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Effect of Face-Down Positioning vs Support-the-Break Positioning After Macula-Involving Retinal Detachment Repair
The PostRD Randomized Clinical Trial

Edward J. Casswell, MBBS; David Yorston, MBBS; Edward Lee, PhD; Tjebo F. C. Heeren, MD; Nicola Harris; Tapiwa Margaret Zvobgo, RGN, BSc; Sonali Tarafdar, MBBS; Wen Xing, MSc; Elli Bourmpaki, MSc, BSc; Catey Bunce, DSc; Pearse Keane, MD; David G. Charteris, MBBS

IMPORTANCE A lack of consensus exists with regard to the optimal positioning regimen for patients after macula-involving retinal detachment (RD) repair.

OBJECTIVE To evaluate the effect of face-down positioning vs support-the-break positioning on retinal displacement and distortion after macula-involving RD repair.

DESIGN, SETTING, AND PARTICIPANTS A prospective 6-month single-masked randomized clinical trial was conducted at a multicenter tertiary referral setting from May 16, 2016, to May 1, 2018. Inclusion criteria were fovea-involving rhegmatogenous RD; central visual loss within 14 days; patients undergoing primary vitrectomy and gas surgery, under local anesthetic; patients able to give written informed consent; and 18 years old and older. Analysis was conducted following a modified intention-to-treat principle, with patients experiencing a redetachment or failure to attach the macula being excluded from analysis.

INTERVENTIONS Participants were randomized 1:1 to receive face-down positioning or support-the-break positioning for a 24-hour period postoperatively. Positioning compliance was not monitored.

MAIN OUTCOMES AND MEASURES The proportion of patients with retinal displacement on autofluorescence imaging at 6 months postoperatively. Secondary outcomes included proportion of patients with displacement at 2 months; amplitude of displacement at 2 and 6 months; corrected Early Treatment Diabetic Retinopathy Study visual acuity; objective Distortion Scores; and quality of life questionnaire scores at 6 months.

RESULTS Of the 262 randomized patients, 239 were analyzed (171 male [71.5%]; mean [SD] age, 60.8 [9.8] years). At 6 months, retinal displacement was detected in 42 of 100 (42%) in the face-down positioning group vs 58 of 103 (56%) in the support-the-break positioning group (odds ratio, 1.77; 95%CI, 1.01-3.11; P = .04). The degree of displacement was lower in the face-down group. Groups were similar in corrected visual acuity (face-down, 74 letters vs support-the-break, 75 letters), objective D Chart Distortion Scores (range: 0, no distortion to 41.6, severe distortion; with face-down at 4.5 vs support-the-break at 4.2), and quality of life scores (face-down 89.3 vs support-the-break 89.0) at 2 and 6 months. Retinal redetachment rate was similar in both groups (face-down group, 12.2% and support-the-break group, 13.7%). Retinal folds were less common in the face-down positioning group vs the support-the-break positioning group (5.3% vs 13.5%, respectively; odds ratio, 2.8; 95% CI, 1.2-7.4; P = .03). Binocular diplopia was more common in the support-the-break group compared with the face-down positioning group (7.6% vs 1.5%, respectively; odds ratio, 5.3; 95% CI, 1.3-24.6; P = .03). Amplitude of displacement was associated with worse visual acuity (r = −0.5; P < .001) and distortion (r = 0.28; P = .008).

CONCLUSIONS AND RELEVANCE In this study, findings suggest that face-down positioning was associated with a reduction in the rate and amplitude of postoperative retinal displacement after macula-involving RD repair and with a reduction in binocular diplopia. No association was found with visual acuity or postoperative distortion.

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Author Affiliations: Department of Ophthalmology, Moorfields Eye Hospital, London, United Kingdom (Casswell, Lee, Heeren, Harris, Zvobgo, Xing, Keane, Charteris); Tennent Institute of Ophthalmology, Gartnavel Hospital, Glasgow, United Kingdom (Yorston, Tarafdar); Unit of Medical Statistics, Faculty of Life Sciences, King's College London School of Population Health & Environmental Sciences, London, United Kingdom (Bourmpaki, Bunce).

Corresponding Author: Edward J. Casswell, MBBS, Department of Ophthalmology, Moorfields Eye Hospital, 162 City Rd, London EC2A 4PD, United Kingdom (edward.casswell@nhs.net).

