# Mini vitrectomy as an alternative technique for intraocular pressure adjustment in non-drainage scleral buckling

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## Abstract

### Purpose

In non-drainage scleral buckling, anterior chamber paracentesis is usually carried out to decrease intraocular pressure. When the buckling is extensive however, this technique may be inefficient and time consuming. In this study, we tried to determine if a mini 25-gauge pars plana vitrectomy could be used as an efficient and safe alternative procedure to anterior chamber paracentesis for adjusting intraocular pressure during a non-drainage scleral buckling.

### Methods

In this case series, 44 patients with rhegmatogenous retinal detachment (proliferative vitreoretinopathy stage < C) were included. In all cases, a mini 25-gauge pars plana vitrectomy was performed before buckle fixation and repeated if necessary. Complete retinal attachment was defined as the anatomical success.

### Results

Forty-four eyes of 44 patients with mean age of 48.1 ± 18.2 years were included. Silicon buckle nº 276, sponge 505, and sponge 507 were utilized for 7, 34, and 3 eyes, respectively. Intravitreal injection of SF6 gas was performed for 54.5% of the eyes. Mean total time of the operation was 61 ± 16 min and the mean time for vitrectomy was 87 ± 31 s. Complete retinal attachment in 37 and incomplete attachment in 4 eyes were achieved after single operation that was a success rate of 93.2%. One had more than usual vitreous leak at the site of scleretomy and one developed a tiny vitreous hemorrhage at the sclerotomy site. Three sclerotomy sites needed suturing.

### Conclusion

The anatomical outcome and the safety observed in this study were comparable to the current methods reported in the literature. Therefore, if anterior chamber paracentesis fails to adjust intraocular pressure during a non-drainage scleral buckling, performing a small gauge mini vitrectomy is safe and helpful.

## Main messages

- Adjusting intraocular pressure in non-drainage scleral buckling surgery is an important step of the operation that is usually performed by anterior chamber paracentesis.
- A one-port mini vitrectomy with small gauge probe may help to adjust intraocular pressure easily and is safe.
- Small sample size and not having a control group was the major drawbacks of our study.
- This novel technique may help the surgeon to adjust intraocular pressure in non-drainage scleral buckling cases.

# Introduction

Rhegmatogenous retinal detachment, with the reported incidence rates varies from 8 to 14 per 100000 persons per year [1–4], occurs when there is a separation of the neurosensory retina from the retinal pigment epithelium due to the presence of one or more retinal breaks. Nowadays, three most common interventions are utilized for the management of uncomplicated rhegmatogenous retinal detachment and include pneumatic retinopexy, scleral buckling, and vitrectomy. Based on several clinical factors such as the location, size, and number of retinal breaks as well as surgeon-dependent factors like skills and experience, the method of treatment is selected. Nonetheless, in patients with inferior breaks or patients who cannot tolerate the pneumatic retinopexy procedure, scleral buckling is the preferred procedure [5].

One controversial aspects related to scleral buckling is whether carrying out sub-retinal fluid drainage during the procedure is necessary or not [6]. Since both drainage and non-drainage procedures show similar retinal re-attachment rates [7–10], advantage with non-drainage procedure seems to be in avoiding intra- and postoperative complications which are the major causes of unsuccessful surgical outcome [11]. On the other hand, sub-retinal fluid drainage has been utilized to lower intraocular pressure; in non-drainage scleral buckling therefore, other ways such as anterior chamber paracentesis should be carried out [12]. However, paracentesis is not without complication and should be repeated in most cases that could be time consuming and sometimes inefficient because the anterior chamber volume is limited and the surgeon should wait for refilling.

In this case series, we tried to investigate the safety and efficacy of performing a small gauge mini vitrectomy instead of anterior chamber paracentesis in order to adjust intraocular pressure during scleral buckling.

# Methods

The Review Board/Ethics Committee of Ophthalmic Research Center, Shahid Beheshti Medical University (Tehran, Iran) approved this interventional case series. The study protocol, its safety and efficacy were explained to all patients before recruitment and a written consent was obtained.

