Comparative study between conventional scleral and suprachoroidal buckling in management of primary rhegmatogenous retinal detachment

Tamer M. Ibrahim[a], Ashraf Shaaban Shaarawy[a], Ehab N. El Rayes[b], Amr Saad Bessa[a]

[a]Department of Ophthalmology, Alexandria University, Alexandria, [b]Department of Ophthalmology, Research Institute of Ophthalmology, Egypt

Correspondence to Tamer M. Ibrahim, Department of Ophthalmology, Alexandria University, Alexandria, Egypt. e-mail: tamermoussa@gmail.com

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Aim

The aim of the work was to compare the anatomical and visual outcomes of conventional scleral buckling with suprachoroidal buckling in the management of uncomplicated primary rhegmatogenous retinal detachment with peripheral retinal breaks.

Method

A prospective randomized interventional case series of 30 cases of Primary uncomplicated rhegmatogenous retinal detachment with peripheral retinal breaks. Patients were equally distributed into two groups. Group A managed with conventional scleral buckling with 360 circumferential or Localized buckles. Group B managed with suprachoroidal buckling with injection of sodiumhyaluronate14 mg/ml into the suprachoroidal space using specially designed cannula.

Results

In group A,13 cases out of 15 achieved single-surgery attachment with success rate of 86% compared to12 out of 15 cases in group B with attachment rate of 80%. No statistical significance was found between the two groups.With respect to functional success,the visual acuity of patients of scleral buckling improved from a mean of 0.08±0.08 preoperatively to 0.33 to 0.33±0.22 postoperatively. Patients underwent suprachoroidal buckling improved from a mean of 0.12±0.11 preoperativelyto 0.36 to 0.36 to 0.36 to 0.36±0.19 postoperatively. Significant myopic shift was noted in patients of scleral buckling of mean of −2.48±0.83 D as compared with −0.58±0.56 D in suprachoroidal buckling.

Conclusion

Suprachoroidal buckling technique shows non inferior results in management of cases of Primary rhegmatogenous retinal detachment in comparison with scleral buckles,with suprachoroidal buckling less changes in refraction as compared with scleral buckles.

Keywords:
buckling, retina, retinal detachment

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Introduction

Retinal detachment is the separation of neurosensory retina from the RPE which is almost always irreversible and results in degeneration of the sensory retina in absence or surgical treatment. Rhegmatogenous retinal detachments are those which are caused by one or more full thickness retinal breaks [1]. The term retinal break refers either to a retinal tear or to a retinal hole. Retinal tears are commonly associated with vitreoretinal traction either with an attached flap or adjacent to a free-floating vitreous operculum. In contrast, retinal holes that occurs more commonly as a result of localized retinal atrophy and are not believed to be associated with vitreoretinal traction [2,3].

In the presence of liquefied vitreous and vitreoretinal traction, fluid gains access to the subneurosensory space through the retinal break creating neurosensory detachment. In retinal detachment, the normal forces maintaining neurosensory retinal attachment to the RPE (and including the Na^+/K^+-ATPase metabolic pump of the RPE, the osmotic pressure of the choroid, and the weaker forces of the interphotoreceptor matrix) are overwhelmed by opposing forces causing retinal detachment [4].

The management of a rhegmatogenous retinal detachment and its complications remains an important indication for vitreoretinal surgery.

Different techniques exist for treatment, with the type of surgery primarily influenced by clinical and demographic factors, as well as surgeon's choice [5].

Advances in vitreoretinal instrumentation have made pars plana vitrectomy (PPV) with the use of internal tamponade such as nonexpansile gas volumes or silicone oil a popular choice for the primary repair of rhegmatogenous retinal detachment [6]. However, the use of scleral buckles with creating chorioretinal adhesions around the retinal breaks remains the basis of therapy in many cases particularly detachments involving the inferior quadrants as well as those in young phakic patients with clear crystalline lens. This will prevent the access of vitreous fluid to the subretinal space allowing for retinal repositioning [7].

