·Clinical Research·

Comparison of scleral buckling using wide-angle viewing systems and indirect ophthalmoscope for rhegmatogenous retinal detachment

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Abstract

• AIM: To compare the effects of scleral buckling using wide-angle viewing systems (WAVS) with that using indirect ophthalmoscope for the treatment of rhegmatogenous retinal detachment.

• METHODS: The study was a retrospective analyses of the medical records of 94 eyes (94 patients) with rhegmatogenous retinal detachment. Among them, 47 eyes underwent scleral buckling using WAVS with endoilluminator (Group W), and 47 eyes underwent scleral buckling using indirect ophthalmoscope (Group I). Surgical durations, primary success rate, best-corrected visual acuities (BCVA), delayed subretinal fluid absorptions and surgical complications were compared between the two groups.

• RESULTS: At baseline, there were no statistical differences between the two groups in patient´s age (*P*=0.997), gender (*P*=0.853), symptom duration (*P*=0.216), BCVA (*P*=0.389), refractive error (*P*=0.167), intraocular pressure (*P*=0.595), the number of retinal breaks (*P*=0.832), the extent of retinal detachment (*P*=0.246), subretinal demarcation line (*P*=0.801), and macular detachment (*P*=0.811). The follow-up period was 12mo. The surgical durations in Group W (with or without encircling buckling) were significant shorter than those in Group I (*P*<0.001 respectively). The primary success rate was 94.27% in Group W, which was similar to that in Group I (92.38%, *P*=0.931). The BCVA in Group W was better than that in Group I (*P*<0.001) at 1-month follow-up visit. However, there were no significant differences between the two groups at 3-month (*P*=0.221), 6-month (*P*=0.674), and 12-month (*P*=0.363) follow-up visits respectively. Delayed subretinal fluid absorptions were more common in Group I than in Group W at 1-month (*P*=0.045) follow-up visit, but there were no significant differences between the two groups at 3-month (*P*=0.111), 6-month (*P*=1.000) and 12-month follow-up visits respectively.

• CONCLUSION: Scleral buckling using WAVS can be an alternative choose for rhegmatogenous retinal detachment.

• KEYWORDS: scleral buckling; retinal detachment; wide-angle viewing systems

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INTRODUCTION

Scleral buckling is a well-established procedure for uncomplicated rhegmatogenous retinal detachment [1-3]. Conventional scleral buckling is performed using binocular indirect ophthalmoscopy. However, the method has some limitations. During the surgery, it is inconvenient to observe the fundus due to the inverted and small fundus images. Furthermore, the surgical field cannot be easily shared with medical staff during the surgery, and thus the support provided by the surgical assistants may be limited[4-5].

Recently, it has become popular to use a noncontact wide-angle viewing system (WAVS) combined with endoilluminator in vitrectomy, for this option can easily provide a panoramic view of the surgical field[6-9]. Up to date, several studies showed that using a noncontact WAVS combined with endoilluminator for fundus visualization is also feasible for scleral buckling for uncomplicated rhegmatogenous retinal detachment and has favorable surgical outcomes[10-16].

In this study, we compared the surgical outcomes of scleral buckling using WAVS with that of using indirect ophthalmoscope in patients with rhegmatogenous retinal detachment.

SUBJECTS AND METHODS

Subjects This study was a retrospective analysis of 94 eyes (94 patients) with rhegmatogenous retinal detachment treated with scleral buckling at our hospital between January 2010 and January 2013. All surgeries were performed by one experienced surgeon, doctor Li. She is thought to be an experienced doctor who had experienced more than 500 vitreoretinal surgeries and more than 300 conventional scleral buckling. From January 2010 to June 2011, 47 eyes treated with scleral buckling using WAVS with a 25 G endoilluminator were classified as Group W, and from July 2011 to January 2013, 47 eyes using indirect ophthalmoscope as Group I. The study was approved by Zhengzhou University and conducted in accordance with the Declaration of Helsinki for research involving human subjects. Informed consent was obtained from all the patients.

Inclusion criteria for the present study included rhegmatogenous retinal detachment with proliferative vitreoretinopathy (PVR) grade A or B, transparent or mildly opaque refractive media that did not affect clear visualization of the fundus, and follow-up period for at least 12mo. Patients were excluded from the study if they had retinal breaks in the posterior pole, giant retinal breaks not in the ora serrata or other ocular disease that could affect the surgical outcomes (cataract opacities >C1, N1 and P1, vitreous opacities >grade 2 or PVR >grade B, choroidal detachment, a previous history of ocular trauma, choroidal neovascularization and so on); or they had undergone ocular surgery such as cataract surgery, retinal detachment or vitreous surgery[5,17].