All patients with recent rhegmatogenous retinal detachment that were candidate for scleral buckling procedure based on the surgeons' preferences were included. Eyes with significant subretinal fluid that necessitated drainage as well as cases with stage C proliferative vitreoretinopathy [13], significant vitreous hemorrhage, choroidal detachment, and giant retinal tear were not enrolled. Cases with any signs of chronicity such as retinal cyst, subretinal fibrosis and band, demarcation line, and peripheral neovascularization were not included.

All patients underwent a thorough ophthalmic examination preoperatively including best-corrected visual acuity measurement, slit lamp examination, intraocular pressure measurement, and fundoscopy. We tried to find all retinal breaks preoperatively.

Surgical technique consisted of a routine scleral buckling procedure using microscope under general anesthesia. The extent of conjunctiva peritomy and the number of rectus muscles to be grasped were determined based on preoperative examination. After break localization, the buckle was placed in its position by temporary knots. Then a 25-gauge trocar (3.75 mm from limbus in phakic and 3 mm from limbus in pseudophakic eyes) was inserted and a one-port mini pars plana vitrectomy (cut rate:1500, suction:150) was performed under direct observation of the probe head behind the crystalline or previously implanted intraocular lens. The surgeons for each individual case selected the site for trocar. Mini vitrectomy was performed before scleral buckle fixation and it was repeated if necessary during fixation of more knots. The surgeons determined the amount of vitrectomy based on the intraocular pressure, the extent of buckling, and probable need for air or gas injection. Estimation of intraocular pressure was based on digital palpation technique. Total time and the number of probe insertion were recorded. After temporary fixation of the buckle, an indirect ophthalmoscopy examination was carried out to address the position of the break(s) related to the buckle effect. Thereafter, the buckle was fixed accordingly and permanently. In case of excessive subretinal fluid that prevented good apposition of break on the buckle, surgeons were allowed to inject SF6 gas which itself might necessitate more mini vitrectomy. All of the operation in this study were athermal scleral buckling

and the eyes received retinal photocoagulation around the breaks a few weeks after scleral buckling. Any complication encountered during the surgery was recorded. Two surgeons performed all the operations.

Postoperative examinations were carried out at days 1, 3, 7, 15, and 30 and months 2, 4, and 6 in most cases. Anatomical success was defined as complete retinal attachment at the final visit and was the main outcome measure of the study. Retinal non-attachment or redetachment that mandated another operation i.e. repeated scleral buckling or vitrectomy was considered as the failure.

All statistical analyses were performed by SPSS software (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The Kolmogorov-Smirnov test and Q-Q plot were utilized to assess normal distribution of data. For data description, frequency, percentage, mean, standard deviation, and range were used.

## Results

A total of 44 eyes of 44 patients (27 male and 17 female) with mean age of 48.1 ± 18.2 years (range, 12 and 80) were included. Mean duration of symptoms before operation was 15.4 days (ranged, 1 and 150). Most of the eyes were phakic (86.4%); 9.1% (4 eyes) were pseudophakic and 4.5% (2 eyes) had iris-claw phakic intraocular lenses. Thirteen eyes (29.5%) were highly myopic and 5 cases (11.4%) reported a history of trauma before rhegmatogenous retinal detachment development. Macula was not detached in 11 eyes (25%) at presentation. None of the eyes had an accompanying macular hole. Initial characteristics of the eyes before operation are presented in Table 1.

