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Retrospective study of the effectiveness of scleral buckling under direct vision with operating lamp illumination in 17 cases of retinal detachment associated with retinal dialysis

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Abstract

Objective To investigate the effectiveness of scleral buckling under direct vision with the operating lamp illumination for the treatment of retinal detachment (RD) associated with retinal dialysis.

Methods A retrospective study was conducted on 17 selected cases of patients with monocular RD caused by retinal dialysis, representing 17 injured eyes. The patients were treated at the Hebei Eye Hospital from January 1, 2020, to December 31, 2022, which included 10 males (10 impacted eyes) and 7 females (7 impacted eyes), aged 12–39 years (mean: 25.24 ± 13.1 years). Scleral buckling was proposed for all patients as the recommended treatment plan, including both segmental scleral buckling and encircle buckle combined with radial buckling. Segmental buckling was performed in most of these cases while encircling buckling combined with radial buckling was indicated for severe RD cases with extensive dialysis at the ora serrata and serious retinal proliferation. After the surgeries, the patients were followed up once a month for 6 months, during which the corrected visual acuity, intraocular pressure, ultrasonographic results, slit-lamp examination results, and gonioscopy results of the patients were collected to evaluate the restoration progress of the retina.

Results The detached retinas were completely reset in position in all 17 patients in one single operation respectively, representing an operation success rate of 100%. Over the 6-month follow-up period, the retinas of all cases remained in place without recurrence of detachment, representing a retina restoration rate of 100%. No patients reported the serious complications commonly associated with RD, including high intraocular pressure, complicated cataracts, and choroidal hemorrhage.

Conclusion Scleral buckling under direct vision with an operating lamp illumination is safe and effective in the treatment of RD associated with retinal dialysis. In this technique, the operation is visually aided by magnified images that are the real, erect image of the retina, which makes the procedure relatively easy to perform. It has a lower

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requirement for previous training of the operator and operational instruments, which makes it easier to be adopted in the outpatient setting.

Keywords Scleral Buckling, Retinal Detachment, Retinal Dialysis

Introduction

Retinal detachment (RD) associated with retinal dialysis is an arcuate fracture of the retina along the circumferences of the ora serrata, which could be associated with traumatic and non-traumatic causes [1, 2]. Non-traumatic retinal dialysis is considered a special type of rhegmatogenous retinal detachment, accounting for 8–17% of the overall incidences [3], and is the most prevalent cause of RD in adolescents [4]. Retinal dialysis is most commonly found in the inferior temporal and supranasal quadrants, the range of detachment varies from 2°-180° [3]. The condition generally has a long course and is asymptomatic in the early stage. Patients are often not diagnosed until they experience significant decreases in visual acuity when the lesions involve the macula. Currently, pars plana vitrectomy (PPV) is the standard of care for retinal dialysis with a detachment range of > 180° accompanied by severe proliferative vitreoretinopathy (PVR), giant retinal tears, and choroidal detachment [5]. PPV has gained favorability among surgeons due to the advancement of technologies and medical instruments. However, vitrectomy has been found to be accompanied by surgical complications such as iatrogenic retinal breaks and cataracts [6]. In light of the above, segmental scleral buckling is comparatively more effective in retinal dialysis with a range of detachment less than 180°, with or without PVR of grade C1 or less, and without inverted retinal flap [2, 3, 7]. Traditionally, scleral buckling is generally performed with indirect vision under a fundoscopy [8]. In this study, the 17 cases of RD associated with retinal dialysis were treated satisfactorily with scleral buckling under direct vision with an operating lamp. The details are now reported as follows.

Subjects and methods

Subjects of study

We systematically reviewed 17 cases (17 eyes) of RD caused by retinal dialysis, who were presented to Hebei Provincial Eye Hospital from January 1, 2020, to December 31, 2022. All cases involved a monocular disease, including 10 males (10 eyes) and 7 females (7 eyes), with ages ranging from 12 to 39 years old (mean 25.24 ± 13.1 years old). The course of the diseases until the diagnosis ranged from 1 d to 180 d (mean 53.76 ± 57.53 d); 15 cases had unknown causes and 2 cases were associated with known previous traumas; In terms of the refractive states, 6 patients were in emmetropia, 9 patients were myopic by less than – 6.00D, and 2 patients were myopic by greater than – 6.00D; In terms of visual acuity, 10 cases had a corrected visual acuity of Counting Fingers (CF) to < 0.05, 2 cases ≤ 0.05 to < 0.1, and 5 cases ≤ 0.1 to < 0.5; In terms of the degree of detachment, 1 case had a detachment of ≤ 60°, 2 cases > 60-≤90°, 14 cases > 90-≤180°; In terms of the location of the detachment: the detachment was in the superior temporal quadrant in 1 case, in the inferior temporal quadrant in 10 cases, in the inferior temporal and the superior temporal quadrants in 1 case, in the supranasal and infranasal quadrants in 4 cases, and in the supranasal and superior temporal quadrants in 1 case; In terms of PVR classification: there were 13 cases of grade A, 2 cases of grade B, and 2 cases of grade C1 (Table 1). Written consents were received from patients and their families who had been informed in detail about the surgical procedures. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Hebei Provincial Eye Hospital (Approval No.2024LW13).