In scleral buckles, scleral indentation using an explant is used to bring the choroid in contact to the retina and facilitating the creation of chorioretinal adhesion and sealing of the retinal break. However, some cases of scleral buckles face some complications such as, mechanical ocular motility disturbance, corneal contour changes, choroidal circulatory changes, and refractive changes. To avoid these complications, the sclera may not be involved in the buckling effect [8–12].

On the basis of this therapeutic rationale, the idea of suprachoroidal buckling was introduced, which utilizes a specially designed catheter and cannula to inject a suprachoroidal filler, such as long-lasting hyaluronic acid solution to bring the choroid alone in contact with the retinal tear sealing it, minimizing vitreous traction, and supporting the retina instead of suturing a scleral buckle promoting attachment of the retina to the retinal pigment epithelium. The long-lasting hyaluronic acid can remain in the suprachoroidal space for 2–3 weeks, which is sufficient to create a permanent chorioretinal scar sealing the retinal break [5].

The suprachoroidal space represents a transition zone in the choroid (inner boundary and scleral outer boundary). The space consists of collagen and elastic fibers, melanocytes, ganglion cells, nerve plexuses, together with bipolar and multipolar cells. The long posterior ciliary arteries run anterior to the suprachoroidal space together with the nerve. The short ciliary arteries and the vortex veins run a short path in the suprachoroidal space [13,14].

The idea of suprachoroidal buckling was first introduced by Poole and Sudarsky as suprachoroidal implantation for treatment of peripheral retinal breaks in retinal detachment. A direct injection of 1% sodium hyaluronate with a 27-G cannula was successful in 14 patients with rhegmatogenous retinal detachment with peripheral breaks [15].

This indentation effect approached by suprachoroidal method can also be used to treat recurrent retinal detachment under silicone, together with macular buckling in cases of myopic tractional maculopathy [16].

Aim

The aim of the work was to compare the anatomical and visual outcomes of conventional scleral buckling with suprachoroidal buckling in the management of uncomplicated primary rhegmatogenous retinal detachment with peripheral retinal breaks.

Patients and methods

The study was conducted on 30 cases of primary uncomplicated rhegmatogenous retinal detachment with peripheral breaks in the Alexandria Main University Hospital. Ethics committee faculty of medicine Alexandria university approved this study. Patients included were those with peripheral retinal breaks anterior to the equator and with clear crystalline lens.

Exclusion criteria

(1) Patients with recurrent retinal detachment.
(2) Patients with significant visually significant cataract.
(3) Patients with retinal breaks posterior to the equator.
(4) Patients with proliferative vitreoretinopathy grade C.
(5) Patients with tractional retinal detachment.
(6) Patients with vitreous hemorrhage.

Cases were equally distributed into two groups:

(1) Group A: 15 cases managed with conventional scleral buckling with either 360° circumferential buckles or localized buckles.
(2) Group B: 15 cases managed with suprachoroidal buckling using nonilluminated 25-G curved cannula with olive tip (El-Rayes Cannula designed by MedOne Surgical) to inject long-lasting hyaluronic acid solution (Healon GV or Healon V; Abbott Medical Optics Inc.) into the suprachoroidal space.

Preoperative evaluation of all cases was performed including:

(1) Personal data including: age, sex.
(2) History taking: onset and duration of symptoms, previous ocular surgeries, and any relevant medical history.
(3) Ocular examination: visual acuity, refractive status and best spectacle corrected visual acuity, anterior segment examination, intraocular pressure measurement, and ocular motility examination.
(4) Fundus examination using indirect slit lamp 3-mirror lens and indirect ophthalmoscopy with documentation of the configuration of the retinal detachment, localization of the retinal breaks, and documentation of the retinal detachment using color coded diagrams and fundus photography.