Rhegmatogenous retinal detachment (RD), a cause of visual loss, is reported to have a lifetime risk of 1 in 100 in the Scottish population.[1] Macula-involving rhegmatogenous RD repair has a high anatomical success rate[2] but is associated with postoperative distortion (67%-89%),[3-6] which can have negative consequences on quality of life.[6] Accurate, quantitative assessment of postoperative retinal displacement has been demonstrated using fundus autofluorescence (FAF) imaging, indicated by the presence of hyper autofluorescent lines (ghost vessels),[7-9] which may be associated with postoperative distortion.[9]

The association of face-down positioning with visual outcome after RD repair is unclear. Research indicates that a high anatomical success rate can be achieved without positioning,[10] and that face-down positioning offers no additional benefit.[11] Imaging studies suggest that face-down positioning may be associated with reductions in rates of postoperative retinal displacement.[12,13] We aimed to investigate whether face-down positioning after macula-involving RD repair influenced retinal displacement, distortion, and visual outcome.

Methods

A prospective single-masked randomized clinical trial was performed at Moorfields Eye Hospital, London, and the Tennent Institute of Ophthalmology, Glasgow, from May 16, 2016, to May 1, 2018. Before patient recruitment, the study received approval from the Yorkshire and The Humber-Sheffield Research Ethics Committee and the Health Research Authority. The study complied at all times with the tenets of the Declaration of Helsinki.[14] Patients provided written informed consent before enrollment and were offered compensation for travel expenses. An independent trial steering committee consisting of professionals from Southend University Hospital, King's College London, Glasgow, and lay members of the public hosted via conference call in the Research and Development Department at Moorfields Eye Hospital provided oversight during the trial. The trial protocol and statistical analysis plan are available in Supplement 1.

Participants

Inclusion criteria were fovea-involving rhegmatogenous RD; central visual loss within 14 days; patients undergoing primary vitrectomy and gas surgery, under local anesthetic; patients able to give written informed consent; and age 18 years and older. Exclusion criteria were previous vitrectomy or cryobuckle surgery; RD surgery requiring silicone oil tamponade; a preexisting ophthalmic condition that limited the patient's visual acuity (best-corrected visual acuity [BCVA] 6/36 or worse; approximate Snellen equivalent, 20/125); and inability to position postoperatively or commit to follow-up visits.

Intervention

Patients received standard surgical repair with subtenon local anesthetic: 3-port pars plana vitrectomy, retinopexy to breaks by cryotherapy or laser, and intraocular gas tamponade. Patients requiring epiretinal or subretinal membrane

Key Points

Question Does face-down positioning after macula-involving retinal detachment repair reduce retinal displacement or distortion postoperatively?

Findings In this randomized clinical trial of 262 patients with macula-involving retinal detachment, face-down positioning led to a reduction in the rate of postoperative retinal displacement in comparison with support-the-break positioning (42% vs 58%), although no difference in visual acuity or distortion was found.

Meaning Findings of this study suggest that face-down positioning reduces retinal displacement after macula-involving retinal detachment repair.

peeling, retinectomy, or silicone oil tamponade were excluded. Scleral buckling was not used. Subretinal fluid was drained via either a retinal break or a retinotomy at the surgeon's discretion. Participants were randomized after completion of the surgery to 1 of 2 twenty-four-hour positioning regimens, face-down or support-the-break, and immediately placed in that position. Support-the-break positioning was dependent on the location of retinal breaks: detachments with superior breaks were positioned upright, whereas those with nasal, temporal, or inferior breaks were positioned on the contralateral cheek. The face-down group was provided with an inflatable travel pillow during the first 24 hours. After 24 hours, all patients were positioned in the support-the-break regimen for a further 6 days. Patients were asked to position for a minimum of 50 minutes of every hour and throughout the night and were asked to complete a positioning and adverse events diary.

Randomization, Masking, and Assessments

One eye was recruited per study patient. Patients were randomized 1:1 using random permuted blocks of varying sizes, stratified by site. Randomization was carried out by the senior data manager at Moorfields Eye Hospital using Stata (StataCorp).

Because of the nature of the intervention, participants and researchers could not be masked to group allocation. The surgical team was masked to treatment allocation, as randomization occurred only after the surgical procedure was completed. Image graders, data manager, and statistician were masked to treatment allocation and clinical details.