Patient eligibility

Inclusion Criteria: Patients who met all of the following criteria were eligible for the study:

- Confirmed diagnosis of RD associated with retinal dialysis (as determined via fundus fluorescein angiography, ultrasonography, slit lamp, and gonioscopy examinations);
- Less than 180° of ora serrata detachment.
- No inverted retinal flap under the tear.
- Non-severe or the absence of vitreoretinal proliferation, as defined by a PVR grading of grade C1 or less.
- No-received any surgical treatment.

Exclusion criteria: Patients who met one of the following conditions were excluded from the study:

- Severe ocular inflammations;
- Severe systemic conditions, including but not limited to cardiovascular, respiratory, gastrointestinal, neurologic, endocrine, and genitourinary diseases.

Surgical procedures

All patients underwent scleral buckling, including both segmental scleral buckling and encircle buckling combined with radial buckling, where segmental buckling was the standard procedure for most cases. Encircling scleral buckling was indicated when the retinal dialysis caused extensive detachments and vitreoretinal

Table 1 General information of study subjects

Case	Age	Gender	Detachment Range	Dialysis Quadrant	PVR Grade
1	35	F	2: 00–8:00	Superior temporal	A
2	27	M	9:00–3:00	Supranasal & superior temporal	A
3	30	M	3:00–8:00	Inferior temporal	A
4	13	M	3:00–7:0	Inferior temporal	A
5	28	F	1:00–5:00	Superior temporal	A
6	20	F	4:00–9:00	Superior temporal	C1
7	39	M	2:00–9:00	Superior temporal	C1
8	25	F	3:00–9:00	Superior temporal	A
9	25	M	12: 00–8:00	Superior temporal & superior temporal	A
10	25	F	6:00–9:00	Superior temporal	B
11	12	M	2:00–6:00	Superior temporal	A
12	66	F	2:00–7:00	Superior temporal	B
13	20	M	8:00–11:00	Supranasal & infranasal	A
14	17	F	6:00–10:0	Supranasal & infranasal	A
15	14	M	10:00–11:00	Supranasal & infranasal	A
16	12	M	2:00–6:00	Superior temporal	A
17	21	M	8:00–1:00	Supranasal	A

proliferation(180° of ora serrata detachment and PVR grading of grade C1). All patients were operated by Dr. Shanyu Li.

Surgical procedures

A 360° peritomy was performed on the bulbar conjunctiva along the corneal limbus. The tissues were dissected bluntly and pulled back along the four recti muscles to fully expose the sclera. Then, according to the location of the dialysis as determined in the preoperative examinations, pre-placed sutures in 2–3 vertical mattress stitches with 5 – 0 nonabsorbable sutures in the quadrant where segmental buckling would be applied, and in the case of encircle buckling, sutures were applied in the rest of the quadrants to fixate the scleral belt loop. The width of the silicone compression element was 7 mm, and the mattress stitches were placed 7–8 mm from the corneal limbus anteriorly and 16–17 mm posteriorly. Controlled drainage of the subretinal fluid was then performed at the top of the retinal detachment, away from the tears, to reduce intraocular pressure (If the subretinal fluid was in a modest volume, the fluid was either displaced naturally or drained via corneal puncture). Then, the retina was lifted where the ora serrata dialysis was located with the cryopexy probe, and the retinal tears were localized under the direct vision of the surgeons under *operational lamps*, and the posterior edge and both ends of the tears were reattached to the retina by cryopexy. The success of the step was indicated by the creation of artificial scars as shown in the whitening of local retina tissues. The silicone compression element and buckle were then put in place timely with the buckle placed in the groove of the silicone plate. After making sure that the posterior edge and both ends of the tear were located on the ridge of the compression element and that the element provided at least 1 mm of additional support beyond the width of the tear, the pre-placed sutures were ligated. In the case of encircle buckling, the scleral belt loop was tightened circumferentially around the globe until the circumference of the globe was shortened by 10–12 mm. At the end of the operation, depending on the patient's intraocular pressure, an anterior chamber puncture was performed to drain the subretinal fluids if the intraocular pressure was high, or sterilized air was injected into the vitreous cavity if the intraocular pressure was low.

Follow-up indicators

All patients were asked to return to the clinic once a month over 6 months, during which the affected eyes were observed through corrected visual acuity, intraocular pressure, ultrasonography, slit-lamp, and gonioscopy examinations to determine the restitution of the detached retina.