Appropriate preoperative laboratory investigations were carried on with internal medicine consultation if needed.

Informed consent was taken from all patients participating in the study after explaining patients' current condition, the surgery needed, benefits, and possible complications of the surgical intervention.

Group A

Patients managed with conventional scleral buckling surgery using DACE technique outlined by the following steps:

(1) 360° periotomy will be done with hooking and isolation of the four recti muscles using 4-0 nylon sutures.
(2) Draining sclerotomy will be done in the most dependent quadrant with application of diathermy to the choroid and opening of the subretinal space draining all subretinal fluid followed by closure of the sclerotomy using 8-0 polyglycolic acid sutures (Vicryl).
(3) External scleral cryo-application over the retinal break with sealing of all peripheral retinal breaks.
(4) Injection of expansile volume of sulfur hexafluoride (SF6) gas bubble.
(5) Insertion of either 360° circumferential scleral buckle or localized buckle sutured by 5-0 polyester sutures.
(6) Closure of the conjunctiva by using 8-0 polyglycolic acid sutures (Vicryl).

Group B

Patients were managed with suprachoroidal buckling technique outlined by the following steps:

(1) 25-G chandelier light is placed at the 12 o'clock position or in any other quadrant if the tears are at 12 o'clock; then we use an operating microscope combined with a wide-angle viewing system for fundus examination.
(2) Cryoretinopexy is done prior to the usage of suprachoroidal cannula to create chorioretinal adhesion.
(3) The conjunctiva in the quadrant of the tear is incised, and a 3-mm circumferential sclerotomy is created 4 mm from the limbus to expose the choroid. We then displace the choroid by injecting some viscoelastic to form a 1–2-mm pocket to create a space for the introduction of the suprachoroidal catheter.
(4) The catheter is then threaded through the sclerotomy into the suprachoroidal space in the direction of the tear location under viewing of the wide-angle system till reaching the tear location and long-lasting hyaluronic acid (Healon GV or Healon V; Abbott Medical Optics Inc.) is injected into the suprachoroidal space.
(5) This may be accompanied by an anterior chamber paracentesis or subretinal fluid drainage, is necessary to adjust the intraocular pressure.
(6) SF6 gas bubble may be used depending on the site, size, and location of the break.

Patients received appropriate postoperative treatment. Patient follow up will be carried at 1 day, 1 week, 1, 3, and 6 months interval.

Comparison between the two techniques was done with respect to:

(1) Anatomical success in treating retinal detachment.
(2) Functional success in comparison with postoperative visual acuity gain of the two approaches.
(3) Refractive changes in both approaches.
(4) Complication rates in both approaches as suprachoroidal or vitreous hemorrhage, recurrence, and scleral or retinal perforation.

Results

This prospective randomized interventional case series was conducted on 30 cases of primary uncomplicated rhegmatogenous retinal detachment with peripheral retinal breaks in the Alexandria Main University

Table 1 Preoperative baseline criteria

	Group A (N=15) [n (%)]	Group B (N=15) [n (%)]	Test of significance	P
Sex				
Male	6 (40.0)	8 (53.3)	χ^2=0.536	0.464
Female	9 (60.0)	7 (46.7)		
Age (years)				
Minimum–maximum	32.0–62.0	28.0–61.0	t=0.341	0.736
Mean±SD	45.33±8.93	46.53±10.29		
Median	43.0	47.0		
Break quadrant				
Superior	10 (66.7)	10 (66.7)	χ^2=0.000	1.00
Inferior	5 (33.3)	5 (33.3)		
Number of breaks				
1	5 (33.3)	5 (33.3)	χ^2=0.339	1.00
2	7 (46.7)	6 (40)		
3 or more	3 (20)	4 (26.7)		
Configuration of retinal detachment				
Total	3 (20)	4 (26.7)	χ^2=0.186	1.00
Subtotal	12 (80)	11 (73.3)		

Table 2 Comparison between the two studied groups according to the anatomical outcome

Status	Group A (N=15) [n (%)]	Group B (N=15) [n (%)]	χ^2	^{FE}P
Attached	13 (86.7)	12 (80.0)	0.240	1.000
Not attached	2 (13.3)	3 (20.0)		

FE, Fisher's exact test.