Participants were seen postoperatively at 2 weeks, 8 weeks, and 6 months. During the visits, participants underwent full ocular examination, slitlamp examination, and applanation tonometry. Vision was measured using standardized Early Treatment Diabetic Retinopathy Study charts at 4 m, using pinhole correction. At the 8-week and 6-month visits, participants completed a 2-item distortion questionnaire ("whilst looking through your operated eye, do straight lines appear bent?" and "with regard to the size of objects seen in your operated eye compared to your healthy eye, do objects appear smaller, larger, the same size?") and D chart test, described elsewhere,[15] on a touch-sensitive computer screen with the aid of a certified research technician. The D chart software generates an overall

and weighted distortion score, the latter allocating more importance to central distortion. Positioning diaries were collected at the 2-week or 8-week visit, and patients completed the National Eye Institute Visual Function Questionnaire at their 6-month visit.

At 8-week and 6-month visits, bilateral FAF and optical coherence tomographic macular imaging were performed. The FAF imaging was performed using a 50° digital fundus camera (Topcon TRC 50IX) with a 530-nm to 580-nm excitation filter and 615-nm to 715-nm Spaide barrier filter. Confocal scanning laser ophthalmoscope FAF imaging was performed using a 55° confocal scanning laser ophthalmoscope (Heidelberg Retina Angiograph) with a 488-nm laser exciter and 500-nm barrier filter, in high-resolution mode and with an automatic real time of 30. Spectral domain optical coherence tomographic (Heidelberg Spectralis) scans were taken with the following settings: volume scan, 61 sections, 25° x 30°, automatic real time 16, high speed mode. All imaging was performed by certified research technicians following a trial-specific standard operating procedure. Images were deidentified and sent to the reading center via a secure file sharing portal for grading.

Image Grading

All grading was performed by independent certified graders following trial-specific standard operating procedures at the reading center, Moorfields Eye Hospital. Retinal displacement was defined by the presence of hyper autofluorescent lines running approximately parallel to first- or second-order retinal blood vessels, with a similar contour and caliber but distinct from the vessel and of at least 0.25 disc diameters in length. Ghost vessels had to be identified by 2 independent graders on the Topcon FAF image to be judged as present. If the graders disagreed or an image was graded as questionable, then a final decision was sought from an adjudicating grader (T.F.C.H.). The adjudicating grader was permitted to view the patient's confocal scanning laser ophthalmoscope image for final judgments.

Degree of displacement was defined by 2 measures: (1) the number of quadrants (around the fovea) affected, and (2) the mean amplitude of displacement. Displacement measurements were performed using Adobe Photoshop (Adobe Inc). Perpendicular measurements were made between the edge of the retinal and ghost vessel at fixed concentric rings (eFigure in Supplement 2). The mean of these measurements produced the mean amplitude of displacement.

Adverse events were recorded and reported to the sponsor per the study protocol. Participants were withdrawn from the study if they experienced a macula-involving retinal redetachment. The primary outcome was the proportion of patients in each treatment group with RD on FAF imaging at 6 months. The secondary outcomes were (1) proportion of patients in each treatment group with retinal displacement on FAF imaging at 8 weeks; (2) degree of retinal displacement in each treatment group on FAF imaging at 8 weeks and 6 months; (3) best-corrected Early Treatment Diabetic Retinopathy Study VA score at 8 weeks and 6 months; (4) objective Distortion Score (D Chart) at 8 weeks and 6 months; and (5) the National Eye Institute Visual Function Questionnaire scores at 6 months.

Given a displacement rate of 72% for macula-involving RDs,[9] to produce a 30% improvement, a study with 85% power at the 5% level would require 99 patients in each group. We anticipated a loss to follow-up rate of approximately 5%.[16] We allowed for 20% exclusion postrandomization because of retinal redetachment.[17] Incorporating these factors produced the total sample size of 262 patients.

Statistical Analysis

The distribution of continuous data was assessed by inspection of histograms; means and SDs were used for normally distributed data, and medians with interquartile ranges (IQRs) were reported for nonnormally distributed data. Frequencies and percentages were used to describe categorical data.

Analysis was conducted following a modified intention-to-treat principle, with patients experiencing a redetachment or failure to attach the macula being excluded from analysis. An available case analysis was conducted together with best and worst case scenario imputation analysis. For the primary outcome, reasons for missingness were examined using logistic regression.

