Original Article

Long-term Complications of Conventional and Chandelier-Assisted Scleral Buckle for Primary Repair of Rhegmatogenous Retinal Detachment

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Abstract

Purpose: To compare the outcomes of conventional indirect ophthalmoscopy and wide-angled visualization with chandelier endo-illumination methods in scleral buckle surgery by focusing on postoperative complications in the postoperative long-term period.

Methods: In this retrospective comparative study, patients who underwent scleral buckle surgery due to rhegmatogenous retinal detachment were included in the study. Conventional scleral buckle surgery using indirect ophthalmoscopy was performed in Group 1, and wide-angled visualization with chandelier endo-illumination method in scleral buckle surgery was performed in Group 2. The outcomes of the two methods were compared.

Results: The demographic and baseline clinical characteristics of the groups were similar ($P > 0.05$, for all). The mean follow-up time was 70.47 ± 20.32 weeks (52–116) in Group 1 and 64.89 ± 18.12 weeks (52–100) in Group 2 ($P > 0.05$). There was no significant difference in the mean postoperative best-corrected visual acuity and redetachment rates of the groups ($P > 0.05$, for both). The cumulative rate of postoperative complications was more frequent in Group 1 ($P = 0.011$) despite being not significant in one-by-one comparison of the complications including epiretinal membrane, proliferative vitreoretinopathy, glaucoma, cystoid macular edema, foveal atrophy, gaze restriction, and macular hole ($P > 0.05$, for all).

Conclusion: Using wide-angled visualization with chandelier endo-illumination in scleral buckle surgery, favorable surgical outcomes can be achieved in the postoperative long-term period with fewer complications.

Keywords: Chandelier, Complication, Retinal detachment, Scleral buckle, Vitreoretinal surgery

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Introduction

Rhegmatogenous retinal detachment refers to the separation of the sensory retina from the underlying retinal pigment epithelium caused by retinal tear or tears. The treatment options of the disease include scleral buckle, pars plana vitrectomy, and pneumatic retinopexy. Scleral buckle surgery was introduced in the 1950s and was proven as a safe and effective method in rhegmatogenous retinal detachment.[1] Several studies reported scleral buckle may be superior to the other techniques for some cases, such as uncomplicated phakic rhegmatogenous retinal detachment.[1,2]

In the conventional method of scleral buckle surgery, indirect ophthalmoscopy is used for vitreoretinal illumination, and a hand-held magnifying lens is used to identify and treat retinal tears. This method may be challenging especially for

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less experienced surgeons, regarding detecting the details of vitreoretinal pathologies through a small and inverted image. In an alternative method, a chandelier endo-illuminator is inserted through a fine sclerotomy similar to pars plana vitrectomy techniques, and technical difficulties of vitreoretinal visualization are solved with noncontact lens systems. This method provides a wide-angled illuminated area and a magnified and straight image.

Wide angled visualization with chandelier endo-illumination in scleral buckle surgery has been found as technically easier and more comfortable by many vitreoretinal surgeons.[3] On the other hand, the effects of this method on anatomic and functional outcomes during the long-term period are not fully clarified. To fill this gap, this study aims to compare the outcomes of conventional indirect ophthalmoscopy method and wide-angled visualization with chandelier endo-illumination method in scleral buckle surgery by focusing on postoperative complications in the long-term period.

Methods

This retrospective comparative study was carried out at the Ophthalmology Department at a tertiary referral hospital in Ankara, Turkey. The procedures were applied for the ethical standards of the Declaration of Helsinki for human subjects and written informed consent was obtained from each subject after an explanation of the invasive procedures. The ethical board approval was granted by the local research ethics committee.