Surgical Procedures In Group W, 0.25% tropicamide drops were used to dilate the pupil every 10min for 4 times. Then the retrobulbar anesthesia was applied after 2% lidocaine and 0.75% bupivacaine were mixed equally. All the following procedures were performed under a surgical microscope (Carl Zeiss Meditec AG, Jena, Germany). The sclera was exposed with a perilimbal conjunctival peritomy. Then the extraocular muscles were exposed and traction sutures were placed with 3-0 black silk. Mattress sutures were placed on the sclera according to the position of the retinal breaks. For the insertion of an endoilluminator, a 25 G trocar cannula was placed 3.5 mm behind the limbus, in the superotemporal or superonasal quadrant, meanwhile kept away from the localization of the breaks. A valve was inserted into the trocar when the endoilluminator was not in use. The drainage site of subretinal fluid was usually located 13-15 mm behind the limbus, at the highest retinal elevation, and far from the retinal breaks and the vortex veins as well. A sharp knife was used to penetrate the sclera at a 45-degree angle and release the subretinal fluid. Once gradual flat of the retina has been achieved at the end of the drainage procedure, the scleral incision was closed immediately with a non-absorbable polyester 6.0 suture previously passed. Then the whole retina was visualized carefully using WAVS (Carl Zeiss Meditec AG, Jena, Germany) with endoilluminator (Alcon Laboratories, Inc., Fort Worth, TX, USA). Retinal cryotherapy was performed after the retinal breaks and degenerations were visualized and identified. The retinal cryotherapy was stopped as soon as the retinal pigment epithelium or the retina became whitened and then the endoilluminator was removed. For buckling proceder, a silicone tire was placed on the eye for the segmental buckling and a silicone band with silicone sleeve combined with a silicone tire was placed for encircling buckling. After that, the endoilluminator was reinserted to observe the fundus carefully once again and confirm the adequacy of the position and height of the buckle. If the intraocular pressure (IOP) was too low, the intravitreal injection of filtered air was applied. The final IOP was regulated to slightly higher than normal, meanwhile the patient remained light perception. Then the 25 G cannula was removed, followed by cotton swab compression. The conjunctiva was closed with 8-0 silk sutures. After the surgery, antibiotic eye drops were used in all eyes three times a day for three days.

While in Group I, fundus was observed using a binocular indirect ophthalmoscope. The methods of placing silicone materials and draining subretinal fluid were the same as those used in Group W.

Outcome Measures The main outcome measures in our study were surgical durations, primary success rate, BCVA, delayed subretinal fluid absorptions and surgery complications. All patients underwent a broad ophthalmologic examination at baseline and every postoperative follow-up visit (1, 3, 6 and 12mo after the surgery). BCVA was measured with Early Treatment Diabetic Retinopathy Study (ETDRS) charts at 4-meter distance and converted into logarithm of the minimal angle of resolution (logMAR) format. Refractive error was measured with streak retinoscopy and the data were presented as the mean spherical equivalent refractive error. IOP was measured with Goldmann applanation tonometer. The PVR grading was according to the American Retinal Society classification in 1983. The preoperative number and localization of retinal breaks were measured with a three-mirror contact lens. Extent of retinal detachment was recorded as clock hours. Subretinal fluid was measured with OCT at the macula. (Heidelberg Engineering, Heidelberg, Germany).

Primary success was defined as the retina maintaining reattached for at least 3mo after the primary surgery. Localized small subretinal fluid without an increase during follow-up period was not considered surgical failure.

Statistical Analysis All parameters were presented as percentages (%) or means±standard deviation (SD). The continuous variables were tested using Student's *t*-test. The qualitative variables were analyzed using the Pearson

Chi-square test or Fisher's exact test. Statistical analyses were performed with SPSS for windows version 17.0 (SPSS Inc., Chicago, IL, USA). A *P* value less than 0.05 was considered statistically significant.

RESULTS

Patient´s Demographic and Clinical Characteristics The demographic and clinical characteristics of the patients in the two groups were presented in Table 1. At baseline, there were no statistical differences between the two groups in patient's age (*P*=0.997), gender (*P*=0.853), symptom duration (*P*=0.216), BCVA (*P*=0.389), refractive error (*P*=0.167), IOP (*P*=0.595), the number of retinal breaks(*P*=0.832), the extent of retinal detachment (*P*=0.246), subretinal demarcation line (*P*=0.801), and macular detachment (*P*=0.811) (Table1).