The primary outcome was computed by the exact binomial method. Treatment effect estimate was computed as an odds ratio (OR) and 95% CI using logistic regression with adjustment for site. Further exploratory analysis on factors associated with retinal displacement was conducted using univariate logistic regressions after adjusting for site. Linear and logistic regression (for categorical and continuous outcomes, respectively) with adjustment for site were conducted to assess associations between positioning groups and each of the secondary outcomes. Effect estimates are reported with 95% CIs. A post hoc exploratory analysis was conducted on patients to compare adverse events by treatment group. All statistical tests used a 2-sided P value of .05 and were conducted using Stata/IC, version 15.1 (StataCorp).

Results

A total of 262 patients were recruited and randomized, with 23 postrandomization exclusions owing to retinal redetachment (Figure). These patients were excluded as it would be difficult to ascertain if study outcomes were associated with the original or subsequent RD repair. Of the 239 patients, 171 were male (71.5%) and mean [SD] age was 60.8 [9.8] years. A further 18 patients did not complete the study at their own request or because of loss to follow-up. Patient recruitment took place between May 16, 2016, and October 17, 2017, with the final follow-up visit on May 1, 2018. There was a higher than expected dropout rate but a lower than anticipated retinal redetachment rate.

Baseline demographics are summarized for all patients apart from postrandomization exclusions in Table 1 (n = 239). No patients had undergone previous pneumatic retinopexy.

Primary Outcome Measure

Of the 119 patients in the face-down group, 19 (16%) had missing or ungradable images. Of the 120 patients in the support-

Figure. Patient Flow Diagram
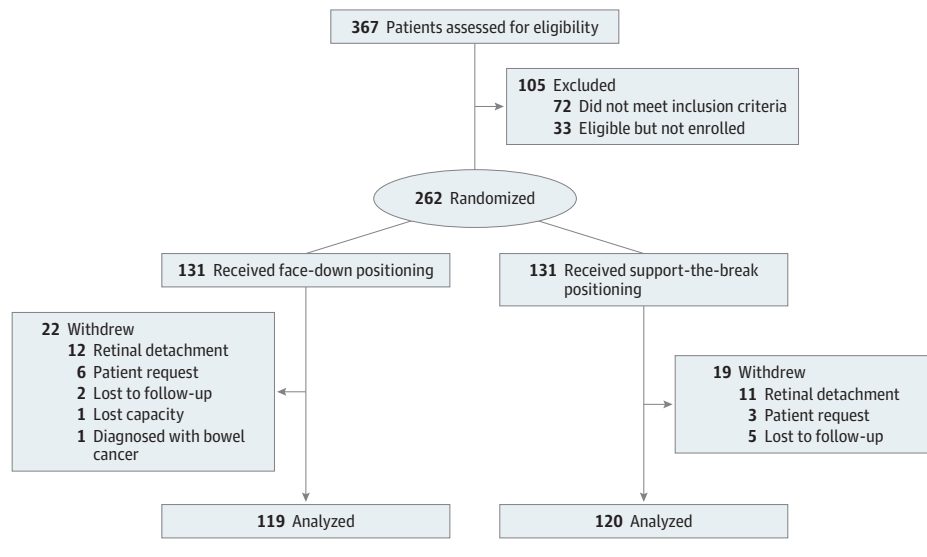
the-break group, 17 (14.2%) had missing or ungradable images (Table 1). Analysis of the gradable images revealed an increased OR of retinal displacement in the support-the-break group (OR, 1.77; 95% CI, 1.01-3.11; $P = .04$) (**Table 2**). Under a best-case scenario, the OR was 1.71 (95% CI, 1.02-2.88; $P = .04$), while under a worst-case scenario, the OR was 1.59 (95% CI, 0.94-2.68; $P = .08$) (eTable 1 and eTable 2 in Supplement 2). Univariate logistic regression found that none of the following factors were associated with retinal displacement at 6 months: extent of RD (OR, 1.05; 95% CI, 0.93-1.12; $P = .44$), route of drainage (break vs retinotomy) (OR, 0.66; 95% CI, 0.34-1.30; $P = .22$), involvement of superior quadrants (OR, 0.69; 95% CI, 0.19-2.56; $P = .58$), duration of visual loss (OR, 1.02; 95% CI, 0.91-1.13; $P = .74$), preoperative lens status (phakic vs posterior chamber intraocular lens) (OR, 0.84; 95% CI, 0.47-1.51; $P = .57$), or gas tamponade (OR, 0.70; 95% CI, 0.09-5.45; $P = .73$) (eTable 3 in Supplement 2).

