Anatomical and Visual Outcomes of Scleral Buckling Surgery in Rhegmatogenous Retinal Detachment

Raj K. Sharma¹, Mohammad T. Akkawi¹,², Mohammad M. Shehadeh²,³, Ammar A. Aghbar², Jamal Qaddumi²

Abstract:

PURPOSE: The aim of this study is to evaluate the short anatomical and visual outcomes of scleral buckling surgery in relation to the pattern of presentation of rhegmatogenous retinal detachment (RRD) in the presence of different situations and risk factors.

METHODS: A total of 206 eyes of 203 patients who underwent scleral buckling surgery for RRD were evaluated in this retrospective study. Information retrieved included patient demographics, duration of symptoms, and presenting vision, lens status, site of a retinal break, extent of retinal detachment, the involvement of the fellow eye, macular involvement, presence of lattice degeneration, and associated refractive errors. Postoperative retinal reattachment, postoperative visual acuity, the need for further surgical intervention, intraoperative, and postoperative complications were also evaluated. Proportions and percentages were used to analyze data.

RESULTS: Primary anatomical reattachment was seen in 172 eyes (83.5%) after the complete resolution of the tamponade used. The mean best-corrected visual acuity improved from 2.81 logarithms of the minimum angle of resolution (LogMar) preoperatively to 1.21 LogMar postoperatively, the most important factors that appeared statistically significantly affecting the anatomic and visual outcome were the duration of macular detachment (P = 0.036), the status of the lens; phakic eyes gave better visual outcome than aphakic and pseudophakic eyes (P < 0.05).

CONCLUSION: Scleral buckling procedure showed high structural and visual success rates, improvement of visual acuity was found to correlate well with the shorter duration of macular detachment and pseudophakic eyes. We believe that scleral buckling, when done appropriately in the appropriate cases, gives the maximum visual outcome with the least cost and need for consecutive procedures.

Keywords: Rhegmatogenous, retinal detachment, scleral buckling

Introduction

Rhegmatogenous retinal detachment (RRD) occurs when there is a separation of the neurosensory retina from the retinal pigment epithelium (RPE) with the accumulation of subretinal fluid (SRF) in the presence of one or more retinal breaks. The reported incidence rates of RRD vary from around 8–14/100 000 persons per year in different countries.[1] Over the last century, several techniques have been used in the surgical treatment of RRD. Jules Gonin performed the first successful retinal detachment surgery after accurate localization of retinal breaks, drainage of SRF and thermocautery in the beginning of the last century.[2] Building on his theories, Ernst Custodis performed the first scleral buckling surgery in 1949.[3] Schepens developed the modern binocular indirect

How to cite this article: Sharma RK, Akkawi MT, Shehadeh MM, Aghbar AA, Qaddumi J. Anatomical and visual outcomes of scleral buckling surgery in rhegmatogenous retinal detachment. Middle East Afr J Ophthalmol 2020;27:100-4.
Sharma, et al.: Outcomes of scleral buckling in regmatogenous retinal detachment

Middle East African Journal of Ophthalmology - Volume 27, Issue 2, April-June 2020

ophthalmoscope with a scleral depressor in 1945, which added a lot to retinal detachment repair surgeries, using that he performed the first buckling surgery in the United States. Lincoff et al. introduced the silicone sponge buckle and modern cryotherapy in 1960. Using all these techniques, modern scleral buckling procedure has resulted in an improved anatomical success rate, especially when it is performed in fresh retinal detachment. The first invention of vitrectomy and its modification during the 1970s made a big revolution in retinal detachment repair surgery. In 1986 Hilton introduced the technique of pneumatic retinopexy (PR) to treat RRDs with retinal breaks in the superior eight clock hours of the retina.

Nowadays, with the advances of pars plana vitrectomy machines and techniques, lots of vitreoretinal surgeons tend to choose it as the primary procedure even in simple RRDs with the single easily visible break. They support their decision by the high rates of intraoperative reattachment, even in very difficult cases, achieved by internal drainage and tamponade. This is further emphasized by the low rate of intraoperative complications. In addition, surgeons nowadays have become more familiar with this technique compared to scleral buckling surgery, as it is the most frequent surgery in their daily practice even for other vitreoretinal pathologies.