The visual acuity (VA) of the patients was graded as follows: Grade 1 means visual acuity $\geqq 0.5$; grade 2 means $0.1 \leqq$ visual acuity < 0.5; grade 3 means $0.05 \leqq$ visual acuity < 0.1; grade 4 means visual acuity from CF to < 0.05, and grade 5 means visual acuity include visions with hand motions (HM) acuity, light perception (LP), and no light perception (NLP) [9]. Based on the World Health Organization criteria, we defined grade 3 as severe visual impairment and grades 4 and 5 as blindness [10]. When patients' visual acuity moved up 2 lines or more on the international standard visual acuity scale, it was defined as an improvement, while when patients' visual acuity moved down 2 lines or more, it was defined as a degradation. Otherwise, the visual acuity was recorded as unchanged. For those with visual acuity less than 0.1, a change of at least 0.02 in visual acuity was used as the critical threshold to define the improvement or degradation in visual acuity, and any change below that threshold was considered insignificant [11].

Clinical efficacy

The success of the surgery was considered successful if the retina was fully restored with relapsed detachment as determined by ultrasound review in more than 6 months after surgery. Failure to reset the retina or recurrence of detachment within 6 months after surgery was considered a surgical failure.

Statistical analysis

The statistical analysis in this study was conducted with SPSS29.0. Continuous data was described as

Table 2 Preoperative and postoperative corrected visual acuity

	Grade 5	Grade 4	Grade 3	Grade 2	Grade 1
Preoperative	0	10	2	5	0
Postoperative	0	8	2	6	1

mean ± standard deviation (`x ± s), and the categorical data was expressed as the number of cases (n, %). The patient's follow-up indicators were compared via the Wilcoxon signed-rank test, where a p-value of < 0.05 was considered statistically significant.

Results

Surgery

Scleral buckling was successfully performed on all patients under direct vision with operating lamp illumination. Among them, 11 patients received segmental scleral buckling and 6 patients received encircling buckling combined with radial buckling; 14 cases required scleral incision for fluid drainage and 3 cases required external needle drainage. In 15 cases, the compression component was put in place above the breaks in a single attempt, and in 2 cases of posterior edge of the detachment was found to not align with the compression component, which required the preplaced stitches to be moved posteriorly by about 3 mm. In both cases, the posterior edge and both ends of the detachment were well aligned with and sealed by the compression element. During all 17 operations, the cryopexy procedure took 1–4 min, with an average time of (2.24 ± 0.97) min.

Retinal reset rate

The detachment of all 17 patients was fully treated in a single operation, with a success rate of 100%. At the 6-month postoperative follow-up, the retina remained in place in all cases and there was no recurrence, with a 100% reset rate.

Postoperative visual recovery

Preoperative visual acuity was recorded in a total of 17 patients. Out of these patients, 5 (5/17, 29.41%) had Grade 2 vision, 2 (2/17, 11.76%), and 10 (10/17, 58.82%) patients had severe visual impairment (Grade 3) and blindness (Grade 4) respectively. At the 6-month follow-up, 2 patients (2/17, 11.76%) reported improved visual acuity 2 cases, 15 (15/17, 88.24%) patients' visual acuity was recorded as unchanged, and no patients reported a decline in visual acuity. The postoperative visual acuity of all patients exhibited no statistical difference compared to the baseline (see Table 2).

Intraoperative and postoperative complications

Intraoperatively, two patients reported vitreous prolapse and incarceration during scleral drainage. In one case, fluid drainage was achieved by the excision of the prolapsed vitreous body, while the other case was managed by transparent corneal paracentesis. Both scleral incision sites were sutured and fixated with cryopexy, followed by placement of scleral buckling.Postoperative follow-up at 6 months showed the two patients'retinas remained attached without abnormalities. Postoperatively, severe vitreous clouding was reported in 1 case, with a fresh retinal tear observed 15 days post-surgery. However, this tear was positioned on the buckling ridge, and the retina remained attached fortuitously. Continued follow-up for 6 months confirmed sustained retinal attachment without complications.

Discussions

Retinal dialysis is a specific type of retinal tear oriented circumferentially and located at the ora serrata, especially in the inferior temporal quadrant, and is most commonly associated with RD in teenagers and young adults, especially those with a history of ocular trauma [1, 2]. These findings were consistent with clinical observations of this hospital. The treatment of retinal dialysis is in line with that of rhegmatogenous retinal detachment: both conditions require closing the retinal tears while relieving the vitreous pull on the retina. Currently, there are multiple surgical approaches available for the management of retinal dialysis, which include PPV and scleral buckling. In PPV, a portion of the vitreous body is resected to relieve the vitreoretinal traction, and the rims of the retinal tear are adhered to the choroid by cryocoagulation or photocoagulation, while inert gas or silicone oil is used as a vitreous substitute to provide the support to the retina [10, 12]. In scleral buckling, an appropriately sized scleral cushion is attached to the sclera to provide external compression. The retinal tears are localized and closed with cryocoagulation, and the retina is reset by depressing the posterior part of the sclera and the surrounding choroid to form a new intraocular ridge at the posterior border of the tears [10, 12].