Hospital. Cases were randomly distributed over two groups, with group A patients managed using conventional scleral buckling and patients in group B managed using suprachoroidal buckle using 23 G curved olive-tipped El-Rayes cannula to inject Healon GV into the suprachoroidal space.

The preoperative baselines criteria of both groups are described in Table 1 with respect to demographic data, position, and number of retinal breaks and configuration of retinal detachment.

Anatomical outcome

Table 2 summarizes the anatomical outcomes of the case series of both groups.

In group A, 13 out of 15 (86%) cases achieved successful single-surgery anatomical reattachment. Only two cases required secondary intervention done using PPV and silicone oil injection with final good retinal reattachment after the second intervention.

In group B, 12 out of 15 (80%) cases achieved successful anatomical reattachment using suprachoroidal technique. Only three cases require secondary intervention and this was achieved using PPV with SF6 gas injection in two cases and silicone oil injection in the third case.

Table 3 Comparison between the two studied groups according to best-corrected visual acuity in Log Mar

BCVA in Log Mar	Group A	Group B	U	P
Preoperative	N=15	N=15		
Minimum–maximum	0.70–2.0	0.40–1.90	80.00	0.173
Mean±SD	1.34±0.49	1.11±0.45		
Median	1.30	1.0		
Postoperative	N=13	N=12		
Minimum–maximum	0.10–1.0	0.20–1.0	70.00	0.658
Mean±SD	0.57±0.30	0.52±0.29		
Median	0.70	0.45		
P_1	0.001*	0.002*		

BCVA, best-corrected visual acuity. *Statistically significant difference.

No statistically significant difference was found between the two groups.

Functional outcome

Table 3 shows a summary of preoperative and postoperative visual acuity in Log Mar units and decimals.

In group A, the preoperative visual acuity ranges from 0.7 to 2.0 Log Mar with mean of 1.34±0.49 (equivalent in decimals 0.1–0.2 mean 0.08±0.08). In group B, the preoperative visual acuity ranges from 0.40 to 1.90 Log Mar with mean of 1.11±0.45 (equivalent in decimals 0.01–0.40 mean 0.12±0.11). No statistical significant difference was found between the two groups.

The postoperative visual acuity in group A ranges from 0.10 to 1.0 Log Mar with mean of 0.57±0.30

Table 4 Comparison between the two studied groups according to change in refraction in diopters

Change in refraction	Group A (*N*=13)#	Group B (*N*=12)#	*U*	*P*
Minimum–maximum	−3.50 to −1.0	−1.75 to 0.0	4.500*	<0.001*
Mean±SD	−2.48±0.83	−0.58±0.56		
Median	−2.25	−0.50		

#Indicates no statistically significant difference.

(equivalent in decimals 0.10–0.80 mean 0.33±0.22). In group B, the postoperative visual acuity ranges from 0.20 to 1.0 Log Mar with mean of 0.52±0.29 (equivalent in decimals 0.10–0.60 mean 0.36±0.19). No statistical significant difference was found between the two groups.

However, improvement in visual acuity was statistically significant in each of the study groups.

With respect to refractive changes that occurred in each group (Table 4); describes briefly a myopic change occurred in patients of group A of average of −2.48 ±0.83 D compared with a mean myopic shift of −0.58 ±0.56 D in group B. This change was significantly higher in group A than in group B.

Complications

With respect to complications, in group A, one case suffered from postoperative submacular hemorrhage, which resolved completely in 2 weeks with no further intervention.