Quadrants of Segmental Buckling The quadrants of segmental buckling in the two groups were presented in Table 2. There were no statistical differences between the two groups in supratemporal quadrant (*P*=0.748), supranasal quadrant (*P*=1.000), infratemporal quadrant (*P*=1.000), supratemporal and supranasal quadrants (*P* =0.804), supratemporal and infratemporal quadrants (*P* =0.614), segmental buckling (supratemporal and supranasal quadrants) combined with encircling buckling (*P*=0.778) and segmental buckling (supratemporal and infratemporal quadrants) combined with encircling buckling (*P*=0.562) (Table 2).

Surgical Durations The surgical durations in the two groups were presented in Table 3. The surgical durations in Group W (scleral buckling with or without encircling) were significant shorter than those in Group I (*P* <0.001 respectively).

Primary Success Rate The primary success rate was 92.38% in Group I and 94.27% in Group W respectively. There were no significant differences between the two groups (*P*=0.931). The failure occurred in four eyes (8.51%) in Group I. And the reasons included occurrence of new breaks in one eye, failure to seal retinal breaks completely in one eye, and PVR aggravation in two eyes. Scleral buckling was performed again in one eye, and vitrectomy was performed in three eyes. After the second surgery, the retinas were all flatted. In Group W, the failure occurred in three eyes (6.38%). Retinal redetachment occurred in two eyes owing to new retinal breaks and scleral buckling was performed again, and then the retinas were flatted. Another one was due to PVR aggravation, and the retina was reattachment after the vitrectomy was performed. In the subsequent follow-up visits, there were no recurrences of retinal detachment in the two groups.

Best-corrected Visual Acuity The BCVA in Group W and Group I was presented in Table 4. The data showed no differences in BCVA between the two groups at baseline (*P*=0.831). After the surgery, the BCVA in Group W was better than that in Group I (*P*<0.001) at 1-month follow-up visit. The BCVA were gradually improved in the two groups. However, there were no significant differences between the two groups at 3-month (*P* =0.221), 6-month (*P* =0.674), and 12-month (*P* =0.363) follow-up visits respectively.

Table 1 Comparisons of demographic and clinical characteristics between Group W and Group I *n*=47 (%)

Items	Group W	Group I	P
Age (a)	37.04±11.12	37.13±11.65	0.997
Male	26 (55.32)	24 (51.06)	0.853
Symptom duration (d)	53.13±20.74	50.24±22.45	0.216
BCVA (logMAR)	0.43±0.42	0.42±0.57	0.389
Refractive error (D)	-4.72±1.85	-4.46±2.21	0.167
IOP (mm Hg)	12.67±2.42	13.41±2.35	0.595
No. of retinal breaks	2.35±1.73	2.36±0.89	0.832
Extent of retinal detachment (h)	6.24±2.45	5.87±1.49	0.246
Subretinal demarcation line	10 (21.28)	9 (19.15)	0.801
Macular detachment	10 (21.28)	9 (19.15)	0.811

BCVA: Best-corrected visual acuity; LogMAR: Logarithm of the minimal angle of resolution.

Delayed Subretinal Fluid Absorptions The delayed subretinal fluid absorptions in Group W and Group I was presented in Table 5. Delayed subretinal fluid absorptions were more common in Group I than in Group W at 1-month (*P* =0.045) follow-up visit. The subretinal fluids were slowly absorbed in the two groups and there were no significant differences between the two groups at 3-month (*P* =0.111), 6-month (*P*=1.000) and 12-month follow-up visits respectively.

Surgical Complications The intraoperative complications included penetration of the sclera by suture needle and subretinal hemorrhage [occurred slightly and locally (≤2 DD) and did not enter the macular area] due to drainage of subretinal fluid or cryotherapy. There were no statistical differences in these complications between the two groups. Elevated IOP (26-40 mm Hg) occurred in 10 eyes (21.28%) in Group W and 13 eyes (27.66%) in Group I in the first three days after surgery, and there were no significant differences between the two groups (*P*=0.613). The IOP dropped to 16-18 mm Hg after topical anti-glaucomatous treatment within three weeks. In addition, one case (2.13%) of macular pucker was found in Group I (*P* =1.000) at 6-month follow-up visit. No other serious complications occurred during the follow-up visits in the two groups.

