BMJ Open

Efficiency benchmarks in the surgical management of primary rhegmatogenous retinal detachment: a monocentric register cohort study of operating room time metrics and influential factors

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ABSTRACT

Objectives To investigate the effect of clinical, methodological and logistic factors on operating room (OR) efficiency in the surgical management of primary rhegmatogenous retinal detachment (RRD).

Design Monocentric retrospective register cohort study.

Setting Single tertiary centre in the western region of Austria.

Participants We audited patients diagnosed with primary RRD who were treated between January 2014 and August 2019. In total, 783 eyes of 776 consecutive patients were included in this study. Various risk factors affecting OR time efficiency and anatomical success after pars plana vitrectomy (PPV) procedures and scleral buckle (SB) surgery were analysed.

Primary and secondary outcome measures OR efficiency was the primary outcome measure. Secondary outcome measures were the primary success rate after PPV procedures and SB surgery.

Results PPV was performed in 641 (81.9%) eyes and SB surgery in 142 (18.1%) eyes. Mean surgical times in PPV and SB under retrobulbar anaesthesia (RA) were 74.0 (±32.6) min and 62.1 (±24.6) min (p<0.001), respectively, while under general anaesthesia (GA), these values were 112.0 (±52.0) min and 76.0 (±22.5) min (p<0.001), respectively. A regression analysis revealed the following main risk factors for prolonged OR time for the surgical management of RRD with PPV (all p<0.001): presence of a giant tear (β=24.01; 32%), proliferative vitreoretinopathy (PVR)-C (β=16.43; 22%), surgery postponed for 72 hours after diagnosis (β=21.40; 29%), GA (β=23.64; 32%) or surgery performed by a trainee (β=17.35; 23%). PVR (p=0.022) in PPV cases, after-hours settings (p=0.006) and surgeon experience (p=0.030) in SB cases were independent risk factors for reduced success rates.

Conclusions OR coordinators should consider various independent clinical (giant tear, PVR-C, advanced detachment), methodological (PPV vs SB) and logistic (GA vs RA, after-hours setting and surgeon experience) factors to improve the success rate and surgical management

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Strengths and limitations of this study

► The present study comprised a large number of patients with primary rhegmatogenous retinal detachment (RRD) at one tertiary referral centre for retinal detachment.

► Data were obtained from a standardised RRD database protocol, established to monitor quality factors of our department in the surgical management of patients with RRD.

► Due to the monocentric nature of the study, we were able to include numerous potential confounders in the logistic regression analysis for operating room (OR) efficiency and binary logistic regression for risk factors of anatomical success after surgery.

► The presented results may help clinicians compare the time metrics of surgery, as well as allow them to benchmark their OR efficiency, success rates and consider various factors for optimised preoperative planning, surgical care and postoperative management.

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planning of RRD accurately while optimising OR resources and staff efficiency.

INTRODUCTION

Primary rhegmatogenous retinal detachment (RRD) represents the most common emergency and reason for non-elective surgery in the ophthalmological departments of industrialised countries.[1] It is a potentially blinding disease if left untreated. An estimated 0.6% of the population is affected at an annual incidence of 6–18 per 100 000 per year.[2 3] Successful reattachment and treatment of all retinal breaks are crucial for a good visual prognosis.[4]

The choice of method and timing of treatment can vary not only between surgeons, centres and regions but also depend on the type and extent of RRD, the involvement of the macula, and the status of the lens. While primary success rates of 62%–98% have been reported after pars plana vitrectomy (PPV),[5–9] single scleral buckle (SB) surgery has shown a success rate of 53%–100%.[5 9–11]

Besides the success of surgical outcomes, the time efficiency of the operating room (OR) has been of great interest in the recent literature.[12–15] However, information on surgical time and clinical and methodological factors that influence OR efficiency is scarce in the field of ophthalmology and has not been reported in the management of primary RRD. In parallel with technological advances, economic pressure has pushed physicians to increase efficiency and focus on performance and time metrics to reduce costs while maintaining the quality of care.

To make operative planning more efficient and accurate, we established a monocentric register at a tertiary referral centre for RRD. In this study, we investigated the impact of potential clinical, methodological and logistic factors on the time efficiency of the OR and primary success rate after RRD surgery.