Many studies showed the good success rate of short- and long-term anatomical and visual results for scleral buckling surgery, as well as comparative studies, were also done between buckling, vitrectomy, or PR as the primary procedure for retinal detachment. The superiority of scleral buckle in terms of final visual acuity and the occurrence of postoperative cataract in uncomplicated phakic RRDs were showed. The aim of this study is to highlight the anatomical and visual outcomes of scleral buckling surgery in relation to the pattern of presentation of rhegmatogenous RD in the presence of different situations and risk factors.

Materials and Methods

This is a retrospective, monocenter interventional case series of all patients who had scleral buckling surgeries done at the Retina Unit of R. M Sahai Eye Hospital and Research center, Jaipur, India, between 2003 and 2012. Patients with simple RRD (with PVR grade b or less), otherwise structurally normal eye, and completed follow-up of at least 1 month were included in the study. Patients with complicated RRD (more than stage B PVR, vitreous hemorrhage, giant tears), history of trauma, follow up <1 month, surgeries done outside our hospital, ocular developmental defects (e.g. coloboma), other acquired ocular conditions that can affect vision (e.g. glaucoma, AMD, amblyopia, moderate to severe cataract,… etc.), patient with no breaks identified preoperatively were excluded. Surgeries were done by the same surgeon (RKS). Case records of all patients that had scleral buckling surgery at our center between 2003 and 2012 were reviewed. Information retrieved included the patient’s demographics, duration of symptoms, and presenting vision. Other information included lens status, site of a retinal break, and extent of retinal detachment, the involvement of the fellow eye, macular involvement, presence of lattice degeneration, refractive error association, and history of Nd-YAG posterior capsulotomy before presentation. Postoperative retina reattachment and postoperative visual acuity, the need for further surgical intervention, and intraoperative and postoperative complications were also recorded.

Surgical technique

Since the scleral buckle surgery can be done in the majority of cases, it was the surgeon’s personal preference to use it choosing the drainage technique to assure early reattachment and rapid visual recovery.

The procedure starts with 360° conjunctival periotomy then identification and hocking of the recti muscles, using the BIO identification of the breaks are made, and identification of the area where the SRF is maximum, marking its location on the sclera, the puncture is done using a special instrument with a sharp edge tip of 2 mm length, squeezing SRF through the puncture site is done, then retinopexy using cryotherapy around all the breaks, followed by injection of air/gas when necessary and insertion and suturing of the buckle making sure to tether site of breaks and puncture point, followed by the closure of the conjunctiva, AC tap was done when the pressure was high digitally Many types of buckles were used including 279 bands and tire, 5 mm or 7 mm silicon sponge split buckle chosen according to the width of the area needed to be tethered, the sites of breaks, and the space available globally.

Retinal reattachment was defined as an apposition between RPE and neurosensory retina observed clinically using binocular indirect ophthalmoscope during and after surgery and the disappearance of SRF. Primary success defined as retinal reattachment with a single operation and no residual intravitreal tamponade after 1 month. The logarithm of the minimum angle of resolution (LogMAR) system was used for visual acuity preoperatively and postoperatively. Counting fingers, hand movement, light perception, and projection assessment were used in patients who cannot see the first LogMAR optotype. The outcomes were measured at different set time-points according to the individual patient follow-up visits.
**Statistical analysis**

Data were analyzed using the Statistical Packages for the Social Sciences SPSS (version 21.0. SPSS Inc, Chicago, IL, USA). Descriptive statistics were generated for continuous variables and categorical variables. The chosen level of statistical significance was $P < 0.05$.

**Results**

Two hundred and three patients (206 eyes) were analyzed with a male-to-female ratio of 2.4:1. The mean age was 46 years ($\pm$19 years).

Subtotal retinal detachment was found in 154 eyes (74.7%) with involving one quadrant in 14 eyes (6.8%), two quadrants in 86 eyes (41.7%), three quadrants in 54 eyes (26.2%). In comparison, total retinal detachment involving four quadrants occurred in 52 eyes (25.3%). One hundred and sixty-five eyes (80.1%) had “macular-off” detachments. Retinal breaks were identified in all eyes preoperatively, 130 eyes (63.1%) had a single retinal break, 28 eyes (13.6%) had two retinal breaks, while the remaining 48 eyes (23.3%) had three or more retinal breaks. The preoperative lens status assessment revealed that 127 eyes (61.7%) were phakic; of those 23 eyes had cataract, 66 eyes (32%) were pseudophakia, whereas the remaining 13 eyes (6.3%) were aphakic, as shown in Table 1.