Secondary Outcome Measures

At 8 weeks postoperatively, the proportion of patients with retinal displacement was higher in the support-the-break group compared with the face-down group (OR, 1.94; 95% CI, 1.1-3.4). Images were missing or ungradable in 10.8% and 17.6% of patients, respectively. At 8 weeks and 6 months postoperatively, the degree of displacement was lower in the face-down group (8 weeks: face-down, 0.5 degree of displacement vs support-the-break, 0.8 degree; 6 months: face-down, 0.3 degree vs 0.9 degree) (**Table 3**). Effect estimates indicate that the support-the-break group had 0.41 (95% CI, 0.05-0.78) more quadrants and 0.32 (95% CI, 0.08-0.55) more fundal degrees of retinal displacement at 8 weeks. At 6 months, the support-the-break group had 0.70 (95% CI, 0.32-1.09) more quadrants and 0.42 (95% CI, 0.13 to 0.72) more fundal degrees of retinal displacement compared with the face-down group. There was no evidence of a difference in BCVA (74 vs 75 letters) (approximate Snellen equivalent, 20/32), Distor-

tion Scores, or quality of life scores at either time point. Post hoc analysis revealed that the amplitude of displacement was associated with higher D chart distortion ($r = 0.28$, $P = .008$) and worse BCVA at 6 months ($r = -0.5$; $P < .001$).

Adverse Events

Selected adverse events are shown in **Table 4**. No difference in rate of retinal redetachment or further ocular surgery was noted between the 2 groups. At 6 months, 54 of 119 patients (45.4%) in the face-down group and 66 of 120 (55%) patients in the support-the-break groups were pseudophakic. Retinal folds occurred more frequently in the support-the-break group compared with the face-down group (18 of 131 [13.7%] vs 7 of 131 [5.3%], respectively; OR, 2.8; 95% CI, 1.2-7.4; $P = .03$) as did binocular diplopia (10 of 131 [7.6%] vs 2 of 131 [1.5%], respectively; OR, 5.3; 95% CI, 1.30-24.6; $P = .03$) (Table 4). Episodes of elevated intraocular pressure (more than 25 mm Hg) occurred more frequently in the face-down group compared with the support-the-break group (40 of 131 [30.5%] vs 23 of 131 [17.6%], respectively; OR, 0.5; 95% CI, 0.3-0.9; $P = .02$), as did median intraocular pressure at 2 weeks (20 vs 19), and transient neck pain (46 of 131 [35.1%] vs 18 [13.7%], respectively; OR, 0.3; 95% CI, 0.2-0.5; $P < .005$). Full adverse events are shown in eTable 4 in Supplement 2.

Discussion

Vitreoretinal surgeons advise differing positioning regimens after RD repair with vitrectomy and gas; however, a paucity of evidence exists to support any regimen. In this study, for the first time to date, we have used a prospective randomized clinical trial design using a range of objective and subjective outcome measures to provide an evidence-based analysis of the effect of postoperative positioning. The methods used may provide a framework for future studies on other postoperative regimens.

Table 1. Baseline Demographic Characteristics of 239 Patients

Characteristic	No. (%)	
	Face-down positioning (n = 119)	Support-the-break positioning (n = 120)
Left eye	62 (52.1)	59 (49.2)
Site		
Moorfields Eye Hospital, London, UK	110 (92.4)	111 (92.5)
Tennent Institute of Ophthalmology, Glasgow, Scotland	9 (7.6)	9 (7.5)
Male	83 (69.7)	88 (73.3)
Age, mean (SD), y	60.3 (11.1)	61.3 (8.2)
Race/ethnicity		
White	98 (82.3)	105 (87.5)
Asian/Asian British	17 (14.2)	9 (7.5)
Black/black British	4 (3.3)	4 (3.3)
Other	0	2 (1.6)
BCVA, median (IQR), Snellen UK	3/60 (HM, 6/36)[a]	3/60 (HM, 6/24)[a]
Lens status		
Phakic	80 (67.2)	72 (60.0)
PCIOL	37 (31.1)	48 (40.0)
Aphakic	1 (0.8)	0
ACIOL	1 (0.8)	0
High myopia (>6 diopters)		
Yes	25 (21)	26 (21.7)
No	84 (70.6)	87 (72.5)
Unknown	10 (8.4)	7 (5.8)
Ocular comorbidity		
Previous retinopexy	2 (1.7)	2 (1.7)
Corneal pathology	2 (1.7)	3 (2.5)
Glaucoma	4 (3.4)	4 (3.3)
AMD	1 (0.8)	1 (0.8)
Diabetic retinopathy	1 (0.8)	1 (0.8)
Uveitis	0	2 (1.7)
Amblyopia	2 (2.5)	1 (0.8)
Duration of central visual loss, median (IQR), d	4 (2-6)	3 (2-5)
Retinal breaks, median (IQR)	2 (1-3)	2 (1-3)
Retinal break location		
Superotemporal	100 (84.0)	91 (75.8)
Superonasal	36 (30.3)	50 (41.7)
Inferotemporal	32 (26.9)	28 (23.3)
Inferonasal	15 (12.6)	19 (15.8)
Retinal detachment		
Extent, median (IQR), clock hours	6 (4-7)	5.5 (4-7)
Location		
Superotemporal	114 (95.8)	110 (91.7)
Superonasal	75 (63.0)	77 (64.2)
Inferotemporal	94 (79.0)	92 (76.7)
Inferonasal	34 (28.6)	40 (33.3)
PVR		
None	115 (96.6)	115 (95.8)
PVR B	4 (3.4)	3 (2.5)
PVR C	0	2 (1.7)
Grade of surgeon		
Consultant	17 (14.3)	14 (11.7)
Fellow	96 (80.7)	98 (81.7)
Registrar	6 (5)	8 (6.7)