DISCUSSION

In the present study, we compared two scleral buckling procedures retrospectively for treating uncomplicated rhegmatogenous retinal detachment. We found that there were no significant differences in the primary success rate of the surgery between the two groups. However, the surgical durations in Group W (with or without encircling) were obviously shorter than those in Group I (*P* <0.001 respectively). Tomita *et al* [16] compared the outcomes of scleral buckling using a noncontact WAVS with that of scleral buckling using conventional indirect ophthalmoscopy

Table 2 Comparisons of the quadrants of segmental buckling between Group W and Group I *n*=47 (%)

Quadrants of segmental buckle	Group W	Group I	*P*
Supratemporal quadrant	5 (10.64)	6 (12.77)	0.748
Supranasal quadrant	3 (6.38)	3 (6.38)	1.000
Infratemporal quadrant	3 (6.38)	4 (8.51)	1.000
Supratemporal and supranasal quadrants	10 (21.28)	11 (23.40)	0.804
Supratemporal and infratemporal quadrants	11 (23.40)	9 (19.15)	0.614
Segmental buckling (supratemporal and supranasal quadrants) combined with encircling buckling	7 (14.89)	8 (17.02)	0.778
Segmental buckling (supratemporal and infratemporal quadrants) combined with encircling buckling	8 (17.02)	6 (12.77)	0.562

Table 3 Comparisons of surgical durations between Group W and Group I *n*=47

Surgical durations	Group W	Group I	*P*
Segmental buckling (min)	62.53±8.43	83.15±9.34	<0.001
Encircling buckling (min)	95.61±11.24	114.24±13.56	<0.001

Table 4 Comparisons of BCVA between Group W and Group I *n*=47

BCVA（logMAR）	Group W	Group I	*P*
Baseline	0.51±0.23	0.51±0.20	0.831
1-month	0.35±0.22	0.40±0.31	<0.001
3- month	0.28±0.16	0.29±0.13	0.221
6- month	0.18±0.16	0.18±0.12	0.674
12- month	0.12±0.08	0.13±0.08	0.363

Table 5 Comparisons of delayed subretinal fluid absorptions between Group W and Group I *n*=47 (%)

Delayed subretinal fluid absorptions	Group W	Group I	*P*
1-month	2 (4.26)	8 (17.02)	0.045
3- month	1 (2.13)	6 (12.77)	0.111
6- month	0	1(2.13)	1.000
12- month	0	0	

for rhegmatogenous retinal detachment. Their results showed that compared with the conventional procedure, the WAVS procedure decreased the surgical duration of segmental buckling (P=0.02). Our study differed from their in that our results showed not only the surgical duration of segmental buckling but also the surgical duration of encircling buckling was significant shorter in Group W than in Group I. In our study, the shorter surgical duration (with or without encircling) in Group W may be owing to WAVS combined with endoilluminator. Firstly, it has erect image and wide and clear surgical field, which makes it more easily for the surgeon to visualize the fundus. Secondly, it requires lesser indentation to observe the breaks and the effects of cryotherapy, so the surgeon can find the breaks and degenerations more easily and perform transscleral cryotherapy more accurately. Thirdly, it makes it more convenient for assistants to share the surgical field and cooperate with the surgeon during the surgery. While in the conventional group, the fundus was visualized using the binocular indirect ophthalmoscope, so some subtle changes may not be seen easily and clearly.

Our study showed that the BCVA in Group W was better than that in Group I (P<0.001) at 1-month follow-up visit. The result of BCVA was consistent with that of the delayed subretinal fluid absorptions. We found that the delayed subretinal fluid absorptions in Group I were more common than those in Group W (P=0.045) one month after the surgery. The reason maybe that, in Group W, the drainage of subretinal fluid during the surgery was more than that in Group I, due to the more clear surgery field under the surgical microscope. Gradually, the subretinal fluids were absorbed, and meanwhile the BCVA were improved in the two groups. There were no significant differences in BCVA and subretinal fluids between the two groups during the subsequent follow-up visits.

Surgery complications included penetration of the sclera and subretinal hemorrhage intraoperatively and elevated IOP and macular pucker postoperatively. The incidence of those complications was similar to those reported with the conventional procedure, and there were no significant differences between the two groups with regard to these complications [18-19]. It was fortunate that all these complications both intraoperative and postoperative were all uneventful after prompt treatment or without any interventions. Theoretically, surgical complications due to the scleral incision and the insertion of the endoilluminator including vitreous wick from the scleral incision, lens and peripheral retina damage, endophthalmitis, or light toxicity may be raised during the surgery in Group W[20-21]. However, these complications did not occur in our present study.

There were some limitations in our study such as the retrospective design, the relatively short follow-up period and the relatively small number of patients from a single center. A further study with a larger sample size and longer follow-up period or a prospective study should be performed to precisely compare the effects of the surgery in the future.

In summary, the present study showed that scleral buckling using WAVS had shorter surgery durations and similar primary success rates, final BCVA, delayed subretinal fluid absorptions and complications compared with that using indirect ophthalmoscope for rhegmatogenous retinal detachment. Our findings suggested that scleral buckling using WAVS may be an alternative choose for uncomplicated rhegmatogenous retinal detachment. But further studies are needed to determine the long-term safety and effectiveness of this surgery.

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