Even though, as the relevant technologies become more sophisticated, PPV has gained increased popularity in clinical practices, scleral buckling remains a viable treatment plan that PPV cannot replace due to its advantages of limited surgical trauma, low technological requirements, and fewer complications [3]. Scleral buckling includes segmental scleral buckling, encircle buckling, and encircle buckling combined with radial buckling. Encircle buckling can reduce the circumference of the eye, and therefore reduce or eliminate the centripetal traction of the vitreous body on the retina to allow for the retina to reattach. The artificial circumferential scleral ridge provides the external compression needed for retinal reattachment and has a preventive sealing effect on any new or unlocalized minor tears near the ridge [5].

Conventionally, in scleral buckling, previous researchers reported performing the procedure under indirect vision using fundoscopy or under direct vision with an operating microscope. The procedures involve localizing the breaks, cryopexy, and fluid draining. These procedures usually have an anatomic success rate of above 95% [5, 1314]. In comparison, this study evaluated scleral buckling performed under direct vision with an operating lamp. In this procedure, the fluid drainage comes before the localization of the breaks and cryopexy to lower the intraocular pressure. This is because it is not easy to lift the eye wall when the intraocular pressure is within and above the normal range, and excessive subretinal fluid makes it difficult to localize the break. When the intraocular pressure is lowered after the fluid is drained, the eye wall and surrounding retina are lifted with a cryopexy prob or a cotton swab. With the innate magnifying effect of the well-moisturized cornea and len and the shortening of the eye axis when the globe is pressurized posteriorly, the retinal breaks can be seen under direct vision, which increases the feasibility and accuracy of the localization and cryopexy. In this study, a total of 17 cases (17 eyes) were treated through this procedure, which was delivered successfully in a single attempt. The results demonstrated a high surgical success rate, high retinal reset rate, and postoperative visual acuity improvement.

Scleral buckling under direct vision with operating lamp lighting is a novel technique of scleral buckling developed by Hebei Provincial Eye Hospital. It utilizes the natural magnifying effect of the cornea and the lens as convex lenses [15]. When the intraocular pressure is low and the retina is pushed up to within the focus of the cornea and the lens, the magnified erect image of the retina through the cornea is visible under direct vision, allowing the surgeon to see the ora serrata in the site of retinal tears. Thus, fluid drainage was required in every patient to create a low intraocular pressure condition. However, fluid drainage tends to induce intraoperative complications such as vitreous overflow due to the surgical incision, as occurred in two cases in this study. Intraoperative management of these complications involves clipping the overflowed vitreous to unblock fluid draining and coagulating and suturing the surgical incision before the placement of the silicone compression element. The surgical incisions were within the range of the external compression element to allow the compression element to be placed in time to minimize the occurrence of postoperative detachment due to vitreoretinal traction. Postoperative complications were mainly caused by the aggravation of vitreous clouding, which leads to the formation of new retinal detachment, as occurred in one case of the study. The mitigation measure involved avoiding excessive cryopexy treatment.No serious complications such as high intraocular pressure, concomitant cataract, or choroidal hemorrhage were reported in all cases in this study.

In conclusion, scleral buckling under direct vision with operating lamp illumination is safe and effective in the treatment of RD associated with retinal dialysis, because the ophthalmologist operates with the magnified, erect, real image of the retina, and the operation is easy to perform, easy to master, and has low instrumentation requirements, which favors its adaptation in the clinic.

Abbreviations

RD	Retinal detachment
PPV	Pars plana vitrectomy
PVR	Proliferative vitreoretinopathy
CF	Counting Fingers
VA	Visual acuity
HM	Hand motions
LP	Light perception
NLP	No light perception

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Author contributions

Shanyu Li and Dong Han: completed the operation.Xiaoxuan Wang: drafted the manuscript. Li Li and Zhixia Dou: statistic analyzed the data.Xiujun Liu: drew charts.Jie Zhang: revised the manuscript.All authors read and approved the final manuscript.Thanks to anyone who has contributed to this manuscript, they have agreed to publish it.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study was conducted following the Declaration of Helsinki and was approved by the Ethics Committee of Hebei Eye Hospital (Ethics Approval Number: 2024LW13). All patients had signed informed consent forms. The participate was obtained from the parents or legal guardians of any participant under the age of 16.

Consent for publication

Not applicable in this study.

Competing interests

The authors declare no competing interests.

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