(continued)

Table 1. Baseline Demographic Characteristics of 239 Patients (continued)

Characteristic	No. (%)	
	Face-down positioning (n = 119)	Support-the-break positioning (n = 120)
Retinopexy		
Cryotherapy	98 (82.4)	103 (85.8)
Laser	8 (6.7)	4 (3.3)
Cryotherapy and laser	13 (10.9)	13 (10.8)
Route of SRF drainage		
Break	92 (77.3)	86 (71.7)
Retinotomy	26 (21.8)	33 (27.5)
None	1 (0.8)	1 (0.8)
PFCL used	2 (1.7)	1 (0.8)
Tamponade used		
SF6	94 (79.0)	104 (86.7)
C2F6	4 (3.4)	5 (4.2)
C3F8	21 (17.6)	11 (9.2)
Sclerotomy sutures		
0	97 (81.5)	97 (80.8)
1	11 (9.2)	11 (9.2)
2	7 (5.9)	4 (3.3)
3	4 (3.4)	6 (5.0)
Unknown	0	2 (1.7)
Posturing advice for first 24 h		
Face down	119 (100)	NA
Upright	NA	69 (57.5)
Cheek		
Right	NA	22 (18.3)
Left	NA	27 (22.5)
Alternating	NA	2 (1.7)

Abbreviations: ACIOL, anterior chamber intraocular lens; AMD, age-related macular degeneration; BCVA, best-corrected visual acuity; C2F6, hexafluoroethane; C3F8, perfluoropropane; HM, hand motion; IQR, interquartile range; NA, not applicable; PCIOL, posterior chamber intraocular lens; PFCL, perfluorocarbon liquid; PVR, proliferative vitreoretinopathy; PVR B, wrinkling on retinal surface; PVR C, presence of retinal membranes; SF6, sulfur hexafluoride; SRF, subretinal fluid.

a Approximate Snellen equivalent for 3/60 is 20/400; for 6/36, 20/125, and for 6/24, 20/80.

Table 2. Primary Outcome Analysis

Primary outcome	No. (%)		
	Face-down positioning (n = 119)	Support-the-break positioning (n = 120)	P value
Retinal displacement at 6 mo			
Positive	42 (35.3)	58 (48.3)	NA
Negative	58 (48.7)	45 (37.5)	NA
Ungradable	9 (7.6)	8 (6.7)	NA
Missing	10 (8.4)	9 (7.5)	NA
Available case analysis			
Retinal displacement at 6 mo, No. (%) [95% CI]	42 (42.0) [32.2-52.3]	58 (56.3) [46.2-66.1]	NA
OR (95% CI)	1 [Reference]	1.77 (1.01-3.11)	.04

Abbreviations: NA, not applicable; OR, odds ratio.

Results of this study demonstrated a reduced rate of retinal displacement after macula-involving RD repair in the face-down group compared with the support-the-break group. When retinal displacement did occur, the face-down group was found to have a reduced amplitude of displacement (Table 3).