METHODS
Dataset and patients
From January 2014 to August 2019, 783 eyes of 776 consecutive patients diagnosed with primary RRD were included into this retrospective monocentric register cohort study. Being the tertiary centre of the western region of Austria, practically all cases with RRD are referred to our department. Patients with primary rhegmatogenous RRD were included. The exclusion criteria were: (1) a history of posterior uveitis, (2) a history of penetrating or blunt trauma and (3) cases with a symptomatic schisis detachment.

Data were obtained from the RRD register of our department. The necessary data for registration followed a standardised RRD database protocol (see online supplemental file retinal detachment register), and information was gathered from medical records (anaesthesia protocol and surgery protocol). This information was collected after discharging a patient from the inpatient clinic. Before statistical analyses were conducted we reviewed the medical records of all cases to retrospectively evaluate whether the patients experienced a re-detachment following surgical reattachment. The RRD register was established to monitor quality factors of our department in the surgical management of patients with RRD. The RRD register has been used in previous studies to evaluate the impact of surgical timing and submacular fluid volume on the functional outcomes of patients with macula-involving primary RRD.[16 17] The implementation and application of the RRD register were validated by the Department for Strategic Quality Management of the University Clinic Innsbruck, Innsbruck, Austria. All data were anonymised prior to analysis.

The following data were collected for analysis: age; sex; affected eye; lens status; best-corrected visual acuity given as the logarithm of minimum angle of resolution (logMAR); presence of pathological myopia (axial length ≥26.5 mm); history of trauma and complicated surgeries (including cataract surgery, previous retinal surgery and laser therapy); presence of vitreous bleeding; characteristics and location of retinal tears; extent of retinal detachment and affected quadrants; surgical methods; foveal detachment verified by spectral domain optical coherence tomography (SD-OCT); grading of proliferative vitreoretinopathy (PVR)-classification as per the updated Retina Society Classification into grades A to C[18]; surgical methods, time spent in the operation theatre; whether patients were treated on weekends or national holidays to analyse a potential difference of the OR efficiency or success rate of patients treated on the weekends compared with patients treated on weekdays (ie, weekend effect); whether patients were treated outside regular working hours to evaluate a potential difference of OR efficiency or success rate between patients treated after regular working hours with patients treated during regular working hours (ie, after-hours surgery); and time from surgery to re-detachment in patients who underwent surgery at least 6 months before the end of the observation period. At hospitalisation, ophthalmological examinations were performed by a retinal specialist.

Clinical assessment and grading
Electronic medical records were used for the outcome analysis. Vitreoretinal surgeries were performed at the university hospital Innsbruck in the federal state of Tyrol. All patients experiencing a second retinal detachment were referred again to Medical University Innsbruck. At presentation, all patients received SD-OCT as a protocol routine to evaluate the foveal status. Primary success was defined as the reattachment of the retina at 6 months after initial surgery without retinal laser coagulation or further reattachment procedures. In cases with silicone oil endotamponade, primary success was defined as retinal attachment 6 months after silicone oil removal. Removal of the silicone oil was recommended within 6 months of follow-up.

Vitreoretinal surgeries were performed by four experienced surgeons and two trainees. Trainees were defined as vitreoretinal surgeons who had performed less than 100 surgeries. The time spent in the OR included surgery time and time needed for the anaesthetic procedure before and after surgery, including turnover time. The surgeries were performed under retrobulbar anaesthesia (RA, performed by the surgeon) or general anaesthesia (GA). The surgical method used was PPV or SB. We also included patients who underwent cataract surgery combined with PPV. PPV consisted of a standard three-port 20-gauge (G), 23G, 25G and 27G instrumentation, endolaser or transscleral cryocoagulation, fluid-air

exchange with air or gas (SF6, C3F8), or silicone oil (5000 centistokes) as endotamponade. SB surgery included a localised silicone sponge. Cases with more than one tear were preferably treated with PPV. In cases with more than one retinal tear that were treated with a silicon sponge, the retinal tears were proximal to each other. Due to the small sample size, we excluded cases that underwent vitrectomy combined with an encircling band and cases with a localised silicone sponge combined with an encircling band.

