



Cost Analysis of Scleral Buckle and Pars Plana Vitrectomy for Retinal Detachment Surgery

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Background and Objective: To compare the cost and utility of scleral buckle (SB) and pars plana vitrectomy (PPV) techniques for repairing moderately complex rhegmatogenous retinal detachment (RRD).

Patients, Materials, and Methods: A cost-utility analysis was conducted using data from the Primary Retinal Detachment Outcomes Study (PRO) and a study conducted by the author. Total costs, patient utility over a lifetime, and cost per quality-adjusted life year (QALY) were calculated for each surgical procedure.

Results: The cost of scleral buckle surgery was €287.93, with an estimated lifetime QALY of 7.49. Costs per QALY were €38.44. According to the PRO study and Belin et al, total costs were \$5975, with a lifetime QALY of 5.4 and costs per QALY of \$1106. The cost of pars plana vitrectomy (PPV) was €1468.26, with an estimated lifetime QALY of 6.84 and costs per QALY of €214.65. Based on the PRO study and Belin et al, total costs were \$8125, with a lifetime QALY of 4.7 and costs per QALY of \$2196.

Conclusion: Repairing moderately complex RRD presents a highly cost-effective profile for both SB and PPV techniques, well below recommended QALY thresholds. SB demonstrated a slightly more favorable profile compared to PPV.

Keywords: retinal detachment, pars plana vitrectomy, scleral buckle, cost-utility analysis, QALY

Introduction

In recent years, the rise in healthcare costs has prompted the need to assess the cost-effectiveness of medical and surgical interventions, given the increase in population life expectancy.^{1,2} In response to these challenges, strategies to optimize resources have emerged, including the evaluation of costs per intervention, lifetime utility, and quality-adjusted life year (QALY).³

Retinal detachment repair has seen a shift in the most commonly used techniques, with pars plana vitrectomy (PPV) gaining ground over scleral buckle surgery.⁴⁻⁶ Nonetheless, findings from the PRO study have shown favorable outcomes for scleral buckle surgery in terms of visual function recovery and anatomical surgical success.⁷ These findings suggest the viability of equitable indication between both techniques, emphasizing the importance of individualized decision-making for each case to benefit the patient.

This study aims to conduct a cost-utility analysis for the treatment of moderately complex retinal detachment with macula involvement. We will compare scleral buckle surgery with pars plana vitrectomy based on the results from the PRO study and research conducted by the author, which also addresses the visual outcomes of both surgical techniques.^{7,8}

Materials and Methods

The study comparing the visual outcomes of both surgical techniques, conducted by the author, received approval from the Ethics Committee for Drug Research at the La Fe University and Polytechnic Hospital in Valencia, Spain. This study adhered to the principles of the Helsinki Declaration. The methodology used for this study is based on the studies by Elhusseiny and Belin.^{9,10} Data published by the author and from the study by Belin et al, based on the PRO study, were used to calculate resource utilization, visual outcomes, and the effectiveness of surgical repair for moderately complex

retinal detachment in phakic patients (Tables 1 and 2). The definition of moderate complexity can be found in the PRO study.

To calculate the costs (in €) of surgical repair for both techniques in the year 2023, the costs of surgical materials and healthcare personnel in the Valencian Community (Spain) were considered,¹¹ including the salaries of the surgeon, anesthesiologist, nursing staff, nursing assistant, and orderly (Table 3). Hospitalization costs were not applied, as the visitation regime was outpatient. The probability of reintervention due to retinal detachment recurrence (obtained from the PRO study) was also considered. The cost derived from reinterventions were considered. The technique assumed for reoperation was pars plana vitrectomy (the cost of PPV was multiplied by the surgical failure rate, multiplied by the average number of reoperations for recurrent retinal detachment). Additional costs for cataract extraction, if required, were considered (acquired from the PRO study). A discount rate of 3% per year (for intervention cost and QALY obtained) was applied for the cost-utility analysis in both groups from the second year (month 13) onwards, as proposed by Brown.¹² These calculated costs were used to conduct the cost-utility analysis for each treatment (total costs, lifetime QALY, and cost per QALY).

Table 1 PRO Study Outcome Data

Outcome	SB	PPV	PPV/SB
Preoperative VA (mean Snellen equivalent)	20/63	20/224	20/205
Macula sparing	20/30	20/37	20/35
Macula involving	20/348	20/1002	20/935
Postoperative VA at 12 Months	20/30	20/44	20/43
Macula sparing	20/29	20/33	20/36
Macula involving	20/34	20/55	20/52
Macular Status (%)			
Macula sparing RD	70	55	54
Macula involving RD	30	45	46
Primary Retinal Reattachment Rate (%)	91,7	83,1	91,2
Secondary anatomic success (%)	99,4	96,4	96,3
Average number of reoperations	1,6	1,8	2,0
Average age, years (SD)	56,2 (7,9)	60,0 (8,4)	59,1 (7,7)
Male gender (%)	55	62	60

Abbreviations: VA, visual acuity; SD: standard deviation.