**Table 1.** Initial characteristics of the eyes before scleral buckling surgery prepared by the authors from the study data.

| | | Number | Percentage |
|---|---|---|---|
| Detachment extension | < 1 quadrant | 4 | 9.1% |
| | 1 to 2 quadrants | 29 | 65.9% |
| | 2 to 3 quadrants | 7 | 15.9% |
| | > 3 quadrants | 4 | 9.1% |
| Number of detected break(s) | No | 3 | 6.8% |
| | 1 | 28 | 63.6% |
| | 2 | 6 | 13.6% |
| | 3 | 6 | 13.6% |
| | > 3 | 1 | 2.3% |
| Break shape | round | 24 | 58.5% |
| | horse-shoe | 16 | 39.0% |
| | dialysis | 1 | 2.5% |
| Total size of the breaks | < 1 disc area | 14 | 34.1% |
| | 1 to 2 disc area | 20 | 48.8% |
| | 1 to 3 disc area | 5 | 12.2% |
| | > 3 disc area | 2 | 4.9% |
| Involved quadrant(s) | superotemporal | 31 | 70.5% |
| | inferotemporal | 34 | 77.3% |
| | superonasal | 8 | 18.2% |
| | inferonasal | 31 | 70.5% |

Source: Prepared by the authors based on the study results.

All of the eyes underwent scleral buckling surgery based on the earlier mentioned protocol. In these cases, silicon buckle no: 276, sponge no: 505, and sponge no: 507 were utilized for 7 (15.9%), 34 (77.3%), and 3 (6.8%) eyes, respectively. Encircling band no: 240 was also placed for 2 (4.5%) cases. The buckle was placed circumferentially in 39 (88.6%) and meridionally in 5 (11.4%) eyes. The extent of buckling in eyes with circumferential buckles was 90°, 135°, 180°, 225°, 270°, and 315°, respectively in 2 (5.1%), 23 (59.0%), 10 (25.6%), 2 (5.1%), 1 (2.6%), and 1 (2.6%) eyes.

During the whole buckling process, the surgeons utilized vitrectomy probe for performing mini vitrectomy once in 13 (29.5%), twice in 20 (45.5%), three times in 9 (20.5%), and four times in 2 eyes (4.5%). Mean time of performing mini vitrectomy was 87 ± 31 s (range, 45 and 180) and the mean total time of the operation was 61 ± 16 min (range, 45 and 180). Based on the surgeons' preferences, 24 eyes (54.5%) received intravitreal injection of SF6 gas at the end of the surgery.

After a mean follow up time of 9.2 ± 6.8 months (range, 1 and 20), complete retinal attachment was detected in 37 (84.1%) eyes and incomplete attachment in 4 (9.1%) eyes. In the later 4 eyes, small parts of unattached retina remained in the peripheral parts that were confined by postoperative laser treatment. The failure of the primary operation occurred in 3 (6.8%) eyes. One of them was a case with non-attached retina immediately after scleral buckling. The patient had been scheduled for intravitreal gas injection 3 days after her primary failed procedure; however, she refused it and underwent vitrectomy in another center. Another failed case developed repeated rhegmatogenous retinal detachment one month after primary operation secondary to a new break that was treated successfully by vitrectomy and gas injection. The last case developed retinal redetachment almost one year postoperatively as a result of proliferative vitreoretinopathy progression and underwent another intervention including phacoemulsification, vitrectomy, intraocular lens implantation, and silicone oil injection. The retina was attached at the last visit.

Regarding the complications encountered related to mini vitrectomy, one eye developed a tiny vitreous hemorrhage at the sclerotomy site which was cleared spontaneously. In another eye, vitreous strands orientation toward the sclerotomy site could be observed during ophthalmoscopy after operation; however, it caused no problem during the follow up period. In total, 3 sclerotomy sites (6.8%) needed suturing as a result of excess leakage.

## Discussion

In this case series, we evaluated the safety and efficacy of performing a small gauge mini vitrectomy instead of anterior chamber paracentesis in cases who underwent a non-drainage scleral buckling procedure. We noticed an anatomical success of 84.1% and failure rate of 6.8%. Meanwhile, no major complication related to the mini vitrectomy was encountered.