Statistical analyses

Demographic data and baseline findings were presented as the number of patients and percentages, normally distributed data were reported as means and SD and non-normally distributed data were reported as median with IQR. The Kolmogorov-Smirnov test was employed to test all variables for normal distribution. The Pearson's correlation or the Spearman's rank correlation coefficient was calculated to analyse correlations between factors. The unpaired t-test was conducted to compare normally distributed continuous data between methods or type of anaesthesia. A linear regression model was used with OR time as the dependent variable to determine the effect of clinical findings, surgical method and logistic variables on OR efficiency. All factors with a p value <0.1 on univariate linear regression were selected as covariates for the multivariate linear regression model. We used the beta coefficient (β) to describe the degree of change of the OR efficiency for every unit of change of the independent variable. Further, we conducted a stepwise binary logistic regression analysis to determine potential clinical and methodical confounders of primary success at 6 months after surgical reattachment of the primary RRD. All factors with a p value <0.1 on univariate analysis were selected as independent variables for the multivariate stepwise binary logistic regression. We also determined the OR of significant independent variables leading to success or failure.

All p values <0.05 were considered significant. Statistical analyses were performed using SPSS Statistics (IBM).

Patient and public involvement

Patients or members of the public were not involved in the design, implementation, analysis, or report of the present retrospective study.

RESULTS

The data of 783 consecutive patients were included in the study. The mean (SD) age was 61 (±12) years, 503 (64%) patients were men and 135 had pathological myopia (17%). At presentation, foveal involvement of the RRD was verified by SD-OCT in 377 (48%) cases. Three hundred and thirty (42%) eyes were found to have more than one retinal tear. PPV was performed in 641 (82%) eyes, and 142 (18%) eyes underwent SB surgery. Surgical treatment was performed within 24 hours after clinical

Table 1 Demographics and baseline characteristics of patients with primary rhegmatogenous retinal detachment treated with pars plans vitrectomy or scleral buckle surgery

Characteristics	Pars plana vitrectomy (n=641)	Scleral buckle (n=142)
Age (SD)	64 (12)	48 (13)
Sex (M/F) (%)	418 (65)/223 (35)	85 (60)/57 (40)
Myopia (%)	93 (15)	42 (30)
Pseudophakia (%)	296 (46)	8 (6)
Vitreous bleeding (%)	69 (11)	18 (13)
Weekend effect (%)	82 (13)	10 (7)
After-hours surgery (%)	161 (25)	23 (16)
PVR (%)	169 (26)	19 (13)
None (%)	472 (74)	123 (87)
A (%)	77 (12)	11 (8)
B (%)	29 (4)	2 (1)
C (%)	63 (10)	6 (4)
Number of retinal tears (IQR)	1 (1–2)	1 (1–1)
Retinal tear		
>1 tear (%)	298 (47)	32 (23)
Giant tear (%)	26 (4)	4 (3)
Ora dialysis (%)	4 (1)	2 (1)
Location of retinal detachment		
Superior temporal (%)	399 (62)	76 (54)
Superior nasal (%)	349 (54)	44 (31)
Inferior nasal (%)	267 (42)	45 (32)
Inferior temporal (%)	330 (51)	64 (45)
Extent of detachment (IQR)	5.0 (3.0–6.0)	3.0 (2.0–4.5)
≤4 hours (%)	284 (44)	103 (73)
4–8 hours (%)	280 (44)	34 (24)
>8 hours (%)	61 (10)	2 (1)
N/A (%)	16 (2)	3 (2)
Foveal involvement (%)	355 (55)	31 (22)
Surgical timing (IQR)	21 (1–193)	22 (1–139)
≤24 hours (%)	440 (69)	84 (60)
24–72 hours (%)	168 (26)	47 (33)
>72 hours (%)	33 (5)	11 (8)
Baseline BCVA in logMAR (IQR)	0.96 (–0.10–2.10)	0.20 (–0.10–2.00)

BCVA, best-corrected visual acuity; F, female; logMAR, logarithm of minimum angle of resolution; M, male; N/A, not applicable; PVR, proliferative vitreoretinopathy.

presentation in 524 (67%) cases. Further baseline characteristics of the patients in the two treatment groups (PPV or SB) are shown in detail in table 1. The number of different gauge sizes and the distribution of surgical methods and OR time according to the different gauge sizes are presented in table 2. Differences of clinical and surgical characteristics between cases treated with PPV

