Chandelier-assisted segmental scleral buckling for rhegmatogenous retinal detachment repair

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Short title*:* Scleral buckling for rhegmatogenous retinal detachment repair

Abstract:

Aim: To evaluate a modified technique for scleral buckling surgery using chandelier endoillumination and minimal segmental buckling through a small conjunctival incision in rhegmatogenous retinal detachment repair.

Methods: A prospective interventional case study included 30 phakic eyes with primary rhegmatogenous retinal detachment (RRD) that was repaired by chandelier assisted scleral buckling (SB) using wide angle viewing (WAV) noncontact lens. A surgical procedure was performed to repair a break using transconjunctival sutures and a radial sponge was placed through a regional conjunctival opening. Anatomical and visual outcome at 6 months were the major outcome measures. Minor outcome measures included other postoperative complications.

Results: The mean ± standard deviation BCVA was improved from 0.33±0.61 preoperatively to 0.13±0.36 logMAR units 6 months postoperatively. External subretinal fluid drainage was performed in 18 cases (60%). Air injection was required in all patients (100%). Paracentesis was performed in 11 cases (37%). The primary anatomical success of retinal reattachment was achieved in all cases. Three patients (10%) experienced epi-retinal membrane (ERM) formation after 3 months. No other surgical complications were detected during follow up period.

Conclusion: In conclusion, scleral buckling using a cannula-based chandelier endo-illuminator is a modified new technique and is promising for the management of rhegmatogenous retinal detachment.

Keywords: buckling, phakic, rhegmatogenous detachment, Chandelier.

INTRODUCTION:

Since the introduction of scleral buckling (SB) in the 1950s, it has been considered as an efficacious technique for the repair of rhegmatogenous retinal detachment (RRD).[1,2] In modern surgery, SB is still the preferred approach in certain indications. This surgical approach implies lower costs than pars plana vitrectomy (PPV) and circumvents numerous potential complications encountered during PPV.[3,4] Despite these benefits, SB popularity seems to be decreasing.[5] Though the technique of SB itself has undergone a lot of progress since its first launch, the modern procedure still entails the intra-operative usage of indirect ophthalmoscope in retinal examination as well as the treatment steps. This in particular hinders the attending learners from following their mentors during the surgery, which poses an additional challenge of limiting its transfer to the next generation of retina fellows. Recent advances in the instrumentation, machines, and visualization systems for PPV, made this approach more attractive for vitreoretinal specialists.[6]

In 2012, Aras et al.[7] first described a trans-scleral fiber optic assisted scleral buckling for the repair of RD. They proposed the use of chandelier light source through an un-cannulated sclerotomy which permitted identification and treatment of retinal breaks using a noncontact wide angle PPV style viewing apparatus. This addition may be fundamental in reversing the trend of waning surgical preference for SB.

In this study we describe a modification on SB surgery using chandelier endoillumination and minimal segmental buckling through a small conjunctival incision.

SUBJECTS AND METHODS

This was a prospective interventional case study. This study was performed in Mansoura Ophthalmic center from September 2020 to February 2021. Thirty patients (30 eyes) with recent primary RRD were included in. The duration between symptoms and operation ranged from 2 days to one week. The experimental design was approved by Mansoura Faculty of medicine ethics committee according to the principles in the declaration of Helsinki. All patients signed a written consent before surgery.

Inclusion criteria: (1) Recent primary RRD in phakic eye. (2) Single retinal break or multiple breaks confined to one clock hour. (3) No history of glaucoma. (4) Patient can cooperate with the examination and regular follow up.

Exclusion criteria: (1) History of previous ocular surgery. (2) Patients with ocular disorders that affect vision such as macular problem, optic atrophy, corneal opacity, cataract and diabetic retinopathy. (3) Proliferative vitreoretinopathy (PVR). (4) Retinal breaks under horizontal or vertical recti.

