ test and Fisher exact probability. The effect of sex and age on the variables and outcomes evaluated was investigated using linear and logistic regression. Binomial regression was used to assess the variables influencing the final VA. Statistical significance was considered if $P$ value $< .005$, based on the exploratory nature of the analysis and the number of comparisons made.

## RESULTS

THE DATA OF 5,181 EYES TREATED FOR RD WERE EXTRACTED. We excluded data on 950 eyes, as the patients were younger than 50 years. Of the remaining 4,231 eyes, 3,019 were phakic and 1,212 pseudophakic. Moreover, among the phakic RD, 310 eyes were identified as being phakic with cataract and 2,709 phakic without cataract.

• **UNIVARIATE ANALYSIS:** *Pseudophakic vs phakic retinal detachment*. The results of the univariate analysis to compare phakic RD with pseudophakic RD, as well as phakic RD with and without cataract, are presented in Tables 1-3.

Pseudophakic RD affected an older age group. There was a higher prevalence of right eye involvement in both groups, with no significant difference between the groups. A male predominance was observed in both groups and was significantly more marked in the pseudophakic RD group.

Pseudophakic RD had worse VA at presentation. Other features significantly more common in pseudophakic RD were presence of posterior vitreous detachment (PVD),

**TABLE 2.** Anatomical Features of Retinal Detachment in Pseudophakic and Phakic Eyes at Baseline

| | Pseudophakic RD N = 1,212 | Phakic RD N = 3,019 | *P* Value | Phakic RD With Cataract N = 310 | Phakic RD Without Cataract N = 2,709 | *P* Value |
|---|---|---|---|---|---|---|
| Vitreous status; % | | | <.001* | | | <.001* |
| No PVD | 1% | 2% | | 2% | 2% | |
| PVD | 75% | 73% | | 87% | 72% | |
| Uncertain or missing data | 24% | 25% | | 11% | 26% | |
| Vitreous hemorrhage; %[15] | | | .005 | | | .041 |
| Grade 0 | 85% | 80% | | 75% | 81% | |
| Grade 1 and above | 15% | 20% | | 25% | 19% | |
| Fovea on; % | 39% | 47% | <.001* | 36% | 48% | <.001* |
| RD extent; median (IQR) | | | | 5 (4-7) | 4 (3-6) | <.001* |
| Clock hours | 6 (4-8) | 4 (4-7) | <.001* | | | |
| RD extent- quadrants; % | | | <.001* | | | <.001 |
| 1 | 8% | 16% | | 11% | 16% | |
| 2 | 40% | 47% | | 42% | 48% | |
| 3 or more | 52% | 37% | | 47% | 36% | |
| Total RBs; median (IQR) | 2 (1-4) | 2 (1-4) | .590 | 2 (1-4) | 2 (1-3) | .006 |
| Largest RB type; % | | | .038 | | | .586 |
| Giant | 2% | 2% | | 1% | 2% | |
| Round hole | 6% | 9% | | 10% | 9% | |
| U tear | 89% | 87% | | 86% | 88% | |
| RB not found | 3% | 2% | | 3% | 2% | |
| Inferior retinal breaks; % | 31% | 23% | <.001* | 23% | 23% | .979 |
| Within 2 clock hours of horizontal midline (3 to 5 and 7 to 9 o'clock) | 10% | 10% | .920 | 11% | 10% | .691 |
| Lower 2 clock hours (5 to 7 o'clock) | 21% | 13% | <.001* | 12% | 13% | .701 |
| RQ - solo involvement; % | | | | | | |
| Only superotemporal | 4% | 9% | <.001* | 7% | 10% | .141 |
| Only superonasal | 3% | 4% | .164 | 2% | 4% | .118 |
| Only inferotemporal | 1% | 2% | .007 | 2% | 2% | .948 |
| Only inferonasal | 1% | 1% | .810 | 0% | 1% | .159 |
| Only superior | 20% | 31% | <.001* | 22% | 32% | .001* |
| Only inferior | 7% | 7% | .776 | 4% | 7% | .025 |
| Only temporal | 21% | 33% | <.001* | 34% | 33% | .950 |
| Only nasal | 8% | 7% | .720 | 4% | 8% | .024 |
| RQ - any involvement; % | | | | | | |
| Including superior retina | 92% | 93% | .191 | 95% | 93% | .115 |
| Including inferior retina | 79% | 69% | <.001* | 77% | 68% | .002* |
| PVR grade C; % | 10% | 7% | .005 | 15% | 7% | <.001* |
| Subretinal bands; % | 4% | 2% | .003* | 4% | 2% | .082 |
| Choroidal effusion; % | 1% | 1% | .264 | 2% | 1% | .067 |