Table 2 Distribution of surgical methods according to different gauge sizes (G) in pars plana vitrectomy

	20G	23G	25G	27G
N	80	247	289	25
Combined phacoemulsification (%)	40 (50)	125 (50)	148 (51)	15 (60)
Anaesthesia				
Retrobulbar Anaesthesia (%), OR time in min (SD)	60 (75) 93 (42)	226 (92) 64 (31)	262 (91) 80 (29)	23 (92) 59 (19)
General Anaesthesia (%), OR time in min (SD)	20 (25) 135 (51)	21 (8) 96 (47)	27 (9) 111 (53)	2 (8) 74 (30)
Tamponade				
Gas (%)	59 (74)	219 (89)	275 (95)	24 (96)
Silicon oil (%)	21 (26)	28 (11)	14 (5)	1 (4)

*Indicates high statistical significance (p<0.01).
N, number; OR, operating room.

or SB surgery under GA or RA are presented in online supplemental table.

OR efficiency

The mean OR time was 93.8 (±42.5) and 71.8 (±30.5) (p<0.001) min for patients who underwent 20G and small gauge PPV under RA, respectively and 135.0 (±51.0) and 103.4 (±50.0) min (p=0.025), respectively for those who underwent PPV under GA. For SB surgery, the mean OR time with RA was 62.1 (±24.6) min, and the mean OR time with GA was 76.0 (±22.5) min (p<0.001). The OR time for SB surgery under GA and RA was significantly shorter than that for the PPV procedures (both p<0.001).

Multivariate linear logistic regression revealed that PPV was performed faster in patients who underwent small gauge vitrectomy (23G, 25G, 27G) than in those who underwent 20G PPV (all p<0.001). The presence of a giant tear (p=0.001, β=24.01), PVR grade C (p<0.001, β=16.43), inferior nasal location of the detachment (p<0.001, β=8.20), concomitant cataract extraction (p<0.001, β=8.52), the extent of detachment of more than 8 clock hours (p<0.001, β=14.17), surgeries postponed for ≥72 hours after diagnosis (p=0.001, β=21.40), GA (p<0.001, β=23.64) and surgeon experience (p<0.001, β=17.35) were correlated with a prolonged OR time (table 3).

Multivariate regression analysis of SB surgery outcomes revealed that the presence of a giant tear (p=0.012; β=26.67), number of retinal tears (p=0.004, β=4.12), GA (p<0.001, β=13.99) and surgeon experience (p<0.001, β=25.25) were associated with a longer OR time.

The patients who needed a second surgical intervention after PPV and SB surgery spent a median of 19 (7–50) min (p<0.001) and 61 (19–90) min (p=0.009) longer at the second intervention in the OR, respectively.

In a linear regression analysis of the time spent in the OR adjusted for the presence of PVR, inferior location of detachment, the extent of detachment, surgical timing and surgeon experience, there was no significant difference between phaco-vitrectomy and PPV alone using 23G, 25G or 27G in phakic eyes or pseudophakic eyes (p=0.244 and p=0.375, respectively). Figure 1 represents the distribution of OR efficiency in SB surgery or PPV in the presence of certain clinical and logistic factors that had, according to the multivariate analysis, a significant impact.

Success rate

Primary success was achieved in 81.7% of the eyes. No further treatment was needed in 521 (81.3%) eyes after surgical treatment with PPV or in 119 (83.8%) cases after SB surgery (p=0.549). A combined phaco-vitrectomy procedure was performed in 328 (51%) cases and showed no significantly different success rate of PPV in pseudophakic eyes (p=0.418). Patients with a re-detachment presented to the department within a median (IQR) of 32 days (15–69), and 50%, 85% and 97% of which experienced re-detachment within 1, 3 and 6 months, respectively.