A previous retrospective series[13] found that the rate of retinal displacement was reduced from 63.6% to 25% if patients were positioned immediately face-down vs face-down after a delay. The report did not examine patient's distortion but did find that the immediate-face-down group experienced less vertical deviation on a synoptophore. Dell'Omo et al[12] reported that the rate of displacement was 35% in patients adopting face-

down positioning for 2 hours postoperatively. Previous publications have questioned the benefit of face-down positioning after RD repair. A noncomparative case series reported a reattachment rate of 95% in the treatment of inferior RDs with gas tamponade without any positioning advice,[10,18] and a nonrandomized clinical trial found no difference in reattachment rate or BCVA when comparing face-down with a variable positioning regimen.[11] A 2017 pilot trial[19] of 56 patients randomized patients to face-down vs face-up positioning postoperatively, with or without intraoperative perfluorocarbon liquid and found that there was no difference in the rate of retinal folds. These studies however did not formally assess retinal

Table 3. Secondary Outcome Analysis

Secondary outcome	Face-down positioning (n = 119)	Missing, No.	Support-the-break positioning (n = 120)	Missing, No.	Effect estimate, OR (95% CI)[a]
Retinal displacement at 8 wk, No. (%)					
Positive	45 (37.8)	NA	67 (55.8)	NA	1.94 (1.10 to 3.41)[b]
Negative	53 (44.5)	NA	40 (33.3)	NA	NA
Ungradable	9 (7.6)	NA	6 (5)	NA	NA
Missing	12 (10.1)	NA	7 (5.8)	NA	NA
Degree of retinal displacement (gradable images), median (IQR)					
Week 8					
No. of quadrants	2 (2 to 3)	NA	2 (2 to 4)	NA	0.41 (0.05 to 0.78)[c]
Amplitude of displacement[d]	0.5 (0.3 to 0.8)	NA	0.8 (0.5 to 1.5)	NA	0.32 (0.08 to 0.55)[c]
Week 26					
No. of quadrants	2 (2 to 2)	NA	3 (2 to 4)	NA	0.70 (0.32 to 1.09)[c]
Amplitude of displacement[d]	0.3 (0.3 to 0.8)	3	0.9 (0.4 to 1.5)	9	0.42 (0.13 to 0.72)[c]
Corrected ETDRS visual acuity, median (IQR)					
Week 8	69 (62 to 78)	11	68 (59 to 77)	7	−0.7 (−4.7 to 3.2)[c]
Week 26	74 (65 to 79)	10	75 (65 to 80)	9	0.1 (−3.1 to 3.3)[c]
Distortion Score (D Chart), median (IQR)					
Week 8					
Distortion Score	7.6 (2.1 to 16)	12	10.2 (1.0 to 23.4)	7	2.7 (−0.9 to 6.3)[c]
Weighted Distortion Score	5.5 (1.4 to 11.8)	12	6.6 (0.5 to 13.5)	7	NA
Week 26					
Distortion Score	4.5 (0.2 to 14.0)	11	4.2 (0.0 to 22.4)	9	1.8 (−2.0 to 5.6)[c]
Weighted Distortion Score	2.8 (0.1 to 8.1)	11	3.0 (0.0 to 13.4)	9	NA
National Eye Institute Visual Function Questionnaire, median (IQR)					
Week 26	89.3 (79.5 to 95.0)	12	89.0 (79.1 to 94.4)	10	−1.8 (−5.6 to 2.0)[c]

Abbreviations: ETDRS, Early Treatment Diabetic Retinopathy Study; IQR, interquartile range; NA, not applicable; OR, odds ratio.

[a] Reference group was patients receiving face-down positioning.

[b] Logistic regression adjusted for site; retinal displacement input as dependent variable.

[c] Regression coefficient. Linear regression adjusted for site; secondary outcomes input as the dependent variable.

[d] Measured in fundal degrees.

Table 4. Adverse Events

Adverse event	No. (%) Face-down positioning (n = 131)	No. (%) Support-the-break positioning (n = 131)	OR (95% CI)	P value
Retinal redetachment (macula sparing and involving)	16 (12.2)	18 (13.7)	NA	NA
Retinal folds (full thickness and ORF)	7 (5.3)	18 (13.7)	2.8 (1.2-7.4)	.03
Binocular diplopia	2 (1.5)	10 (7.6)	5.3 (1.3-24.6)	.03
Elevated IOP	40 (30.5)	23 (17.6)	0.5 (0.3-0.9)	.02
Median (IQR) IOP at 2 wk	20 (16-30)	19 (15-24)	NA	.046
Transient neck pain	46 (35.1)	18 (13.7)	0.3 (0.2-0.5)	<.005
Further ocular surgery	31 (23.7)	39 (29.8)	NA	.33

Abbreviations: IOP, intraocular pressure; IQR, interquartile range; NA, not applicable; OR, odds ratio; ORF, outer retinal folds.

displacement or distortion, or were limited by participant numbers or study design. We believe the findings of our study support the hypothesis that immediate face-down positioning does reduce the rate and amplitude of retinal displacement in comparison with the support-the-break regimen.