IQR = interquartile range; PVD = posterior vitreous detachment; PVR = proliferative vitreoretinopathy; RB = retinal break; RD = retinal detachment; RQ = retinal quadrant.

*Significant result.

foveal detachment, inferior retinal breaks, and PVR grade C, whereas VH was more frequently observed in phakic RD.

Pseudophakic RD was of greater extent and had more common involvement of the inferior retinal quadrants, with phakic RD being more commonly localized to the superior and temporal zones.

With regard to the surgical management, pars plana vitrectomy (PPV) was by far the most commonly performed procedure in both groups. There was no significant difference in anatomical success, but the pseudophakic RD group has significantly improved visual outcomes.

A history of a fellow-eye RD was significantly more common in pseudophakic RD than phakic RD.

*Phakic retinal detachment with cataract vs phakic retinal detachment without cataract*. Details are presented in Tables 1-3. Patients with phakic RD with cataract were

**TABLE 3.** Surgical Management and Outcomes in Pseudophakic and Phakic Eyes With Retinal Detachment (Phakic Group Further Divided as Phakic Eyes With and Without Cataract at Baseline)

| | Pseudophakic RD N = 1,212 | Phakic RD N = 3,019 | *P* Value | Phakic RD With Cataract N = 310 | Phakic RD Without Cataract N = 2,709 | *P* Value |
|---|---|---|---|---|---|---|
| Surgery performed; n | 1,209 | 3,003 | | 308 | 2,695 | |
| Vitrectomy; % | 98% | 96% | .001* | 98% | 96% | .156 |
| Scleral buckle; % | 0% | 3% | <.001* | 2% | 3% | .178 |
| Vitrectomy + buckle; % | 2% | 1% | .010 | 0% | 1% | .507 |
| Pneumatic retinopexy; % | <0.5% | <0.5% | .530 | <0.5% | <0.5% | 1.000 |
| Phacoemulsification combined with vitrectomy; % | N/A | 3.8% | N/A | 20% | 2% | <.001* |
| Tamponade in cases undergoing vitrectomy; n | 1,202 | 2,897 | | 301 | 2,596 | .015 |
| Gas; % | 91% | 93% | .004* | 90% | 93% | .015 |
| Silicone oil; % | 9% | 7% | .004* | 10% | 7% | |
| Missing outcome; % | 14% | 12% | .229 | 16% | 12% | .044 |
| Follow-up duration, days; median (IQR) | 82 (61-117) | 83 (61-125) | .307 | 76 (57-145) | 84 (62-123) | .308 |
| VA at last follow-up, logMAR; median (IQR) | 0.18 (0.00-0.48) | 0.30 (0.18-0.60) | .001* | 0.48 (0.18-0.78) | 0.30 (0.18-0.60) | <.001* |
| Final VA ≤0.3 logMAR; % | 67% | 59% | <.001* | 49% | 60% | .002* |
| Primary anatomical success in those with known outcomes; % | 85% | 88% | .026 | 82% | 89% | .002* |

IQR = interquartile range; logMAR = logarithm of the minimum angle of resolution; VA = visual acuity.
*Significant result.

older and had worse initial VA than patients with phakic RD without cataract.

Phakic RD with cataract were characterized by a significantly higher rate of PVD, foveal detachment, RD extent, and presence of PVR grade C.

There were significantly more superior RDs in the phakic RD without cataract group and a greater involvement of the inferior retina in the phakic RD with cataract, similar to the pseudophakic RD group.