In cases treated with PPV, after applying a stepwise binary logistic regression adjusted for age, vitreous bleeding, after-hours surgery, retinal tear in the superior nasal and inferior temporal quadrants, foveal involvement of retinal detachment, gauge size used in PPV procedure and surgical timing, only the presence of PVR (p=0.022, β=0.499±0.219) remained as a significant risk factor for re-detachment (table 4). Eyes with the presence of PVR had 65% higher likelihood of experiencing re-detachment. In cases treated with SB surgery, stepwise binary logistic regression adjusted for pseudophakic eyes, weekend effect, after-hours surgery, surgical timing and surgeon experience revealed that after-hours surgeries (p=0.006; β=1.52±0.549; 95% CI 1.54 to 13.27) and surgeon experience (p=0.030; β=1.17±0.538; 95% CI 1.11 to 9.12) were correlated with a reduced primary success rate. The odds for re-detachment were 3.2 times higher when SB surgery was performed by a trainee and 4.5 times higher if the surgery was performed after-hours.

Table 3 Potential factors affecting time efficiency of pars plana vitrectomy and scleral buckle surgery

Characteristics	Pars plana vitrectomy		Scleral buckle	
	Univariate analysis	Multivariate analysis*	Univariate analysis	Multivariate analysis†
	P value (β–SE)	P value (β–SE)	P value (β–SE)	P value (β–SE)
Age	0.018‡ (−0.288–0.121)	0.267 (−0.113–0.101)	0.048‡ (−0.276–0.138)	0.692 (−0.053–0.133)
Sex (M/F)				
Male	Reference		Reference	
Female	0.080 (−5.42–3.09)	0.107 (−3.98–2.47)	0.190 (−5.51–4.19)	
Myopia	0.983 (0.092–4.19)		0.026‡ (10.03–4.46)	0.078 (7.04–3.97)
Cataract§	0.057 (10.68–2.89)	<0.001¶ (8.52–2.36)	N/A	
Vitreous bleeding	0.270 (5.23–4.74)		0.571 (3.55–6.24)	
Weekend effect	0.175 (5.94–4.37)		0.874 (1.29–8.14)	
After-hours surgery	0.465 (−2.47–3.38)		0.383 (4.93–5.63)	
Gauge sizes				
20G	Reference		N/A	
23G	<0.001¶ (−37.10–4.49)	<0.001¶ (−32.48–4.09)	N/A	
25G	<0.001¶ (−20.82–4.41)	<0.001¶ (−18.20–4.09)	N/A	
27G	<0.001¶ (−43.47–8.03)	<0.001¶ (−31.81–6.91)	N/A	
PVR	<0.001‡ (10.01–1.45)	<0.001¶ (5.45–1.37)	0.012 (7.55–2.96)	0.073 (4.95–2.74)
None	Reference		Reference	
Grade A	0.293‡ (4.63–4.41)		0.561 (−4.42–7.58)	
Grade B	<0.001‡ (26.85–6.98)	0.175 (8.13–5.99)	0.077 (30.67–4.32)	0.372 (13.72–15.33)
Grade C	<0.001‡ (29.15–4.81)	<0.001¶ (16.43–4.13)	0.010‡ (26.36–10.08)	0.057 (17.38–9.04)
Number of retinal tears	0.674 (0.376–0.892)		<0.001‡ (7.75–1.65)	0.004¶ (4.12–1.42)
Retinal tear				
1 tear	Reference		Reference	
>1 tear	0.265 (3.33–2.98)		0.001‡ (15.99–4.68)	0.045‡ (8.26–4.09)
Giant tear	0.001‡ (24.11–7.37)	<0.001¶ (24.01–5.81)	0.008‡ (33.06–12.23)	0.012‡ (26.67–10.43)
Ora dialysis	0.035‡ (38.99–18.47)	0.081 (25.12–14.65)	N/A	
Location of retinal detachment				
Superior temporal	0.842 (0.588–2.95)		0.381 (−3.73–4.24)	
Superior nasal	0.227 (3.65–3.03)		0.587 (−2.24–4.11)	
Inferior nasal	<0.001‡ (15.02–2.92)	<0.001¶ (8.2–2.72)	0.004‡ (12.64–4.32)	0.520 (2.62–4.06)
Inferior temporal	<0.001‡ (11.66–2.90)	0.080 (3.47–2.65)	0.003‡ (12.12–4.00)	0.610 (1.92–3.74)
Extent of detachment	<0.001‡ (4.57–0.554)	<0.001¶ (2.45–0.641)	<0.001‡ (3.94–1.09)	0.020‡ (2.36–1.00)
≤4 hours	Reference		Reference	
4–8 hours	0.010‡ (7.71–2.98)	0.154 (3.94–2.76)	0.047‡ (9.34–4.66)	0.628 (2.02–4.15)
>8 hours	<0.001‡ (31.43–5.04)	<0.001¶ (14.17–4.94)	0.006‡ (45.62–17.13)	0.061 (28.15–14.88)
Foveal involvement	0.564 (−3.29–5.69)		0.965 (−0.334–7.79)	
Surgical timing	0.001‡ (0.144–0.041)	<0.001¶ (0.193–0.041)	0.902 (−0.008–0.067)	
≤24 hours	Reference		Reference	
24–72 hours	<0.001‡ (15.16–3.25)	0.010‡ (6.83–2.75)	0.413 (3.66–4.46)	
>72 hours	<0.001‡ (38.41–7.68)	0.001¶ (21.40–6.50)	0.282 (8.11–8.52)	
General anaesthesia	<0.001‡ (33.63–3.12)	<0.001¶ (23.64–2.98)	<0.001‡ (13.10–4.00)	0.001¶ (13.99–3.91)
Surgeon experience	0.029‡ (8.68–3.97)	<0.001¶ (17.35–3.22)	<0.001‡ (21.72–4.85)	<0.001¶ (25.25–4.40)