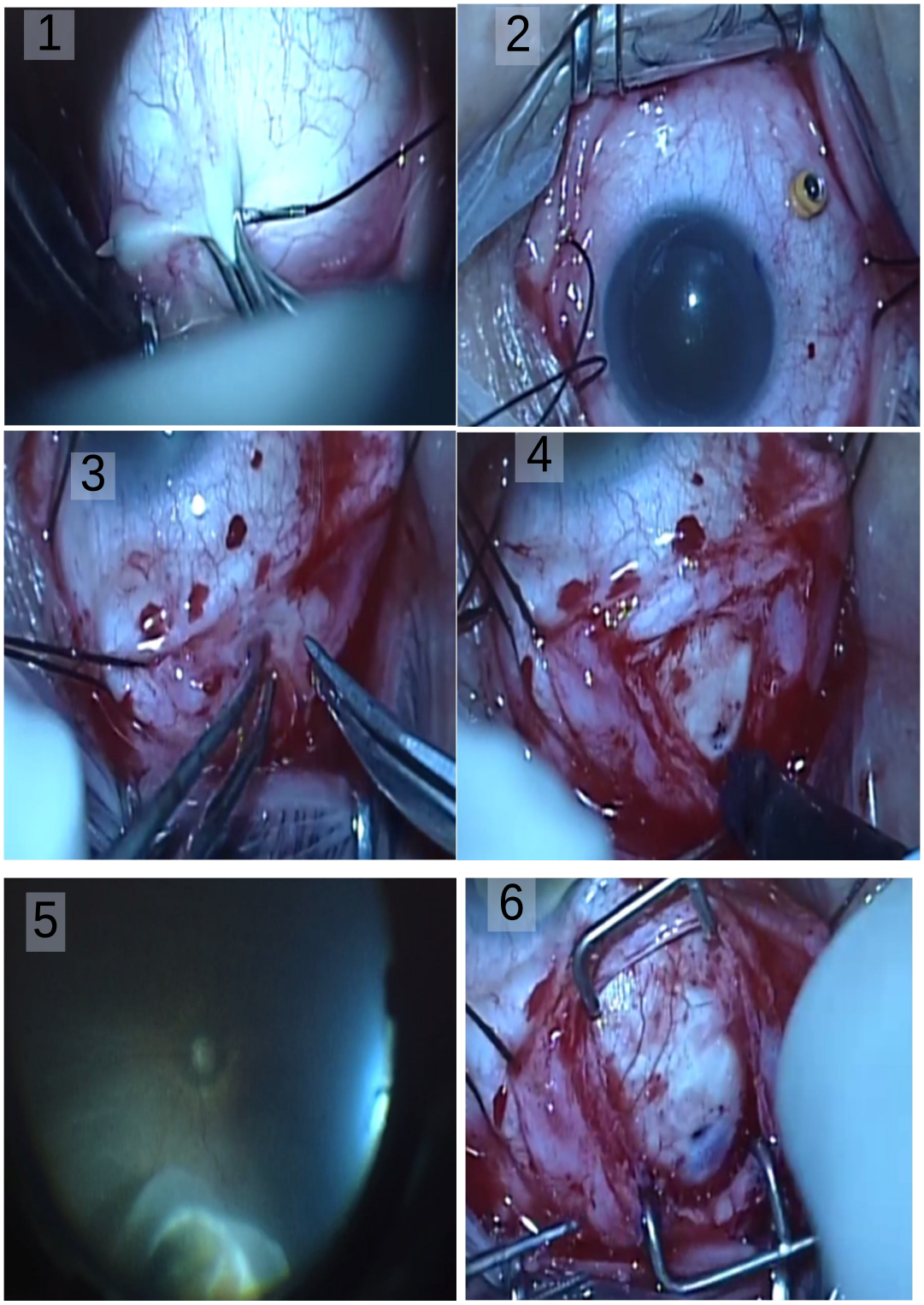
The baseline characteristics that were collected includes: age, gender, best corrected visual acuity, mapping of retinal breaks, break type and extent of detachment.

Surgical technique: All patients were operated under general anesthesia. Routine disinfection of the skin was performed with 10% povidine iodine followed by draping of the eye then the conjuntival sac was washed by using 5% povidine iodine eye drops. All surgeries were performed by single surgeon.

Transconjunctival traction sutures were placed in four rectus muscles under surgical microscope to avoid 360° conjunctival peritomy (figure 1).

25-gauge valved cannula with chandelier illumination (R-Evolution CR; Optikon 2000, Inc., Rome, Italy) was inserted through the pars-plana(figure 2). The position of the trocar cannula was chosen according to the localization of the break; 180 degree from the site of the break, at 4 mm from the limbus. Under direct visualization through the surgical microscope using noncontact wide-angle viewing system (Resight; Carl Zeiss Meditec, Jena, Germany), retinal breaks were localized. A posterior radial conjunctival opening was made between recti muscles over the break(figure 3). Break location was marked on the sclera by diathermy or marker (figure 4). Cryotherapy was performed (figure 5). Using pediatric speculum to retract the conjunctiva and Tenon's capsule pre-placed 5-0 Dacron mattress suture was secured in the area planned for buckle placing (figure 6). Sub retinal fluid was drained if needed. A radial sponge (507 style, Labtician Ophthalmics, Inc., Oakville, Canada) of appropriate length and width was inserted and tightened with sutures in place (figure 7). Chandelier illumination was used to confirm the buckle height. Before Chandelier removal, anterior chamber paracentesis was performed to decrease IOP if needed. Chandelier's sclerotomy was sutured by absorbable vicryl if needed.