No significant difference was found in the choice of surgical procedure, with a clear predominance of PPV in both groups again.

Both anatomical and functional outcomes were significantly worse in phakic RD with cataract. There were 154 patients who had combined phacovitrectomy performed in the phakic RD group, mainly in the phakic RD with cataract group. There were borderline significantly worse results both anatomically and visually in the phacovitrectomy group ($P = .03$ and $P = .04$, respectively).

• **MULTIVARIATE ANALYSIS:** *Multivariate analysis for effects of age and sex*. Multivariate analysis demonstrated age dependency of several variables in both the pseudophakic RD and phakic RD (Table 4). In both groups, increasing age correlated with a worse presenting and final VA, higher likelihood of foveal involvement, presence of PVR grade C, and greater RD extent.

The only effect of sex was on the age in the pseudophakic RD group, where female patients were older than male patients (median age: male 67 years vs female 70 years; $P < .001$).

*Multivariate analysis for visual acuity ≤0.30 logMAR at last follow-up*. Data are presented in Table 5. Binomial regression showed that the likelihood of achieving final VA of 0.30 logMAR or better was increased by several preoperative features, namely male sex, younger age, better initial VA, shorter duration of vision loss, smaller RD extent, inferior RD distribution only, absence of foveal detachment, PVR, and, importantly, pseudophakia.

## DISCUSSION

IN THIS LARGE, PROSPECTIVELY COLLECTED DATABASE study we have characterized the differences between the features and outcomes of phakic and pseudophakic RD, and have also assessed differences between phakic RD with and without cataract. Few previous studies have highlighted the specific features of pseudophakic DR compared to phakic eyes,[3,13,14,18,19] whereas only 1, as far as we are aware, has assessed phakic RD with and without cataract.[13] These 2 research questions are related, as there has been debate as to how much cataract surgery on its own contributes to RD, as compared to a genetic predisposition to both conditions. If the latter were correct, then it might be expected that pseudophakic RD would share similarities with phakic RD with cataract, as compared to phakic RD without cataract. We studied an older than 50-year-old age population to match the groups in terms of relationship with the onset of PVD, rather than confounding the results with atrophic break or dialysis-related RD, typical of

**TABLE 4.** Age Dependency in Pseudophakic and Phakic Eyes With Retinal Detachment (Only Showing Variables With a Significant Association With Age)

| | Age in Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50-59 | | 60-69 | | 70-79 | | ≥80 | | *P* Value | |
| Variable | Pseudophakic RD (N = 256) | Phakic RD (N = 1,134) | Pseudophakic RD (N = 444) | Phakic RD (N = 1,172) | Pseudophakic RD (N = 341) | Phakic RD (N = 579) | Pseudophakic RD (N = 171) | Phakic RD (N = 134) | Pseudophakic RD | Phakic RD |
| Presenting VA, logMAR; median | 0.48 | 0.48 | 0.78 | 0.78 | 1.64 | 1.98 | 2.28 | 1.98 | <.001 | <.001 |
| Fovea on; % | 53 | 55 | 43 | 45 | 35 | 39 | 20 | 31 | <.001 | <.001 |
| Total extent – clock hours; median | 5 | 4 | 5 | 4 | 6 | 5 | 7 | 6 | <.001 | <.001 |
| Quadrants; mean | 2.7 | 2.3 | 2.7 | 2.4 | 2.8 | 2.6 | 3.1 | 2.9 | .003 | <.001 |
| RQ – superior only; % | 23 | 36 | 24 | 33 | 19 | 21 | 11 | 13 | <.001 | <.001 |
| RQ – including inferior retina, % | 76 | 64 | 76 | 67 | 80 | 79 | 88 | 86 | <.001 | <.001 |
| PVR grade C; % | 7 | 4 | 7 | 7 | 12 | 13 | 18 | 19 | <.001 | <.001 |
| Primary anatomical success in those with known outcomes; % | 88 | 91 | 84 | 89 | 87 | 86 | 81 | 76 | .112 | <.001 |
| Final VA ≤0.3 logMAR; % | 75 | 67 | 71 | 60 | 64 | 47 | 46 | 28 | <.001 | <.001 |
| VA at last F/U, logMAR; median | 0.18 | 0.18 | 0.18 | 0.30 | 0.30 | 0.48 | 0.48 | 0.60 | <.001 | <0.001 |

F/U - follow-up; IN = inferonasal; IT = inferotemporal; logMAR = logarithm of the minimum angle of resolution; PVR = proliferative vitreoretinopathy; RD = retinal detachment; RQ = retinal quadrant; VA = visual acuity.