Patients who underwent scleral buckle surgery due to bullous type rhegmatogenous retinal detachment were included in this study. Patients with the following conditions were excluded from the study: (1) Media opacity (e.g., dense cataract or vitreous hemorrhage); (2) aphakia (no crystalline or intraocular lens) or intraocular lens drop; (3) proliferative vitreoretinopathy more than grade B; (4) history of other retinal diseases (e.g., diabetic retinopathy, retinal dystrophies, age-related macular dystrophy, macular hole, uveitis, or intraocular tumor); (5) history of previous ocular surgery except for cataract surgery (e.g., surgical repair of open globe injury, trabeculectomy, strabismus surgery, intravitreal injection, or pars plana vitrectomy); (6) history of systemic diseases or conditions that have a potential to affect the retina (e.g., hematological malignancy, Behcet's disease, radiotherapy, or corticosteroid use); and (7) <1-year follow-up time after scleral buckle surgery. The subjects were separated into two groups: Group 1 was constructed with patients who underwent conventional scleral buckle surgery using indirect ophthalmoscopy. Group 2 was constructed with patients who underwent scleral buckle surgery using wide-angled visualization with the chandelier endo-illumination method. Any preoperative clinical characteristics were not determined as a criterion to select one of these two different techniques.

After obtaining medical history, all patients underwent a complete ophthalmological examination including the best-corrected visual acuity (BCVA) with a Snellen chart (the results were converted to logMAR), intraocular pressure (IOP) with applanation tonometry, and slit-lamp biomicroscopy for anterior segment. The posterior segment was evaluated after pupillary dilation with topical tropicamide 0.5% using a 90D magnifying lens, and a Goldmann three-mirror lens was used to view retinal tear or tears. A detailed colored scheme for retinal mapping was drawn before scleral buckle surgery. Ophthalmological evaluation including BCVA, IOP, anterior segment, and dilated posterior segment examination was performed in the postoperative examinations. Macular configuration and vitreomacular interface were also evaluated using a spectral-domain optical coherence tomography (Spectralis, Heidelberg, Germany).

All scleral buckle surgeries were performed by a highly trained retinal surgeon (M.C.). The surgeries were performed under local anesthesia, and 4 ml lidocaine 2% was injected with a 25-gauge 38 mm needle into the retrobulbar space. The operation site was cleaned with a povidone-iodine solution and covered with a sterile surgical drape. A surgical microscope was used, and 360° perilimbal peritomy was performed with Westcott scissors to expose sclera. The rectus muscles were secured with sling sutures (4-0 silk sutures). To visualize retinal tear or tears, indirect ophthalmoscopy and 20D condensing lens were used in Group 1. In Group 2, a sclerotomy was performed with a 25-gauge trocar 3.5 mm behind the limbus, 90° to 180° away from the retinal tear, and a noncontact wide-field visualization system (EIBOS 2; Haag-Streit Surgical GmbH, Hamburg, Germany) was used after a 25-gauge cannula-guided single-fiber chandelier probe (Alcon Laboratories Inc., Fort Worth, TX) insertion. All retinal tears were identified [Figure 1], and cryopexy was performed on the site corresponding with the retinal tears. Buckling material including a silicone sponge or silicone band was sutured to the sclera with a 5-0 ethibond and using mattress suture technique. In Group 2, the accuracy and adequacy of the height and position of the buckling material and cryotherapy area were evaluated using the wide-angled visualization. The sclerotomy site was sutured using 7-0 polyglactin suture. Subretinal fluid drainage and intravitreal air injection were performed in all cases. Conjunctiva was also sutured using 7-0 polyglactin suture, and topical antibiotic, steroid, and cycloplegic were prescribed for the postoperative medical treatment.

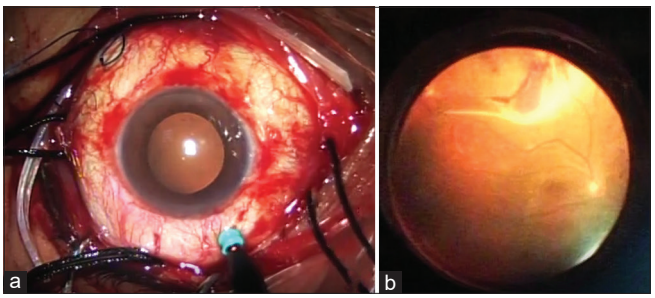

Figure 1: (a) Macroscopic view of chandelier-assisted scleral buckle surgery. (b) Intraoperative image of a retinal break

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0 software (IBM Corp., New York, USA). Descriptive statistics were presented as mean ± standard deviations and minimum-maximum values. Chi-square test was used for categorical variables, and a one-sample Kolmogorov–Smirnov test was used to test the normal distribution of variables. The Mann–Whitney *U* test was performed for the nonparametric variables. The statistical significance was set at $P < 0.05$.

