PRIMARY VITRECTOMY VERSUS SCLERAL BUCKLING IN PATIENTS WITH RETINAL DETACHMENT AFTER CATARACT SURGERY

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Abstract- The purpose of this study was to compare the anatomic and visual outcome of primary vitrectomy with scleral buckling in patients with retinal detachment following cataract surgery. Fifty-six consecutive patients with retinal detachment after cataract surgery were randomly assigned to two treatment groups: standard scleral buckling and standard three-port deep vitrectomy. Successful treatment was defined as improvement in vision (minimum of 2 lines in Snellen chart), anatomic reattachment and prevention of post-operative proliferative vitreo-retinopathy (PVR). The prognostic role of pre-operative and intra-operative conditions of the affected eye was also evaluated. Twenty-six of fifty-six eligible patients underwent scleral buckling and thirty had deep vitrectomy. Anatomic reattachment was achieved in 18 (69.2%) cases in scleral buckling group and 19 (63%) cases in vitrectomy group. Improvement in visual acuity was achieved in 76.9% and 83.3% and PVR occurred post-operatively in 23.1% and 16.7%, respectively. The differences were not statistically significant, and pre- and intra-operative ocular conditions did not prove to be prognostic factors, either. Scleral buckling and primary deep vitrectomy seem to have comparable outcomes in terms of anatomic reattachment and visual improvement in patients with pseudophakic and aphakic retinal detachment. Failure to achieve anatomic reattachment and visual improvement or PVR occurred in about one third and one fifth of the cases respectively, irrespective of the technique used. This warrants further research to improve treatment results.

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INTRODUCTION

About 40% of retinal detachments occur after cataract surgery. The reported incidence rate is 1.4% following extracapsular cataract extraction (ECCE). Retinal detachments occur 0.005 to 0.01% per year in phakic eyes (0.3-0.5% during lifetime) (1,2). In the last quarter of the 20th century, retinal detachments after cataract surgery were reduced by one third, by means of maintaining an intact posterior capsule, both intra-operatively and post-operatively (3). Fifty to sixty percent of the patients develop retinal detachment in the first post-operative year, which increases by 10-20% in the second year, and then the probability reaches 0.9-1% a year until the sixth post-operative year (4). Four mechanisms have been assumed to play roles in the increased rate of retinal detachment (RD) following cataract surgery: post-operative inflammatory reaction, mechanical effects of surgery, post-operative vitreous changes and weakening of chorio-retinal adherence (5). In aphakic and pseudophakic eyes, retinal breaks are usually located in ora serrata and far periphery of the retina, and they are often multiple and small (49% in

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aphakic compared to 9% in phakic patients). The probability of a break being located in the equator is also higher in pseudophakic eyes (6).

Macular detachment, total RD, and PVR are seen more frequently in these patients, which inevitably results in lower surgical success rates compared with phakic patients. The reported incidence rates of retinal break formation and RD in myopic eyes after cataract surgery are high; up to 6%, and even up to 40% in highly myopic eyes of -10 D and above (6-8). Surgery is technically more challenging in these eyes, with less promising results compared with phakic eyes. Retinal breaks can not be found in 20% of these patients even by the most experienced examiners. Potential causes are: a small pupil, difficulty in viewing peripheral retina, lens cortical remnants and capsular opacity. Generally, scleral buckling is a successful technique to manage RD following cataract surgery, but recently some surgeons have recommended performing primary deep vitrectomy to treat these patients due to inability to visualize all retinal breaks. This technique facilitates removing lens remnants, floating RPE cells in the vitreous, and epiretinal membranes, allows controlled drainage of subretinal fluid and retinopexy (by either laser or cryo), and presumably results in higher success rates and lower incidence of PVR. Other benefits of primary vitrectomy are lower morbidity rates and less refractive changes following surgery.

On the other hand, performing a vitrectomy requires more sophisticated equipment, a well-trained surgeon, and costs more. Considering the advantages and disadvantages of each technique and also lack of a well-controlled clinical trial comparing these two methods, we designed a randomized, prospective study. This study is still in progress, with the cooperation of several academic centers in Iran (university hospitals and the National Research Center), but as our sample size was sufficient to statistically analyze the results, we decided to report the findings of our center separately, which will also be included in the final report of this multicenter study.

MATERIALS AND METHODS

Clinical examination

All patients with RD following cataract surgery who visited the Retina Clinic at Farabi Hospital between 2002 and 2003 were evaluated. The date of cataract surgery, history of previous ocular surgeries, other ocular diseases including glaucoma and diabetic retinopathy, ocular trauma and retinal detachment in the fellow eye were recorded. Clinical examination included Best Corrected Visual Acuity (BCVA), refraction of the affected and fellow eye, Relative Afferent Pupillary Defect (RAPD). Slit lamp examination including assessment of the anterior segment and the intra ocular lens (IOL), integrity of the posterior capsule and measuring intraocular pressure (IOP). Fundoscopic examination was performed to evaluate the extent of retinal detachment, search for predisposing pathology in the peripheral retina, and presence of PVR or signs of myopic degeneration, and to find retinal breaks and determine their extent and number.

Inclusion and exclusion criteria

Patients with a history of RD surgery in the affected eye, ocular trauma, diabetic retinopathy, macular hole, giant retinal tear, PVR of more than Grade B severity, one-eyed patients, patients younger than fifteen years, patients with dense vitreous hemorrhage obscuring the view to evaluate the retina, and those with a detachment, extending less than one quadrant with a definite break were excluded from the study. The patients were randomly allocated to two treatment groups: scleral buckling or deep vitrectomy without encircling band or buckle. Random allocation was performed through the use of a table of random numbers.