**TABLE 5.** Multivariate Analysis of Effect of Baseline Features of Retinal Detachment on Final Postoperative Visual Acuity

| Baseline Variable | Final VA ≤0.3 logMAR N = 1,908 | Final VA >0.3 logMAR N = 1,222 | *P* Value |
|---|---|---|---|
| Sex; % male | 63% | 61% | .001 |
| Age, years; median (mean) | 63 (63) | 66 (66) | <.001 |
| Lens status; % phakic | 69% | 75% | <.001 |
| Foveal attachment; % on | 60% | 21% | <.001 |
| Tamponade used in vitrectomy; % gas | 98% | 86% | <.001 |
| RD distribution | | | <.001 |
| @Superior only % | 35% | 16% | |
| @Inferior only % | 65% | 84% | |
| PVR grade C; % present | 4% | 14% | .003 |
| Presenting VA, logMAR; median (mean) | 0.30 (0.80) | 1.98 (1.60) | <.001 |
| Total extent – clock hours; median (mean) | 4 (5) | 6 (7) | <.001 |
| Duration of RD, days; median (mean) | 4 (8) | 7 (23) | .004 |

logMAR = logarithm of the minimum angle of resolution; PVR = proliferative vitreoretinopathy; RD = retinal detachment; VA = visual acuity.

younger age groups with a different RD phenotype. We confirmed some distinctive characteristics of pseudophakic RD as compared to phakic RD but, interestingly, also found that phakic RD with cataract, in contrast to phakic RD without cataract, showed some similarities with pseudophakic RD.

• **EPIDEMIOLOGIC FINDINGS AND GENETIC HYPOTHESIS:** The overall male predominance of RD and mean age affected is consistent with previous studies.[8,12–14,20,21] However, patients with pseudophakic RD were older and more frequently male than those with phakic RD, while the phakic RD groups differed in age only. The age difference is likely explained by the lag time between cataract surgery and rhegmatogenous RD where the risk is reportedly cumulative up to 10 years of follow-up.[1]

The sex difference is more complex to explain. Although the number of women undergoing cataract surgery in the general population is greater than that of men, the mean age of men is younger.[6,7,22] Bjerrum and associates reported that the proportion of men aged 40-49 and 50-59 years undergoing cataract surgery was 2.9% and 8.9%, respectively, compared to female percentages of 1.6% and 5.8% in the same age ranges.[7] It is also known that the RD risk after cataract surgery in men is not influenced by age, whereas it reduces with age in women, meaning that younger men in particular will end up with a greater proportion of pseudophakic RD.[23,24] The higher prevalence of bilateral RD in the pseudophakic RD group also favors a male predominance, suggesting that genetic factors might have a role in pseudophakic RD. The extent to which phacoemulsification itself and/or a predisposition to cataract play a role in the pathophysiology of RD is still matter of debate. A recent meta-analysis of genome-wide association studies demonstrated that the genetic correlation of RD with cataract requiring surgery was 0.44.[25] The proportion of RD liability contributed by common genetic variants has been estimated at between 23% and 27%, and between 35% and 48% for age-related cataract.[26] It is known that the phenotypic correlation of RD with cataract surgery will be limited by the degree of genetic correlation and also by the heritability of each trait.[27] With approximately 20%-33% of RD cases being pseudophakic, this would suggest that ~50% of the risk for pseudophakic RD was genetic, which fits in with our findings on bilateral RD. This is also supported by the fact that population studies on patients undergoing sequential cataract surgery have suggested that patients with cataract have a substantially higher risk of RD prior to cataract surgery.[7]