Results

Group 1 included 25 eyes of the 25 patients and Group 2 included 20 eyes of the 20 patients. The mean age of the patients was 61.14 ± 10.67 years (38–74) in Group 1 and 59.45 ± 11.54 years (40–72) in Group 2. The male-to-female ratio was 14/11 in Group 1 and 11/9 in Group 2. The demographic characteristics of the groups were similar ($P > 0.05$, for both). The details of the demographic characteristics of the groups are given in Table 1.

The mean preoperative BCVA and IOP values were similar in the groups ($P > 0.05$, for both). The rates of the systemic diseases were also similar in the groups ($P > 0.05$). The most common risk factors associated with retinal detachment were previous cataract surgery, posterior capsular rupture, and pathologic myopia. There was no significant difference in the rates of retinal detachment-associated risk factors and the mean duration between the time of diagnosis and surgical procedure ($P > 0.05$, for both). The details of the baseline clinical characteristics of the groups are given in Table 1.

Eleven patients (44%) in Group 1 and 9 patients (45%) in Group 2 had no proliferative vitreoretinopathy. Seventeen patients (68%) in Group 1 and 12 patients (60%) in Group 2 had one retinal tear. Superotemporal and inferotemporal quadrants were the most common detached retinal quadrants. Sixteen patients (64%) in Group 1 and 10 patients (55%) in Group 2 had two detached retinal quadrants. Macula was attached in 20 patients (80%) in Group 1 and 12 patients (60%) in Group 2. The preoperative retinal examination findings of the groups were similar ($P > 0.05$, for all) and the details are given in Table 2.

An encircling band was used for all patients and it was combined with a local silicone sponge in 3 patients (12%) in Group 1 and 2 patients (10%) in Group 2 ($P > 0.05$). Any intraoperative complication was not observed in both groups, and vitreous loss did not happen in Group 2. The mean follow-up time after scleral buckle surgery was 70.47 ± 20.32 weeks (52–116) in Group 1 and 64.89 ± 18.12 weeks (52–100) in Group 2 ($P > 0.05$). The mean final BCVA and IOP values were similar in the groups ($P > 0.05$, for both). On the other hand, four patients in Group 1 and no patient in Group 2 needed IOP lowering medication in the final visit ($P > 0.05$). Redetachment occurred in 5 patients (20%) in Group 1 and 3 patients (15%) in Group 2 ($P > 0.05$). The cumulative rate of postoperative complications was significantly more frequent in Group 1 ($P = 0.011$), despite being not significant in a one-by-one comparison of the complications, including

Table 1: The details of the baseline clinical characteristics

	Group 1, *n* (%)	Group 2, *n* (%)	*P**
BCVA (logMAR)	0.89±0.21 (2.00-0.40)	0.92±0.24 (2.00-0.20)	0.510
IOP (mmHg)	11.94±4.03 (7-22)	13.60±3.14 (10-20)	0.081
Systemic diseases			0.368
Systemic hypertension	8 (32)	2 (10)	0.077
Coronary artery disease	2 (8)	4 (20)	0.239
Diabetes mellitus	1 (4)	2 (10)	0.422
Cerebrovascular diseases	2 (8)	1 (5)	0.688
Hematological diseases	1 (4)	0	0.365
Rheumatological diseases	0	1 (5)	0.258
Associated risk factors			0.746
Cataract surgery	10 (40)	6 (30)	0.486
Posterior capsule rupture	6 (24)	1 (5)	0.080
Pathologic myopia	4 (16)	3 (15)	0.928
Laser capsulotomy	1 (4)	1 (5)	0.871
Blunt trauma	1 (4)	1 (5)	0.871
The duration between the time of diagnosis and surgical procedure (weeks)	1.77±1.33 (1.00-6.00)	1.96±1.45 (1.00-6.00)	0.824

*Statistical analysis was made with Mann-Whitney-*U* test for continuous variables and Chi-square test for categorical variables. IOP: Intraocular pressure, BCVA: Best-corrected visual acuity