In group B, one case suffered from localized suprachoroidal hemorrhage at the site of entry which resolves spontaneously. In single case, there was retinal perforation at the site of buckling with localized subretinal hemorrhage. Intraoperative cryopexy and rebuckling successfully managed the perforation with smooth postoperative course and successful anatomical reattachment.

Discussion

In our study, 30 cases of primary uncomplicated rhegmatogenous retinal detachments were randomly and equally distributed over two groups, group A patients were managed using conventional episcleral buckling, and group B patients were managed using suprachoroidal buckling using 23 G olive-tipped cannula to inject Healon GV (14 mg/ml) into the suprachoroidal space overlying retinal breaks. Both groups were compared for their functional and anatomical results as well as their complication rates.

With respect to the baseline preoperative criteria, no statistical significant differences were found between the two groups pertaining to demographic data, position, and number of retinal breaks, or the configuration of retinal detachment proving equal and bias-free allocation of cases between the two groups.

With respect to anatomical success, in patients managed with scleral buckling, 13 cases out of 15 achieved single-surgery attachment with success rate of 86%. In reviewing literature, long-term anatomical and functional stability in cases managed by episcleral buckling was proven in many studies. Rodriguez *et al.* [17] reported achieving single-surgery success rate of 37 cases out of 40 (92.5%) cases, achieved single-surgery attachment with only three cases requiring second intervention by 3 months. In a retrospective study to test the long-term outcome of conventional scleral buckling, Quijano *et al.* [18] have reported to achieve single-surgery anatomical success rate of 96.7% in management of 90 cases with primary uncomplicated rhegmatogenous retinal detachment. In SPR study comparing scleral buckling with PPV in rhegmatogenous retinal detachment, it was reported to achieve 93% primary success rate with final reattachment of 97% after secondary intervention [19].

In group B patients managed with suprachoroidal buckling, 12 out of 15 cases achieved primary reattachment with single intervention with success rate (80%). In comparison to previous studies El-Rayes and colleagues achieved higher single-surgery success in 38 out of 41 (92%) cases. Our inferior results can be explained by the steep learning curve that is needed in performing suprachoroidal buckling together with the smaller number of cases.

In comparing the anatomical success rates in both groups 86% in group A and 80% in group B, no statistical significant difference was found between the two groups suggesting the noninferiority of suprachoroidal buckling in management in rhegmatogenous retinal detachment in comparison with conventional scleral buckling.

In reviewing the anatomical results in both groups, our study proved promising results in management of cases with inferior retinal breaks. So, 17 out of 20 (85%)

cases who had superior breaks in both groups achieved single-surgery anatomical success in comparison with 8 out of 10 (80%) cases with inferior breaks. There were no statistical significant differences between both groups. In reviewing literature, a retrospective study of 48 cases of rhegmatogenous retinal detachment with inferior breaks, Quijano *et al*. [18] reported a success rate of 80%, which is similar rate to our results.

With respect to the functional outcome of both groups, statistical significant improvement of visual acuity occurred. In comparing the final visual outcome of both groups, no significant differences were found.

In group A, patients treated with conventional scleral buckling, patients' mean preoperative visual acuity was 1.34±0.49 Log Mar units (equivalent in decimals to a mean 0.08±0.08). Significant visual acuity improvement occurred postoperatively with a mean of 0.57±0.30 (equivalent in decimals to 0.33±0.22). Wong *et al*. [20] reviewed the functional outcome of cases treated by scleral buckling alone as compared with cases treated with combined PPV and scleral buckling showed 43.2% functional success in scleral buckling as compared with 28% functional success in combined PPV and scleral buckling group.

In group B, treated with suprachoroidal buckling, significant improvement of visual acuity occurred from mean of 1.11±0.45 Log Mar (equivalent in decimals to 0.12±0.11) preoperatively to a mean of 0.52±0.29 Log Mar (equivalent in decimals to 0.36 ±0.19) postoperatively. Similar results was obtained by El-Rayes *et al*. [5] who reported significant functional improvement to Log Mar 0.324±0.317 in average of 41 cases of rhegmatogenous retinal detachment treated with suprachoroidal buckling.