The mean duration before the presentation was 54 days (50% of the cases presented within 13 days of detachment). SRF drainage was done in 200 eyes (97.1%). Air tamponade was used in 53 eyes (25.7%). Intravitreal injection of nonexpansible mixture of sulfur hexafluoride was used in 39 eyes (18.9%) and nonexpansible mixture of octafluoropropane in two eyes (1%), as shown in Table 2.

The follow-up periods ranged from 1 month to 7 years. Primary success (retinal reattachment) was seen in 172 eyes (83.5%) without the need for other operations. The mean best-corrected visual acuity preoperatively was 2.81 LogMar (counting fingers close to face), while it was 1.21 LogMar postoperatively. 16.7% of cases had visual acuity of 1.0 LogMar or better preoperatively, while 56.6% had that vision in the last visit postoperatively, as shown in Table 3. Postoperative complications included buckle infection in 3 eyes (1.4%), diplopia in one eye (0.5%), proliferative vitreoretinopathy (PVR) in one eye (0.5%), and cataract in one eye (0.5%).

Many risk factors that can affect anatomic and visual outcome were studied, the most important factors that appeared statistically affect significantly the anatomic and visual outcome were the duration of macular detachment, patients who had a duration of 30 days or less had a statistically significant difference ($P = 0.036$) than who had >30 days of macular detachment, the other factor was the status of the lens where phakic eyes gave better outcome than aphakic and pseudophakic eyes. The duration of the RD cut point in this study is 30 days, that patients who had duration of 30 days or less (postoperative LogMar: 1.08) has a statistical significant difference ($P = 0.036$) than who had >30 days of RD (postoperative LogMar: 1.42).

**Table 1: Characteristics of retinal detachment at presentation**

| Frequency, n (%) |
|------------------|
| LATERALITY       |
| Right eye        | 110 (53.4) |
| Left eye         | 96 (46.6)  |
| LENS STATUS      |
| Phakic           | 127 (61.7) |
| Aphakic          | 13 (6.3)   |
| Pseudophakic     | 66 (32.0)  |
| ASSOCIATED RISK FACTORS |
| Lattice          | 41 (19.9)  |
| Post-ND:YAG laser posterior capsulotomy | 6 (2.9) |
| MACULAR ON/OFF   |
| Off              | 165 (80.1) |
| On               | 41 (19.9)  |
| NUMBER OF BREAKS |
| 1                | 130 (63.1) |
| 2                | 28 (13.6)  |
| 3 or more        | 48 (23.3)  |
| EXTENT OF DETACHMENT (QUADRANTS) |
| 1                | 14 (6.8)   |
| 2                | 86 (41.7)  |
| 3                | 54 (26.2)  |
| 4                | 52 (25.3)  |

ND:YAG: Neodymium-doped yttrium aluminum garnet

**Table 2: Subretinal fluid drainage and internal tamponade in scleral buckle surgery**

| Frequency, n (%) |
|------------------|
| SFD              |
| No               | 6 (2.9)    |
| Yes              | 200 (97.1) |
| GAS INJECTION    |
| No               | 112 (54.4) |
| Air              | 53 (25.7)  |
| SF6              | 39 (18.9)  |
| C3F8             | 2 (1.0)    |

SFD: Subretinal fluid drainage

**Table 3: Visual acuity pre- and post-surgery**

| Mean   | SD     | Pearson r | P      |
|--------|--------|-----------|--------|
| LogMar |        |           |        |
| Preoperative | 2.81  | 1.41      | 0.332* | <0.001 |
| Postoperative | 1.21  | 1.04      |        |        |

*Correlation is significant at the 0.01 level (two-tailed). SD: Standard deviation, LogMar: Logarithm of minimum angle of resolution
Discussion

This study provides data about retinal detachment surgery at the Retina Unit of R. M Sahai Eye Hospital and Research center, Jaipur, India, between 2003 and 2012. In all of the cases, 360° scleral buckle was done, and in few cases, additional radial bands were added when there was more than one break in different levels. In most of the cases (97%) external subretinal fluid drainage was performed, and nondrainage procedure was done in cases with shallow RD, especially in the young patient where the RPE pump is expected to be functioning properly, retinopexy was done in all cases using cryotherapy, and intraocular gas tamponade was done in 46% of cases, especially in superior detachments were patient positioning is quite effective.