Table 2: The details of the preoperative retinal examination findings

	Group 1, *n* (%)	Group 2, *n* (%)	*P**
Proliferative vitreoretinopathy			0.945
No proliferative vitreoretinopathy	11 (44)	9 (45)	0.949
Grade A	8 (32)	7 (35)	0.832
Grade B	6 (24)	4 (20)	0.748
Number of tears			0.320
Tear not found	2 (8)	0	0.195
1	17 (68)	12 (60)	0.577
2	4 (16)	7 (35)	0.140
>2	2 (8)	1 (5)	0.688
Localization of tear			0.562
Superotemporal quadrant	12 (60)	7 (35)	0.380
Inferotemporal quadrant	6 (24)	9 (45)	0.137
Superonasal quadrant	3 (12)	3 (15)	0.768
Inferonasal quadrant	2 (8)	1 (5)	0.688
Detached quadrant			0.671
1	3 (12)	5 (5)	0.256
2	16 (64)	10 (50)	0.344
3	3 (12)	2 (10)	0.832
4	3 (12)	3 (15)	0.768
Attached macula	20 (80)	12 (60)	0.141

*Statistical analysis was made with Chi-square test for categorical variables

epiretinal membrane, proliferative vitreoretinopathy, glaucoma, cystoid macular edema, foveal atrophy, gaze restriction, and macular hole ($P > 0.05$, for all). The details of the postoperative clinical characteristics are given in Table 3.

Discussion

Many studies have attempted to determine the optimal surgical method for rhegmatogenous retinal detachment and comparable results have been reported for scleral buckle surgery and pars plana vitrectomy.[4,5] On the other hand, there has been a tendency for choosing pars plana vitrectomy for the first surgery in treating rhegmatogenous retinal detachment.[6,7] According to the American Society of Retinal Specialists Preferences and Trends Survey, scleral buckle surgery for primary rhegmatogenous retinal detachment was preferred as 28.7% by vitreoretinal surgeons from the USA, and 39.5% by vitreoretinal surgeons from the European countries.[8] The difficulties in the visualization with the indirect ophthalmoscope of the retina seem to be one of the important factors in the abandonment of scleral buckle surgery.[6,7] For this reason, clinical studies investigating the results of improved vitreoretinal illumination and visualization techniques in scleral buckle surgery with wide-angled visualization, heads-up surgery, and 3D visualization platforms have become more popular.[9,10] This study also contributes to the literature reporting the outcomes of wide-angled visualization with chandelier endo-illumination method in scleral buckle surgery.

Table 3: The details of the postoperative clinical characteristics.

	Group 1, *n* (%)	Group 2, *n* (%)	*P**
Follow-up time (weeks)	70.47±20.32 (52-116)	64.89±18.12 (52-100)	0.204
BCVA (logMAR)	0.41±0.37 (1.50-0.00)	0.48±0.30 (1.50-0.00)	0.915
IOP (mmHg)	15.62±3.78 (9-25)	14.99±5.05 (10-20)	0.921
Redetachment	5 (20)	3 (15)	0.662
Redetachment time (months)			0.874
3	3 (12)	1 (5)	0.465
6	1 (4)	1 (5)	0.673
>6	1 (4)	1 (20)	0.673
Complications			0.011
Epiretinal membrane	6 (24)	2 (10)	0.222
Proliferative vitreoretinopathy	4 (16)	2 (10)	0.556
Glaucoma	4 (16)	0	0.060
Cystoid macular edema	1 (4)	4 (20)	0.089
Foveal atrophy	4 (16)	0	0.060
Gaze restriction	2 (8)	1 (5)	0.688
Macular hole	1 (4)	0	0.365

*Statistical analysis was made with Mann-Whitney-*U* test for continuous variables and Chi-square test for categorical variables. IOP: Intraocular pressure, BCVA: Best-corrected visual acuity