There is a debate about choosing the procedure for the primary repair of rhegmatogenous retinal detachment. These procedures generally include pneumatic retinopexy, scleral buckling, and vitrectomy. It was reported that scleral buckling had a higher morbidity than primary vitrectomy [14–16]. Nonetheless, this conclusion was made when comparing an extensive buckling procedure consisting of a cerclage with additional buckles, extensive coagulation therapy, and drainage of subretinal fluid which was reported to be the most hazardous step in rhegmatogenous retinal detachment surgery [17]. If minimal scleral buckling surgery, which does not include cerclage and SRF drainage is compared with primary vitrectomy, the result will be different. Many authors believe that segmental scleral buckling has less morbidity than primary vitrectomy [18–23].

In an analysis of 595 detachments treated with vitrectomy, performed by experts [24], they found that the rate of reoperation was 24.5% and proliferative vitreoretinopathy formation was 11.5% in contrast to those of the minimal scleral buckling surgery which were 10.7 and 1.9%, respectively. Like many authors, we also believe that the procedure of choice for many cases of rhegmatogenous retinal detachment is minimal scleral buckling surgery. In our series, drainage of subretinal fluid was not performed for any case; however, an encircling element was utilized for 2 eyes (4.5%). Therefore, our results could be extrapolated for all eyes that underwent a non-drainage scleral buckling and not only for minimal scleral buckling cases.

During a non-drainage scleral buckling, a major concern in many cases is a rise in intraocular pressure after buckle tightening. This could be adjusted, to some extent, by anterior chamber paracentesis; however every anterior chamber paracentesis has its potential complications [25] such as lens damage, hyphema, and infection [26–28]. Despite these rare complications, this procedure is considered to be relatively safe even when it is performed at the slit lamp [29]. Nonetheless, there is a drawback for this technique. Since anterior chamber volume is limited, repeated paracenteses may not work easily and the surgeon should wait for anterior chamber to reform again. This limitation becomes more obvious in case of using large buckles, an encircling element, or air or gas bubble injection. In addition, the effect of anterior chamber paracentesis may not last long as far as the primary mechanism remains. This was demonstrated after uneventful phacoemulsification that anterior chamber decompression immediately lowered intraocular pressure, but the effect was transient [30]. For such cases therefore, we introduce mini vitrectomy as an alternative approach to deal with this problem. By removing a volume directly from the vitreous cavity instead of anterior chamber, we in fact compensated directly for the reduced volume in the posterior segment that is induced by the scleral buckling.

It has been demonstrated that proliferative vitreoretinopathy is the most common cause of recurrent retinal detachment after surgical repair of rhegmatogenous retinal detachment and occurs in 5–11% of patients [31–34]. Our technique may theoretically reduce the chance of proliferative vitreoretinopathy progression by reducing the pathogenic elements in the vitreous body. These elements mainly originate from blood-ocular barrier breakdown as well as dispersed retinal pigment epithelium cells, macrophages and vitreous hemorrhage [35]. After a mean follow-up of 9.2±6.8 months, proliferative vitreoretinopathy developed in only one of our cases (2.3%) which was a lower rate when compared to that of other studies [31–34]. Nonetheless, this hypothesis that mini vitrectomy might reduce the chance of proliferative vitreoretinopathy formation should be verified in further investigations.

One may believe that the presence of the whole vitreous body is necessary for closing the retinal break(s) and having a successful scleral buckling surgery. However, it was demonstrated in a comparative study that scleral buckling surgery in 41 vitrectomized eyes did not have a lower success rate compared to the non-vitrectomized eye [36]. Therefore, we may conclude that removing a small part of the vitreous by a mini vitrectomy does not affect the process of reattachment as it was reflected in our success rate. Another possible drawback for this technique could be the possible breakdown of blood ocular barrier following mini vitrectomy which might increase the rate of proliferative vitreoretinopathy formation. However, this breakdown could also occur in association with anterior chamber paracentesis [37]. Furthermore, with the follow up of 9.2 ± 6.8 months, only one (2.4%) eye of the 42 eyes that had early-attached retina developed proliferative vitreoretinopathy.