*Linear regression adjusted for age, sex, eyes with combined cataract surgery, PVR, detached inferior nasal, detached inferior temporal quadrant, extent of detachment, surgical timing, general anaesthesia and surgeon experience.
†Linear regression adjusted for age, myopia, presence of PVR, number of retinal tears, detached inferior nasal quadrant, detached inferior temporal quadrant, general anaesthesia and surgeon experience.
‡Indicates statistical significance (p<0.05).
§Combined phaco-vitrectomy.
¶Indicates high statistical significance (p<0.01).
F, female; M, male; N/A, not applicable; PVR, proliferative vitreoretinopathy; β, beta coefficient.
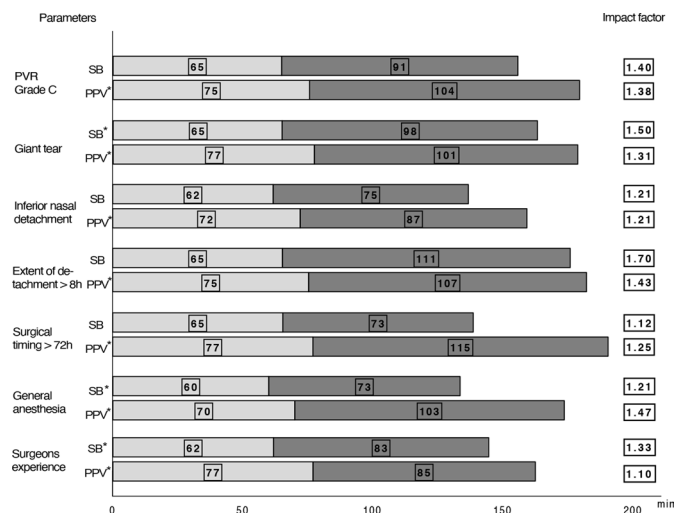
Figure 1 Distribution of operating room (OR) time for scleral buckle (SB) or pars plana vitrectomy (PPV) surgeries with the involvement of clinical and logistic factors. The graph shows a distribution of OR time in minutes according to method (SB or PPV) in the presence of certain factors that had, in accordance with the multivariate analysis, a significant impact on OR efficiency. The dark grey bar chart represents the OR efficiency with the given factor, and the light grey bar chart represents that without the given factor. Impact represents the relative change in OR time if the given factor was present. PVR, proliferative vitreoretinopathy.

DISCUSSION

The identification of clinical, methodological and logistic features affecting OR efficiency and the recognition of risk factors reducing the success rate in the surgical management of RRD are paramount in order to individually optimise preoperative planning and postoperative management. Thus, we established an electronic register to monitor quality and efficiency indicators for vitreoretinal surgery at one tertiary referral centre for retinal detachment, and 783 consecutive cases with primary RRD were included in this retrospective registry study.