• **ANATOMICAL FEATURES: PSEUDOPHAKIC VS PHAKIC RETINAL DETACHMENT:** The clinical findings, in particular foveal involvement and distribution of retinal breaks and subretinal fluid, are crucial to plan the timing and type of surgical management. In this regard, we found that in pseudophakic RD, the fovea is more commonly involved, as previously reported[13]; the RD is more extensive, with a higher prevalence of inferior half involvement and inferior breaks; and the rate of PVR grade C is higher, in agreement with a previous study.[13]

Pseudophakic RD was less frequently confined to individual quadrants or halves of the retina; indeed, over 50% of cases involved 3 or more quadrants of the retina, compared to less than 40% in the phakic RD group. Phakic RD were more frequently confined to the superotemporal and superior zones, whereas pseudophakic RD more frequently involved the inferior half of the retina. Moreover, in terms of location of retinal breaks we found that the difference was driven by breaks located in the lowest 2 clock hours of the retina (ie, between 5 and 7 o'clock). Although pseudophakic RD have classically been described with multiple small anterior retinal tears, we

did not find any significant difference in the number of retinal breaks comparing pseudophakic and phakic RD.[1,13,18] The higher rate of PVR grade C could possibly be associated with the greater extent and longer duration of the pseudophakic RD cases,[28] but may represent an intrinsic difference between the 2 groups. We did not have data on the timing of prior cataract surgery or the occurrence of complications, which is a limitation of our study, but previous studies found no difference in the level of cytokines previously associated with PVR between pseudophakic RD and phakic RD eyes.[29,30]

• **ANATOMICAL FEATURES: PHAKIC RETINAL DETACHMENT WITH CATARACT VS PHAKIC RETINAL DETACHMENT WITHOUT CARATACT:** This is the largest study to date that has studied phakic eyes with and without cataract. Consistent with the only previous study to have looked at this, we found several similarities with pseudophakic RD, including a higher proportion of foveal detachment and PVR, in phakic RD with cataract compared with phakic RD without cataract.[13] This could not be explained by duration of RD with no significant difference between the groups, but we cannot exclude later presentation in the cataract group completely. Patients with phakic RD with cataract were significantly older than those without cataract, having a median age similar to that of the pseudophakic group. However, we were also able to identify other differences: phakic RD with cataract cases showed a significantly greater extent and more frequent involvement of the inferior retina than phakic RD without cataract. Moreover, in contrast to data reported by Mahroo and associates, phakic RD with cataract showed a trend to a greater number of retinal breaks ($P = .006$).[13]

• **SURGICAL MANAGEMENT AND OUTCOMES:** The vast majority of cases in this study were treated with vitrectomy alone, consistent with recent trends in surgical choice in the UK.[31] Despite the higher rate of inferior breaks in the pseudophakic RD group, there were very few combined vitrectomy and scleral buckling surgeries. Whether combined vitrectomy and scleral buckle surgery offers any advantage compared with vitrectomy alone is still unclear. A large retrospective study published this year demonstrated a higher single-surgery success rate with combined surgery.[32] Conversely, a large multicenter randomized trial reported no additional benefit of combined surgery in either pseudophakic or phakic RD, including those with inferior retinal breaks.[33,34]

The anatomical success rate in pseudophakic RD cases was 85%, similar compared with phakic RD (88%), despite many of the clinical findings of the pseudophakic RD group having been previously identified as risk factors for primary anatomical failure.[31,35,36] It is possible that an improved fundal view and peripheral retinal access intraoperatively in pseudophakia, with more complete identification of retinal breaks, peripheral vitrectomy, and drainage, etc, led to better outcomes and mitigated the effects of the adverse prognostic features. Moreover, pseudophakic RD had significantly better visual outcomes, in terms of both overall final VA and proportion of eyes with final VA 0.3 logMAR or better. It is likely that lens opacities in the phakic group confounded the visual findings, but it confirms that in routine clinical practice vitrectomy alone is a successful treatment for both groups of patients.