In our settings, scleral buckling surgery was chosen whenever we have a single break, or multiple breaks that can be tethered by a circumferential buckle, young phakic patients with clear media were preferred candidates, especially in the absence or minimal PVR.

Drainage of SRF was chosen in most of the cases, though the literature supports the high success rate of nondrainage approach,[8] but the authors felt it is more convenient to drain in all of the cases except when the retina could be reattached with preoperative ocular rest or if the retinal break could be closed without drainage at the time of surgery, this approach was adopted because of the low complication rate,[9] and to avoid the problems of delayed absorption of SRF after scleral buckling procedure, especially the marked increase in the intraocular pressure postoperatively, in particular, in eyes with a history of glaucoma, recent wound, or presence of staphyloma.

The cost of the procedure in India is much less expensive than vitrectomy, and it costs around 200 USD for buckling while it varies from 450 to 650 USD for vitrectomy and associated tamponades. Cost is not the only reason, the reduced risk, and the need to remove silicone oil if it was injected with vitrectomy, cataract, infections, the risk of re-RD following silicon oil removal are some of the other reasons to avoid vitrectomy.

This study shows that scleral buckle surgery for RRD gives sufficient anatomical and visual outcomes. Primary anatomic success was 83.5% which means that it is a good choice for uncomplicated RD; it is minimally invasive procedure compared to pars plana vitrectomy, with slight reaction to intraocular inflammation, cheaper, with less risk of complications, especially with young adults where preservation of lens clarity is extremely important. The mean duration of symptoms before presentation was 54 days (50% of the cases presented within 13 days of detachment) which had significantly affected the visual outcome and increased the number of cases with PVR, and this is not unconnected to problems of diagnosis, late referrals, shortage of nearby ophthalmic facilities and financial status. The mean best-corrected visual acuity postoperatively was 1.21 LogMar (between 20/250 and 20/320), mentioning that preoperatively, it was 2.81 LogMar (counting fingers close to face), which showed visual improvement after scleral buckling surgery. Phakic eyes gave a better outcome than aphakic and pseudophakic eyes. These results were consistent with a study done by Heimann et al.,[10] comparing scleral buckling versus primary vitrectomy in RD, it showed the greater benefit of scleral buckles in phakic eyes with respect to BCVA improvement. Another study done by Hejsek et al., among 17 patients with RRD with the primary anatomic success of 94% with an average best-corrected visual acuity postoperatively of 20/50.[11]

Another study done by Oluleye et al.,[12] also showed anatomical attachment success in 40 eyes (90.9%) at the 1st day postoperatively and in 32 eyes (86.5%) at 6 weeks after scleral buckle surgery. In a study done on 43 eyes of patients who underwent scleral buckling and cryopexy, anatomic success was achieved in 95.3% of eyes.[13]

The visual improvement rate after scleral buckling surgery was affected by the duration of RD and macular involvement. Patients who had a duration of the macular detachment of 30 days or less (post LogMar X = 1.08) had a statistically significant improvement in visual acuity (P = 0.036) than those who had more than 30 days of RD (post LogMar X = 1.42). That means the sooner the surgery for macula off detachment is done, the better the results until after 30 days where there was no difference in the visual outcome. In this study, analysis showed that the visual outcome of scleral buckling surgery was not affected by the extent of retinal detachment, number of breaks, the presence or absence of lattice degeneration, whether SRF was drained or not, or whether an intraocular gas tamponade was injected or not during the surgery.