Finally, closure of the conjunctiva and Tenon's in layers was performed by 8-0 absorbable suture and intra-vitreal air was injected as tamponading.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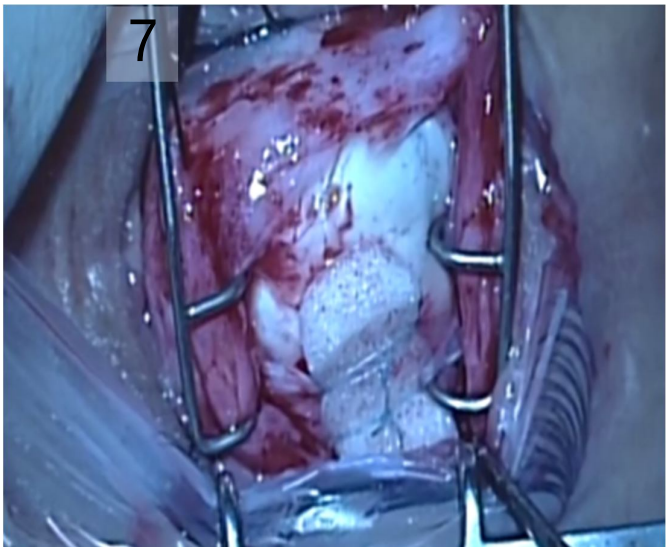

Fig (1): 1;trans-conjuntival traction sutures, 2; 4 recti with traction sutures and sclerotomy of chandlier, 3; posterior radial conjuntival opening, 4; Break location and marking, 5; Cryotherapy, 6; pediatric speculum to retract the conjunctiva, 7; radial sponge of appropriate length and width

Strict **head position** is started immediate post-operatively for at least 16 hours per day. Postoperative medications included topical antibiotics, topical steroids and systemic analgesics for 2 weeks. Comprehensive ophthalmic examinations were performed Preoperative and during 6 months postoperative visits. BCVA was collected in Snellen equivalents and later converted into the logarithm of the minimum angle of resolution (logMAR) for statistical analysis. slit-lamp biomicroscopy and detailed fundus examination were performed using contact lens (SuperQuad 160; Volk Optical, Inc., Mentor, OH, USA)

Criteria of success

The major outcome measures in the study were the anatomical success and the functional success at six months post operation. Anatomical success was defined as the successful repositioning of the detached retina to its proper location within the eye. Visual outcome at six months was determined through standard tests of visual acuity, including the Snellen chart and was considered an indicator of the functional success of the surgery. Minor outcome measures included postoperative complications e.g. cataract, vitreous prolapse, sustained subretinal fluid, epiretinal membrane, glaucoma and limited ocular motility.

Statistical methods

Statistical analysis was performed with STATA, version. 14.0 (StataCorp, TX). Continuous variables were described by mean ± SD; categorical variables were described by counts and percentages. Normal distribution of continuous variables was analyzed by the Shapiro–Wilk test.

RESULTS

A total of 30 eyes of thirty patients with age range 22-45 years old were included in this study. Macula on, lateral RD and single retinal tear were the most common encountered (Table1). Median post-operative follow up was 6 months.

The mean ± standard deviation BCVA was 0.33±0.61 logMAR units and 0.13±0.36 logMAR units preoperative and 6 months postoperative respectively. External subretinal fluid drainage was performed in 18 cases (60%). Air injection was performed in all patients. Paracentesis was performed in 11 cases (37%).

The primary anatomical success of retinal reattachment was achieved in all cases. Three patients (10%) experienced epi-retinal membrane (ERM) formation after 3 months. No other surgical complications (e.g., sub retinal hemorrhage, scleral perforation, cataract formation, proliferative vitreo-retinopathy, glaucoma, explant extraction, diplopia, or conjunctival tear) were detected during follow up period.

Table (1): Baseline demographic data of the included patients.