Our findings demonstrate that numerous factors were involved in prolonged OR time for PPV or SB surgery. Multivariate analysis revealed that presence of a giant tear, a PVR grade C, or an advanced extent of detachment had the greatest impact on OR time in cases treated with PPV, which accounted for 24 (32%), 16 (21%) and 14 (18%) min, respectively, of additional time spent in the OR. Combined phaco-vitreytomy or an RRD located in the inferior nasal quadrant had an impact of up to 8 (10%) min. Surgery performed under GA, postponed beyond 72 hours after diagnosis and performed by a trainee consumed up to 23 (31%), 21 (28%) and 17 (22%) min more OR time, respectively. We also found that the time spent in the OR was 18–30 (24%–40%) min shorter for small gauge vitrectomies (23G, 25G and 27G) than for 20G vitrectomy. Overall, after conducting the multivariate analysis, we did not find a difference in OR efficiency or success rate between small gauge vitrectomies.

In cases treated with SB surgery, regression analysis revealed that the average OR time was 26 (41%) min longer if a giant tear, and it was 8 (12%) min longer if more than one retinal tear was present. However, in this study cohort, cases with more than one retinal tear were only treated with SB surgery if the retinal tears were proximal to each other. When SB surgeries were performed by a trainee or under GA, 25 (40%) and 14 (22%) min of additional OR time was needed, respectively.

In our study cohort, only 11% of cases undergoing PPV and 8% of cases undergoing SB surgery were performed under GA. Further, there was no difference in anatomical success between types of anaesthesia or gauge sizes utilised for PPV. With regard to the presented OR efficiency, the additional costs and negative effects of GA on OR efficiency should be considered individually before choosing the surgical settings.[19 20] It should also be considered that an increased failure rate has an immense effect on the efficiency of the OR. In addition to the fact that a second surgery needs to be planned, patients experiencing a second detachment spent a significant longer time in the OR for the second surgery compared with the primary surgery. However, it has to be mentioned that the duration of second interventions in this study showed a high variance and the aspect of OR efficiency in these cases should be considered individually.

In the present study, we found a primary anatomical success rate of 81% after PPV treatment in 641 cases, which is comparable with the results of recent reports of a national register and other monocentric retrospective studies.[5 21] Our finding of a success rate of 84% among 142 eyes after SB surgery is also similar to that in these studies. PPV was preferred as the second surgical intervention in 78% of cases with re-detachment after SB surgery.

Several studies have analysed various factors potentially influencing the success rate of surgical treatment in RRD. Depending on the definition of primary success, the extent of detachment, macular involvement, reduced visual acuity, presence of PVR and surgeries performed on weekends have been related to reduced success rate.[11 21 22] However, the power of the statistical analysis has been limited by either the number of patients or the difficulty in including all considerable confounders in national register studies.[3 5 21–23] In our study, after conducting a stepwise binary logistic regression, the presence of PVR was the only factor associated with a reduced success rate after performing PPV. In these cases, there was a 68% greater chance of a second detachment within 6 months after surgery. In patients treated with SB surgery, we conducted a stepwise binary logistic regression and found that an after-hours setting and surgeon experience were correlated with a reduced primary success rate. After-hours setting and lack of experience increased the risk for surgical failure by threefold to fourfold. In contrast to the findings of Lee et al,[22] we were not able to confirm the weekend or after-hours effect in the success rate of RRD after surgical treatment with PPV.

Table 4 Potential risk factors associated with re-detachment after pars plans vitrectomy and scleral buckle surgery