A meta-analysis of randomized controlled clinical trials of primary vitrectomy versus scleral buckling for the treatment of RRD of 523 phakic eyes, 690 eyes showed that scleral buckle is superior in terms of final visual acuity in uncomplicated phakic RRDs. PPV is more likely to achieve a favorable final re-attachment in pseudophakic/aphakic RRD.[14]

On the other hand, some studies comparing vitrectomy versus scleral buckling for RRD showed higher primary anatomic success rates for vitrectomy with a lower risk of reoperation, like a retrospective study done in Finland.[15]
The rate of PVR was low (1 eye (0.5%)), and this may be attributed to the time of presentation of retinal detachment since 50% of cases presented after 13 days of macular detachment. Some of them had some degree of PVR, and hence, they were planned for vitrectomy rather than buckling if PVR was severe enough, or the author believes that buckling alone will not be sufficient. In cases were buckling alone was planned, PVR characteristics were taken into consideration while planning the buckle site, size, height and extent, as a general rule the very minimal and targeted cryotherapy used during buckling surgery may be the cause of not having many cases of PVR postoperatively. Furthermore, there were no complications during SRF drainage, that may be attributed to the measures taken to avoid complications like making the drainage site distant from the breaks, to avoid a prolapse of vitreous through the sclera, avoiding to puncture in the area of vortex veins to avoid choroidal bleeding, making sure to cover the drainage site by the buckle.

This study has limitations because of its retrospective nature; also, the secondary reattachment rate could not be assessed because of compliance issues after the second procedure.

**Conclusion**

Despite an increasing trend toward primary vitrectomy for RRD, scleral buckling procedure showed high structural and visual success rates, improvement of visual acuity was found to correlate well with the shorter duration of macular detachment and the status of the lens with a better outcome in phakic eyes more than aphakic and pseudophakic eyes.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

---

**References**

1. Saw SM, Gazzard G, Wagle AM, Lim J, Au Eong KG. An evidence-based analysis of surgical interventions for uncomplicated rhegmatogenous retinal detachment. Acta Ophthalmol Scand 2006;84:606-12.
2. Gonin J. La pathogenie du decollement spontane de la retina. The spontaneous pathology of the detachment of the retina. Ann Oculist 1904;132-230.
3. Custodis E. Treatment of retinal detachment by circumscribed diathermal coagulation and by scleral depression in the area of tear caused by imbedding of a plastic implant. Klin Monbl Augenheilkd Augenarztl Fortbild 1956;129:476-95.
4. Schepens CL. Progress in detachment surgery. Trans Am Acad Ophthalmol Otolaryngol 1951;55:607-15.
5. Lincoff HA, Baras I, Mclean J. Modifications to the custodis procedure for retinal detachment. Arch Ophthalmol 1965;73:160-3.
6. Lincoff HA, Mclean JM, Nano H. Cryosurgical treatment of retinal detachment. Trans Am Acad Ophthalmol Otolaryngol 1964;68:412-32.
7. Wilkinson CP, Bradfort RH Jr., Complications of draining subretinal fluid. Retina 1984;4:14.
8. Chignell AH. Retinal detachment surgery without drainage of subretinal fluid. Am J Ophthalmol 1974;77:1-5.
9. Hilton GF. The drainage of subretinal fluid: A randomized controlled clinical trial. Trans Am Ophthalmol Soc 1981;79:517-40.
10. Heimann H, Bartz-Schmidt KU, Bornfeld N, Weiss C, Hilgers RD, Foerster MH, et al. Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment: A prospective randomized multicenter clinical study. Ophthalmology 2007;114:2142-54.
11. Hejsek L, Dusová J, Stepanov A, Rozšíval P. Scleral buckling for Rhegmatogenous retinal detachment. Cesk Slov Oftalmol 2014;70:110-3.
12. Oluleye TS, Ibrahim O, Olusanya B. Scleral buckling for retinal detachment in Ibadan, Sub-Saharan Africa: anatomical and visual outcome. Clin Ophthalmol 2013;7:1049-52.
13. Espinosa A, Mendoza G, Millan M, Espinosa NC, Elliott D, Scott IU, et al. Scleral buckling for rhegmatogenous retinal detachment an alternative to vitrectomy in uncomplicated cases. Retina Today 2011:34-38.
14. Sun Q, Sun T, Xu Y, Yang XL, Xu X, Wang BS, et al. Primary vitrectomy versus scleral buckling for the treatment of rhegmatogenous retinal detachment: A meta-analysis of randomized controlled clinical trials. Curr Eye Res 2012;37:492-9.
15. Sahanne S, Tuuminen R, Haukka J, Loukovaara S. A retrospective study comparing outcomes of primary rhegmatogenous retinal detachment repair by scleral buckling and pars plana vitrectomy in Finland. Clin Ophthalmol 2017;11:503-9.