In comparing the change in refraction in both groups, statistically significant myopic shift was found in patients undergoing scleral buckling than patients treated with suprachoroidal buckling. The mean change in spherical equivalent was −2.48±0.83 D in group A compared with a mean myopic shift of −0.58 ±0.56 D in group B. The myopic shift in conventional scleral buckling can be explained with the increase in axial length associated with the encircling band. Shallowing of the anterior chamber associated with displacement of the lens anteriorly in phakic eyes with an encircling buckle may also contribute to a shift toward myopia.

Nassaralla and colleagues have demonstrated the change in refractive status in all eyes treated with scleral buckles. Thus, 100 eyes treated with encircling scleral buckle alone, scleral buckle with PPV or encircling band with additional segmental buckling show a myopic shift of −1.0 to −2.93 at 6 months of follow up. The explanation provided in this study was elongation of the globe by the pressure of equatorial band. It was stated in this study that there was an average increase of 2.45 D of spherical equivalent per each increased millimeter in axial length. Smiddy found axial lengthening and corresponding induced myopia. In this study, the correlation between the increase in spherical equivalent and axial length was high. Lancaster states that an increase of 1 mm in axial length corresponds to a refractive change of 2.5–3 D [9].

This induced change in refraction was not seen in patients of suprachoroidal buckling group as there was neither change in the axial length or lengthening of the globe by any encircling band.

With respect to complications, both techniques showed good safety profile with no visual morbidity and no effect on final visual outcome. In our study only one patient managed with conventional scleral buckle suffered submacular hemorrhage. Probably this complication might have occurred during the step of drainage of subretinal fluid due to temporary hypotony. However, this submacular hemorrhage eventually disappeared with no effect on the final anatomical or functional outcome.

After 6 month of follow-up, none of the cases showed any long-term complications. This may be due to small number of cases included in the study. Long-term complications were reported in larger case series and, it included exoplant extrusion, cystoid macular edema, epiretinal membrane formation, proliferative vitreoretinopathy, diplopia and extraocular muscle motility disorders, and glaucoma. There were no cases of progression of cataract formation in our case series. Sun *et al*. [21] reported in a meta-analysis of randomized controlled clinical trial that analyzed scleral buckles and PPV, that no cataract progression was seen in cases of rhegmatogenous retinal detachment treated with scleral buckling. On contrary cataract formation was a major drawback in cases treated by PPV. Feng and Adelman [22] reported the cataract progression in cases treated by PPV irrespective of the gauge used.

In patients treated with suprachoroidal buckling, only one case of localized suprachoroidal hemorrhage was seen and this was eventually resolved in 2 weeks with no effect on the final visual acuity. El-Rayes and colleagues reported an incidence of 2 out of 41 cases of suprachoroidal hemorrhage that disappeared spontaneously. In their explanation, El-Rayes and colleagues explained the high safety profile of the suprachoroidal buckling technique, despite the direct cannulation of the suprachoroidal space, by the atraumatic olive-tip of the cannula. Furthermore, they postulated that the cushion-like effect of the viscoelastic material causes less mechanical pressure on the choroidal circulation, when compared with silicone explants [5].

Conclusion

(1) Conventional scleral buckling and suprachoroidal buckling are both equally effective in management of primary uncomplicated retinal detachment with peripheral retinal breaks.
(2) Both episcleral and suprachoroidal buckling shows promising functional results in managing cases of rhegmatogenous retinal detachment.
(3) Suprachoroidal buckling induce less myopic shift and refractive changes than that produced by conventional episcleral buckling.
(4) Despite the steep learning curve of suprachoroidal buckling, it represents a safe method in management of rhegmatogenous retinal detachment.

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Conflicts of interest

There are no conflicts of interest.

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