Criteria	n (%)
Laterality	
Right	20 (67)
Left	10 (33)
Gender	
Male	22 (73)
Female	8 (27)
Break	
Single tear	28 (93)
Multiple breaks	2 (7)
(confined to one clock hour)	
Extent of RD	
Lateral	11 (37)
Superior	9 (30)
Inferior	8 (27)
Total	2 (6)
Macular state	
on	18 (60)
off	12 (40)
No of breaks, mean ± _SD	1.3±0.6

DISCUSSION

The use of a chandelier endo-illumination system has proved to improve visualization as well as treatment of retinal breaks during SB surgery. The combination of a wide-angle viewing lens with diffuse endo-illumination provides brilliant visualization of retinal breaks, even in the far periphery, warranting precise identification and defined cryotherapy application of all breaks. Missed breaks are often the most common causes of recurrent RD. This combined approach guarantees treatment of all breaks while avoiding excessive or more posterior treatment. Moreover, it is possible to share the fundus information with the attending trainee.[7–10]

The current study was a prospective interventional study including phakic patients with RRD with one break or breaks in one clock hours treated with SB surgery using chandelier endo-illumination and minimal segmental buckling through a small conjunctival incision. All the patients were followed up for minimal 3 months. primary anatomical success full retinal reattachment was achieved in all cases with correct buckle location postoperatively.

Ryan et al, confirmed scleral buckling better results in phakic RRD.[11] In Shu *et al*'s multicenter study, the incidences of cataract development within 1y after PPV was 6.5% versus 1.0% in the scleral buckle (SB) group.[12] Infusion fluids used during vitrectomy.[13,14] and removal of barrier effect of the vitreous during vitrectomy increase the lens exposure to excessive oxidative stress.[15]

In order to improve visualization and comfort during buckling surgery Aras et al. reported using a noncontact wide-angle viewing system combined with an uncannulated 25-gauge chandelier light source.[16] Other multiple modifications were also tried such as; self-retained endo-illumination[17], double 27 gauge chandelier lights [18], even using light pipe.[19] Imai, et al. conducted chandelier assisted SB on 76 phakic eyes with an initial and final anatomical success rates of 92.4% and 100%, respectively.[20]

Lincoff et al introduced a minimally invasive buckling surgery by using temporary ballon.[21] also, Shimada passes the cerclage beneath recti muscles through next conjuntival incisions with special retractor to avoid 360° limbal peritomy .[22] Jin et al reported a successful minimal segmental buckling by localized break closure without further traumatic injury to conjunctiva and recti muscles.[23]

We advocate in situ segmental buckling for RRD under direct visualization through microscope and using noncontact wide-angle viewing system to make scleral buckling more effective, comfort and time staffing.

In the current study, primary anatomical success full retinal reattachment was achieved in all cases with correct buckle location postoperatively. Also, Jin et al reported 100% primary success rate.[23] Others reported minimal success rate up to 90.48% with re-detachment due to PVR.[24] Our high success rate may be due to patient selection preoperatively with localized detachment needed minimal cryotherapy and phakic. Three patients (10%) experienced epi-retinal membrane (ERM) formation after 3 months with satisfied vision and no surgical intervention needed. Furthermore, Cacioppo et al, reported that ERM development after RRD was 51,1% at both 3 months and 6 months. Cacioppo et al suggested that retinal detachments

involving the macular region ERM were more severe and more common.[25] This difference of less significant and low percentage of ERM formation in the current study may be due to most of RRD are macular on.

SB cause postoperative pain which may continue as chronic ocular discomfort .[26] Although in the current study, a pain score was not used postoperatively, the chronic postoperative discomfort was not detected.

Also persistent diplopia was documented postoperative in SB.[27] In present study postoperative diplopia was not detected.

The major limitation of our study is the lack of control group. Therefore, it is difficult to address the advantage of this modified SB procedure compared to the traditional procedure. A large randomized comparative study will need to be undertaken to definitively determine whether this new SB procedure is superior to the traditional SB.

CONCLUSION

In conclusion, SB using a combination of a noncontact wide-angle viewing system and a cannula-based chandelier endo-illuminator is a modified new technique and is promising for the management of RRDs.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

All data are included in this article.

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Conflict of Interest

Authors declare no conflicts of interest.

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Ethics declarations

Conflict of interest

Hossam E. Abouelkheir, Amr M. El-Kannishy, Ahmed Alnagdy, Ahmed M. Eissa, Mohammed Elashri. all authors have no conflicts of interest that are directly relevant to the content of this review.

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