Both anatomical and functional outcomes were worse in phakic RD with cataract compared with the phakic RD without cataract group. The greater severity of initial clinical findings and the presence of cataract limiting the view during surgery may explain these results.[36,37] Moreover, the predictable progression of cataract after vitrectomy may have also contributed to the worse vision. Although the combination of phacoemulsification with vitrectomy (phacovitrectomy) has been described as a safe and effective surgical option,[38,39] many surgeons in the UK prefer sequential cataract surgery for rhegmatogenous RD.[40] This could be attributed to concerns related to combined surgery, including the less certain refractive outcome and the formation of posterior synechiae in up to 30% of cases.[38] Interestingly, the cases that did have combined phacovitrectomy had worse outcomes both anatomically and visually than the vitrectomy-alone cases, although this could have been confounded by case mix.

• **THE EFFECT OF AGE:** Related to the finding that the pseudophakic RD group contained older and more male patients, we investigated the effect of age and sex on the variables studied in the pseudophakic RD and phakic RD groups. Mahroo and associates have previously reported a relationship between age and the presence of inferior retinal breaks and foveal detachment.[13] We confirmed the increasing prevalence of foveal involvement with age but not the effect of age on location of retinal breaks. The association of inferior retinal breaks would seem therefore to be specific to pseudophakic RD. Furthermore, the trend of pseudophakic RD and phakic RD with cataract to having a greater number of retinal breaks did not seem to be influenced by age. RD distribution showed age dependency in both the pseudophakic RD and phakic RD groups, with increasing age associated with a reducing prevalence of superior quadrant involvement, but with an increasing involvement of the inferior quadrants suggesting that at least some of the differences in distribution in pseudophakic RD are related to the older age group affected.

Increasing age was associated with lower postoperative VA in both groups and a lower anatomical success rate in the phakic RD group, but not in the pseudophakic RD group. It is possible that in older phakic eyes, the increased size of the lens can limit the ability to perform certain surgical maneuvers during PPV, such as internal searching and peripheral shaving, which is not the case with pseudophakic RD. Pseudophakia remained a significant factor positively affecting postoperative VA with multivariate analysis.

• **LIMITATIONS AND CONCLUSIONS:** We acknowledge that this study has several limitations. The study, based on its database design, relied on prospective case recording and contemporaneous outcomes assessment; however, we found no evidence of systematic differences in data recording between the groups studied. We accept, however, that the mechanism for completion of the database as an add-on to standard patient records can have some intrinsic limitations, as reflected by the high percentage of "uncertain or missing" vitreous status and the percentage of missing outcome data that, even if similar between the groups, potentially could hide some important information. There was no patient identifier to allow the use of patients rather than eyes as a cluster variable in the analysis; however, we believe that this would have affected only a relatively small number of patients. The BEAVRS database is completed by a self-selected group of surgeons and thus may be not representative of overall UK vitreoretinal surgical practice. We used the presence of cataract as a criterion to distinguish phakic RD with and without cataract, but the criteria used in reporting "cataract" were not standardized, and likely included a range of severities and types. The RD drawing tool used to record data only recorded break size in whole clock hours and does not record location with respect to equator, and hence we could not analyze for break size below 1 clock hour in extent or the anteroposterior location of retinal breaks.

To conclude, our study has shown that there are significant differences between pseudophakic RD and phakic RD in terms of presenting clinical findings and RD distribution. The presence of retinal breaks in the lower 2 clock hours in particular appears to be specific to pseudophakia. Interestingly, phakic RD with cataract share several clinical features with pseudophakic RD. The greater age of pseudophakic RD and phakic RD with cataract could contribute to these findings, but further study of the potential role of shared genetic factors, supported by the increased rate of bilaterality in pseudophakic RD, would be of interest. Despite having a more advanced presentation, and several features previously associated with worse anatomical and functional outcomes, the success rate of pseudophakic RD repair is high and visual outcomes generally good.

FUNDING/SUPPORT: NONE. FINANCIAL DISCLOSURES: NO FINANCIAL DISCLOSURES. ALL AUTHORS ATTEST THAT THEY MEET the current ICMJE criteria for authorship.

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