Although we found an anatomical difference between the 2 groups, we found no evidence of a difference in BCVA, distortion, or quality of life. We did observe an increased rate of binocular diplopia in the support-the-break group, likely because of the increased amplitude of displacement observed in this group impairing patients' ability to vertically fuse images. This is a notable finding given that diplopia can have substantial consequences on quality of life.[20] A previous report has retrospectively found no difference in VA when patients had been positioned face down.[11] Lee et al[9] did find an association between subjective distortion and the presence of retinal displacement on FAF imaging in their retrospective series but did not use an objective measure of distortion. It is possible we found no evidence of a difference in Distortion Scores between the 2 groups because metamorphopsia may be associated with mul-

tiple factors. It has been reported that the fovea stretches during an RD[21] and it is possible that this stretching may cause postoperative distortion regardless of whether concurrent macula displacement occurs. There may also be limitations in measuring distortion that made it difficult to discern between the 2 groups. When investigating patients with epiretinal membrane, Dell'Omo et al[8] also found no difference in objective Distortion Scores in patients with or without retinal displacement. We found that the amplitude of retinal displacement was associated with higher Distortion Scores and worse BCVA, and we think this highlights the importance of avoiding retinal displacement given its potential consequences on visual function. It should be noted that BCVA and distortion were secondary outcome measures in our study, so the study may not have been sufficiently powered to detect a true clinical difference. Therefore, a larger investigation with these parameters as primary outcome measures may be warranted.

To our knowledge, this is the first study to systematically examine retinal displacement or postoperative distortion at different points after RD repair. We found that there was a reduction in D chart and weighted D chart scores in both groups between 2 months and 6 months. This finding suggests that postoperative distortion may resolve over time, so a more detailed comparison is planned. It has previously been suggested that the ghost vessels may move closer together over time.[7] We did not find any change in the amplitude of retinal displacement between the 2-month and 6-month points (Table 3). Shiragami et al[7] previously found that the extent of RD was associated with retinal displacement, but we found that postoperative positioning was the only factor associated with retinal displacement on regression analysis. This finding appears to be consistent with a study[22] reporting that the only statistically significant factor associated with displacement was the use of gas tamponade (41.2% gas vs 14.3% silicone oil tamponade) and found no association with the quadrants involved, perfluorocarbon liquid use, or the location or number of breaks.

We found a higher rate of transient neck pain or stiffness in the face-down group, which would be expected from a more rigorous postoperative regimen. The retinal redetachment rate was similar in both groups, 12.2% and 13.7%. These rates may have been in part owing to a high proportion of cases being performed by junior retinal specialists (fellows) but is consistent with the 13.3% reoperation rate reported from the UK Vitreoretinal Operative Database.[2] One unexpected adverse outcome was the higher rate of elevated intraocular pressure observed in the face-down group 2 weeks postoperatively (Table 4). One possible reason for this outcome is that face-down positioning leads to the residual intraocular fluid (containing inflammatory mediators) being displaced toward the iridocorneal angle, leading to inflammation and a delayed elevation in intraocular pressure.

Limitations

This study has limitations. Patients' positioning compliance was not monitored postoperatively. Thus, our study is an assessment of positioning advice, meaning our results are potentially more applicable to real-world clinical practice. We did not include other positioning regimen groups within our study (eg, a no-position or macula-dependent position), which is advocated by some surgeons and could be investigated in the future using our methods. A total of 69 of 120 (58%) patients in the support-the-break group were advised to position upright postoperatively, so this may be similar to a no-position group.

Conclusions

We believe our investigation found an association between face-down positioning after macula-involving RD repair by primary vitrectomy and a reduction in postoperative retinal displacement and binocular diplopia in comparison to the support-the-break regimen. It found no evidence of an effect on visual acuity, objective distortion or quality of life but was not powered to provide definitive answers on these outcomes.

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