Characteristics	Pars plana vitrectomy		Scleral buckle	
	Univariate Analysis	Multivariate analysis*	Univariate analysis	Multivariate analysis†
	P value (β–SE)	P value (β–SE)	P value (β–SE)	P value (β–SE)
Age	0.056 (0.017–0.009)		0.917 (−0.002–0.002)	
Sex (M/F)	0.265 (0.233–0.209)		0.303 (−0.505–0.409)	
Axial length (≥26.5 mm)	0.865 (−0.048–0.284)		0.551 (−0.288–0.483)	
Pseudophakic	0.794 (0.054–0.207)		0.086 (1.32–0.773)	
Vitreous bleeding	0.059 (−0.784–0.412)	0.057 (−0.790–0.415)	0.461 (0.457–0.619)	
Weekend effect	0.109 (−0.568–0.354)		0.007‡ (0.184–0.681)	
After-hours surgery	0.034‡ (−0.549–0.260)	0.057 (−0.501–0.263)	0.002‡ (1.57–0.513)	0.006‡ (1.52–0.549)
PVR	0.010‡ (0.560–0.216)	0.022‡ (0.499–0.219)	0.195 (−1.37–1.05)	
None	Reference		Reference	
Grade A	0.158 (0.471–0.296)		0.430 (−0.846–0.068)	
Grade B	0.043‡ (0.857–0.423)		N/A	
Grade C	0.094 (0.527–0.314)		N/A	
Number of retinal tears	0.429 (0.046–0.058)		0.631 (0.081–0.168)	
Retinal tear				
1 tear	Reference		Reference	
>1 tear	0.920 (−0.021–0.207)		0.790 (0.148–0.556)	
Giant tear	0.999 (19.7–23.2)		N/A	
Ora dialysis	N/A		N/A	
Location of retinal detachment				
Superior temporal	0.235 (−2.45–2.06)		0.753 (0.145–0.459)	
Superior nasal	0.021‡ (−0.471–0.204)		0.593 (−0.036–0.068)	
Inferior nasal	0.303 (0.210–0.204)		0.268 (−0.600–0.541)	
Inferior temporal	0.024‡ (0.467–0.207)		0.282 (−0.511–0.475)	
Extent of detachment	0.672 (0.017–0.039)		0.811 (−0.032–0.134)	
≤4 hours	Reference		Reference	
4–8 hours	0.850 (0.41–0.218)		0.435 (−0.463–0.592)	
>8 hours	0.367 (0.308–0.341)		N/A	
Foveal involvement	0.053 (0.202–0.104)		0.991 (−0.003–0.276)	
Surgical timing	0.198 (0.005–0.004)		0.643 (−0.005–0.011)	
≤24 hours	Reference		Reference	
24–72 hours	0.100 (0.369–0.224)		0.090 (0.816–0.482)	
>72 hours	0.281 (0.459–1.16)		0.559 (0.497–0.851)	
Baseline BCVA, logMAR	0.109 (0.227–0.141)		0.815 (0.096–0.410)	
Surgeon experience	0.713 (0.099–0.268)		0.016‡ (1.20–0.495)	0.030‡ (1.17–0.538)

*Stepwise binary logistic regression adjusted for age, vitreous bleeding, after-hours surgery, retinal tear in the superior nasal and inferior temporal quadrants, foveal involvement of retinal detachment, gauge size used in PPV procedure, surgical timing and proliferative vitreoretinopathy (PVR).
†Stepwise binary logistic regression adjusted for pseudophakic eyes, weekend effect, after-hours surgery, surgical timing and surgeon experience.
‡Indicates statistical significance (p<0.05).
BCVA, best-corrected visual acuity; logMAR, logarithm of minimum angle of resolution; N/A, not applicable; PVR, proliferative vitreoretinopathy; β, beta coefficient.

The limitations of the study include its retrospective nature and that a follow-up visit for every individual patient was not possible. Therefore, many patients were followed up by private ophthalmologists or local clinics. However, our clinic is the tertiary centre in the region, and practically all patients diagnosed with a re-detachment are referred again to our department.

The strength of the study is the large number of patients that were diagnosed and treated at one tertiary referral centre for retinal detachment. To the best of our knowledge, this is the first study to comprehensively analyse

various clinical, methodological and logistic factors affecting time efficiency in the OR. Further, in contrast to national register studies, we were able to include numerous potential confounders in the multivariate analysis for OR efficiency and risk factors of anatomical success. Six surgeons with different levels of experience were involved in the surgical treatment of primary RRD in the present study, thus allowing us to include the level of experience in the multivariate analysis. Based on these findings, the presented results may help clinicians compare the time metrics of surgery, as well as allow

them to benchmark their OR efficiency, success rates, and consider various factors for optimised preoperative planning, surgical care and postoperative management.

In conclusion, the present study identified clinical factors, including giant tear, PVR-C, advanced detachment, and inferior nasal detachment, that prolonged OR time by a factor of 1.1–1.3. Surgical methods and choice of anaesthesia had an additional impact on OR time by a factor of up to 1.4. As a result of the current findings, the surgical coordination department of our institution consequently assigns patients with RRD with a giant tear, advanced PVR signs, and retinal detachments involving more than 8 clock hours to be performed during normal OR hours with the regular theatre staff.

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