Through one trocar, we performed a mini vitrectomy and injected a small amount of gas intravitreally. Despite adding these two maneuvers, SB could still be considered as a mainly extraocular surgery. Nevertheless, doing a complete vitrectomy with gas tamponade, as a major intraocular surgery, is an acceptable alternative to SB and is becoming more popular among vitreoretinal specialists.

We conclude from this study that performing a small gauge pars plana mini vitrectomy instead of anterior chamber paracentesis in order to adjust intraocular pressure during non-drainage scleral buckling is a safe procedure and results in good anatomical success. However, it should be emphasized that using a mini vitrectomy is a more aggressive procedure than a simple even repeated anterior chamber paracentesis. Therefore, we would recommend this procedure to carry out only in case that anterior chamber paracentesis fails to adjust intraocular pressure during operation. Nonetheless, this study was a case series without a control group and conducted only on 44 patients. To validate the safety and efficacy of this technique, running larger double-blind studies with more sample size is mandatory.

## Notes

### Contributor roles

AR: Conceptualization, methodology, investigation, writing - original draft, visualization, supervision, project administration. ME: Investigation, writing - review & editing. SB: Investigation, data curation, project administration. AN: Investigation, data curation. MY: Formal analysis, data curation.

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### Competing interests

None of the authors has any potential interest related to this paper.

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### Ethics

The Review Board/Ethics Committee of Ophthalmic Research Center, Shahid Beheshti Medical University (Tehran, Iran) approved this interventional case series.

### Data sharing statement

The data is available to anyone who requests it.

### Provenance and peer review

Not commissioned. Externally peer-reviewed by three reviewers, double-blind.

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# La minivitrectomía como técnica alternativa para el ajuste de la presión intraocular en el cerclaje escleral sin drenaje


## Resumen

**Objetivo**

En el cerclaje escleral sin drenaje, se suele realizar una paracentesis de la cámara anterior para disminuir la presión intraocular. Sin embargo, cuando el cerclaje es extenso, esta técnica puede ser ineficaz y requerir mucho tiempo. En este estudio, intentamos comprobar si una vitrectomía pars plana de calibre 25 podría utilizarse como procedimiento alternativo eficaz y seguro a la paracentesis de la cámara anterior para ajustar la presión intraocular durante un cerclaje escleral sin drenaje.

**Métodos**

En esta serie de casos, se incluyeron 44 pacientes con desprendimiento de retina regmatógeno (vitreorretinopatía proliferativa estadio < C). En todos los casos, se realizó una mini vitrectomía pars plana de calibre 25 antes de la fijación de la hebilla y se repitió si era necesario. La fijación completa de la retina se definió como el éxito anatómico.

**Resultados**

Se incluyeron 44 ojos de 44 pacientes con una edad media de 48,1 ± 18,2 años. Se utilizó la hebilla de silicona nº 276, la esponja 505 y la esponja 507 en 7, 34 y 3 ojos, respectivamente. Se realizó una inyección intravítrea de gas SF6 en el 54,5% de los ojos. El tiempo total medio de la operación fue de 61 ± 16 minutos y el tiempo medio de la vitrectomía fue de 87 ± 31 segundos. Se consiguió la fijación completa de la retina en 37 y la fijación incompleta en 4 ojos tras una única operación, lo que supuso una tasa de éxito del 93,2%. Uno tuvo una fuga de vítreo mayor de lo habitual en el lugar de la esclerotomía y otro desarrolló una pequeña hemorragia vítrea en el lugar de la esclerotomía. Tres zonas de esclerotomía necesitaron sutura.

**Conclusión**

El resultado anatómico y la seguridad observados en este estudio fueron comparables a los métodos actuales descritos en la literatura. Por lo tanto, si la paracentesis de la cámara anterior no consigue ajustar la presión intraocular durante un cerclaje escleral sin drenaje, la realización de una minivitrectomía de pequeño calibre es segura y útil.