Table 2 Surgery Costs (Personnel, Materials, Total)

Cost Category	PPV	Scleral Buckling
Health personnel	154,3 €	154,3 €
Surgical Material	661,4 €	25,6 €
Total	815,7 €	180,0 €
Reinterventions (Pro Study)	1,8	1,6
Total Costs	1.468,26 €	287,94 €

Table 3 Total Imputed Costs (in €) for RRD Repair, QALY Gained, and Cost per QALY at 12 Months

Metric	PPV	Scleral Buckling
Cost	1.468,26 €	287,93 €
QALY	6,84	7,49
Cost/QALY	214,65 €	38,44 €

Table 4 Total Imputed Costs (in US Dollars) for RRD Repair, QALY Gained, and Cost per QALY at 12 Months (PRO Study, Belin et al Study)

Metric	PPV	Scleral Buckling
Cost	5.975,00 USD	3.775,00 USD
QALY	3,7	5,4
Cost/QALY	1.374,00 USD per QALY	699,00 USD per QALY

Ophthalmic surgeries are considered not to influence life expectancy but do affect vision-related quality of life.³ Utility values from the study proposed by Brown,¹¹ were used as a reference for both the analysis of the first (other) eye and the second (better) eye. An untreated retinal detachment is associated with a visual acuity of counting fingers, corresponding to a utility value of 0.52.¹⁰ Postoperative visual acuity in the pars plana vitrectomy group was 20/44, and in the scleral buckle group was 20/30 (PRO study). Visual acuity in the study conducted by the author was 20/32 in the PPV group and 20/40 in the scleral buckle group. Utility values proposed by Brown¹³ in the analysis of the first eye range from 0.87 for visual acuity ranging from counting fingers to 20/30, indicating minimal differences between non-intervention and retinal detachment surgery. However, utility gains in the analysis of the second eye can be calculated by obtaining the difference in utility for untreated counting fingers vision (0.52) and the postoperative vision obtained in the studies (ranging from 0.84 for 20/30 vision to 0.8 for 20/40 vision).

The mean age in the PRO study was 56.2 years in the scleral buckle group and 60.0 in the PPV group. The mean age in the author's study was 56.45 in the scleral buckle group and 58.75 in the PPV group. Life expectancy was obtained from data from the Ministry of Health of Spain, which was 83.2 years.² Lifetime QALY and cost per QALY were calculated based on the age of each group in the PRO study and the author's study. Microsoft Excel was used for data analysis.

Results

Retinal Detachment of Moderate Complexity, Repaired with Scleral Buckling

The total cost of the intervention (on an outpatient basis), including healthcare personnel and surgical material, was €287.93. The estimated lifetime QALY was 7.49 QALYs (macula off). The costs per QALY were €38.44. Based on the PRO study and Belin et al^{7,10} (Table 4), the total costs were \$5975. The lifetime QALY was 5.4. The costs per QALY were \$1106.

Retinal Detachment of Moderate Complexity, Repaired with Pars Plana Vitrectomy

The total cost of the intervention (on an outpatient basis), including healthcare personnel and surgical material, was €1468.26. The estimated lifetime QALY was 6.84 QALYs (macula off). The costs per QALY were €214.65. Based on the PRO study and Belin et al^{7,10} (Table 4), the total costs were \$8125. The lifetime QALY was 4.7. The costs per QALY were \$2196.

Discussion

Surgery for moderate difficulty retinal detachment has proven to be highly cost-effective in both surgical techniques (slightly favoring scleral buckling). Both interventions demonstrate significantly lower costs/QALY than the maximum threshold of \$100,000–\$150,000/QALY.^{14,15} Compared to the costs/QALY of other medical treatments, it has been shown to be superior to the treatment of arterial hypertension (7389\$),³ dyslipidemia (77800\$),³ or hemodialysis in chronic kidney disease (72476\$).¹⁶ Likewise, using the second eye as a model (better eye),¹¹ compared to other ophthalmological treatments, it is superior to surgical treatment of epiretinal membrane (4680\$/QALY)¹⁷ and wet AMD treatment with intravitreal ranibizumab injections (45995\$/QALY),¹⁸ which are widely used in daily ophthalmological practice.

Similar previous studies had shown a very favorable profile for scleral buckling in phakic patients, while PPV had shown to be more favorable in pseudophakic patients.¹⁹ However, these studies were based on the RRD study,²⁰ which

showed less favorable final visual acuities (20/80). Other comparative articles between pneumatic retinopexy and PPV, using similar methods, also showed highly cost-effective results, slightly favoring pneumatic retinopexy.^{17,21}

It is important to note the limitations of our study, such as the calculation of total costs based on personnel costs from the Valencian community. Therefore, while these results may be approximate, they cannot be extrapolated exactly to the rest of Spain or Europe due to the lack of salary uniformity between regions. Another significant limitation would be the difference in age between surgical groups, being lower in the scleral buckling group, thus influencing the costs/QALY, slightly benefiting the scleral buckling group.

Conclusions

This study demonstrates that surgeries for moderate difficulty retinal detachment repair present a highly favorable cost-effectiveness profile in both surgical techniques, surpassing that of other widely used treatments in medicine. Additionally, it is well below the \$100,000–\$150,000/QALY threshold. Scleral buckling surgery exhibits a more favorable profile compared to PPV. These results should guide other specialists in choosing the most appropriate surgical technique in each case, considering the individual characteristics of each patient.

Abbreviations

PPV, Pars plana vitrectomy; RRD, rhegmatogenous retinal detachment; QALY, quality-adjusted life year.

Ethical Considerations

All of the methods within this study were in compliance with the declaration of Helsinki.

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Disclosure

The authors declare no conflicts of interest.

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