The endo-illumination concept was introduced by Peyman[11] in 1976, for a 20-gauge vitrectomy. To perform bimanual surgery, chandelier light instruments were developed by Eckardt,[12] in 2003. Today, the chandelier endo-illumination method is commonly used in vitreoretinal surgery worldwide. In 2012, Aras *et al*.[13] described trans-scleral fiber-optic-assisted scleral buckle surgery for the first time in the repair of rhegmatogenous retinal detachment. Nam *et al*.[3] reported the results of the method using a chandelier endo-illuminator in scleral buckle surgery, while Seider *et al*.[14] summarized the advantages of this method as improved visualization of the peripheral retina, direct viewing during external drainage of subretinal fluid, facility in conversion to pars plana vitrectomy, enhanced teaching capabilities, and improved ergonomics. In the literature, there are several studies comparing the results of conventional method and chandelier endo-illuminator in scleral buckle surgery, and they reported the advantages of this method as to be an easier and more practical way to visualize the vitreoretinal pathologies.[3,5,13] This investigation focuses on another aspect of this method beyond being an easier and more practical way, the anatomical and functional outcomes of wide-angled visualization with chandelier endo-illumination method in scleral buckle surgery. According to the results of this study, postoperative BCVA values and redetachment rates of the two methods were slightly worse in the conventional method, but they were statistically similar after the relatively longer follow-up period.

In the literature, a few case series reported complications occurred after chandelier endo-illuminator-associated scleral buckle surgery, and nearly all of them focused on complications in the early postoperative period. Hu *et al*.[15] reported subretinal hemorrhage and ocular hypotony, which are some complications occurring immediately after surgery, and proliferative vitreoretinopathy and retinal detachment are other complications that can occur in a relatively longer postoperative period. English *et al*.[16] reported postoperative endophthalmitis following chandelier-assisted scleral buckle for primary repair of rhegmatogenous retinal detachment as a severe complication. One of the most important aspects of this study is focused on complications that occurred in the postoperative long-term period, and postoperative endophthalmitis was not observed in any of the subjects. Despite not being statistically significant, some postoperative complications, including epiretinal membrane, proliferative vitreoretinopathy, glaucoma, foveal atrophy, gaze restriction, and macular hole, more commonly occurred after scleral buckle surgery performed with conventional indirect ophthalmoscopy method. In addition, the cumulative rate of these postoperative complications reached statistical significance level, and it can be said that the conventional method is more associated with a total of the aforementioned complications. On the other hand, despite not being statistically significant, cystoid macular edema was found as the only postoperative complication that occurred more commonly in chandelier endo-illuminator-assisted scleral buckle surgery.

Identifying all retinal lesions is the key factor for the anatomical and functional success in scleral buckle surgery and missing retinal lesions, inadequate, or misplaced buckling material, and inadequate retinopexy due to poor visibility of retina are considered the most important causes for unsuccessful surgeries.[17] Small retinal tears can be missed even in a careful preoperative examination through indirect ophthalmoscopy. In wide-angled visualization with chandelier endo-illumination in scleral buckle surgery, better identification of retinal tears and determination of the adequacy of buckle height and position can be responsible for having lower rates of postoperative complications. In these cases, performing better screening for retinal tears and finding a greater number of retinal tears may cause the more intense performance of cryotherapy. This can be a reason why cystoid macular edema occurred more commonly (but statistically not significant) in cases using a chandelier endo-illuminator. Nevertheless, the results of this study did not support this hypothesis because the time and amount of cryotherapy application were not evaluated. Besides, the small sample size of the study and performing all surgeries by a highly experienced surgeon (who is already well-trained for conventional method) can be a reason for some parameters to be found as statistically not significant.

The previous studies reported some chandelier endo-illuminator-associated complications in scleral buckle surgery including suprachoroidal hemorrhage, endophthalmitis, retinal tear, and vitreous loss.[15-20] In this study, any chandelier endo-illuminator-associated complication or vitreous loss at the sclerotomy site was not observed. It was previously reported that the smaller sclerotomy decreases the risk of vitreous incarceration from the sclerotomy site and the risk of chandelier-associated complications.[21] The results of this study indicate wide-angled visualization with chandelier endo-illuminator in scleral buckle surgery to be as safe as the conventional method, and using of 25-gauge sclerotomy is probably the most important factor for this favorable outcome.

This study has important limitations including the retrospective design, relatively small sample size, relatively short follow-up duration, and not evaluating the time and amount of cryotherapy. On the other hand, focusing on complication rates in postoperative long-term periods and providing a different perspective from the previous studies are the most important strength of this study. In conclusion, wide-angled visualization with chandelier endo-illuminator in scleral buckle surgery is as safe as the conventional indirect ophthalmoscopy method. Using this method, favorable surgical outcomes can be achieved with fewer complications in postoperative long-term periods.

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Conflicts of interest
There are no conflicts of interest.

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