Surgical intervention

All patients were operated on either by an attending retina specialist, or a fellow with at least six months of training. Conventional scleral buckling surgery was used in each case of buckling group: after 360 degrees limbal peritomy and passing traction sutures under the rectus muscles, retinal breaks were localized (if possible) and the sutures were put in the sclera in a way that the buckle indented the site of the break and one hour on either side of it, 2-3 mm posterior and 4 mm anterior to the break. If the fish-mouth effect was probable due to the type of the break, or if circumferential buckling was not possible because of the location of the break, a meridianal buckle was used to indent the break and 2-3 mm posterior to it. There were cases in which no definite retinal break could be found, either before or during the operation. If the detachment was incomplete, a circumferential buckle (Silicone tire 276) was used in the area of detachment, but if there was a total RD, the same buckle was used 360 degrees, and in all cases a 240 encircling band was used to produce a moderate buckle height. We used cryotherapy to induce a chorioretinal scar at the site of the break after we had localized it and put scleral sutures in place.

A three-port pars plana vitrectomy was used in the vitrectomy group. Sclerotomies were created 3 millimeters from the limbus, and a classic deep vitrectomy was performed, avoiding debulking the vitreous base.

All vitreous attachments to the edge of retinal breaks were removed, as were the attachments to the iris or wound in aphakic patients. Sub-retinal fluid was drained using Perfluorocarbon liquid (DK-line) injection and endo-laser was used to create chorio-retinal scars, with cryotherapy as an alternative in cases with far peripheral breaks, especially in the superior quadrants. If retinal breaks could not be found, laser was used to create 2-3 rows of burns posterior to the entire vitreous base. Finally, air-fluid exchange was followed by SF6 injection (20% non-expansile concentration), using flushing technique. If a fraction of the sub-retinal fluid remained at the end of the surgery, no attempts were made to drain it by retinotomy. The patients were strictly advised to remain in the prone position for 5 days, after that the appropriate position was advised, depending on the location of the break. Intra-operative findings regarding surgical technique in both groups, as well as early post-operative complications including IOP rise, choroidal detachment, severe uveitis and failure to achieve retinal reattachment were recorded. Patients were examined 3 weeks, 6 weeks, 3 months and 6 months after the operation and the following findings were recorded: BCVA, refractive error, retinal attachment, indications for a second operation, ocular deviation or impaired ocular movements, PVR due to a re-detachment, cystoid macular edema (CME) and macular pucker formation. Similar settings were provided to measure BCVA before and after the operation; optometrists were blinded to the status of the patients to avoid possible bias. In all cases with capsular opacity (more than 2+), obscuring surgeon's view during the operation, YAG laser capsulotomy with a diameter of 5 mm was used. (2+ opacity is defined as an opacity which impedes visualization of the second branching of retinal vessels).

RESULTS

Baseline characteristics

Fifty-six enrolled patients were enrolled in the study. The average age of the patients was 63.5 years, including 34 men (60%) and 22 women (40%). Eligible patients who visited the Retina Clinic of Farabi Hospital were randomly allocated to two study groups: scleral buckling group (26 cases) and vitrectomy group (30 cases), based only on their time of arrival. Of those who entered the study, 20 were aphakic and 36 pseudophakic. Twelve (22%) had pathologic myopia and two had a positive family history of RD. Twenty-five (45%) developed RD in the first year after cataract surgery and the remaining in the following years. In 35 cases (62.5%) the right eye and in 21 (37.5%) the left eye was affected. Fifty-one (82%) had macular involvement, and 20 (36%) had total RD. In 24 patients (43%) at least one break was detected before the operation. Breaks were most often located in ora serrata or posterior vitreous base; they were found in the equator in only three cases. In fifteen patients (27%), the break was found only during the operation.

Iatrogenic breaks occurred in eight patients (14%), only two (3.5%) as a result of scleral buckling. A history of vitreous loss was present in 27 cases (48%). Media opacity was present in 31 cases (55%) and peripheral retinal pathology in 13 (23%). There was no statistically significant difference in the baseline characteristics between the study groups.

Complications

The most common post-operative complication was a transient rise in IOP in fourteen patients: 7 (14%) after scleral buckling and the same number after vitrectomy. Disc pallor was observed after the operation in one patient in each group.

One patient had no light perception three days after intraocular gas injection following a failed vitrectomy, due to an IOP rise. Two cases developed persistent high IOP which was controlled by medication.

Re-detachment occurred in eight patients (31%) in the buckle group and eleven (36.5%) in the vitrectomy group. Of the eight re-detachment patients in the scleral buckling group, one underwent two further surgeries due to severe PVR, one did not return for treatment because of advanced cancer, and the rest had vitrectomy, macular photocoagulation (MPC), endolaser photocoagulation (ELP) and silicone oil injection. Of eleven re-detachments, three achieved anatomical attachment using total fluid-gas exchange and laser application, one suffered endophthalmitis and had two further surgical interventions, and one went blind (NLP vision) after intraocular gas injection, as he failed to return for follow-up visits. Five had successful anatomic attachment with one operation, and one patient refused to have further operations. The etiology of re-detachment was PVR in 10 (18%, four after buckling, six after vitrectomy), missed breaks in 7 (12.5%, two after buckling, five after vitrectomy), and new break formation in two (3.5%, one in each treatment group).

Cystoid macular edema (CME) occurred in four eyes (15.4%) after scleral buckling and four eyes after vitrectomy (13.3%). An average post-operative myopic shift of 1 diopter was observed in the buckling group, and there was no significant post-operative refractive change in the vitrectomy group. Macular pucker occurred in two eyes in each study group. Persistent muscle imbalance (after three months) was observed in one patient in the scleral buckling group.

Visual outcome

Pre-operative visual acuity (VA) was hand motions (HM) or less (Log MAR > 2.9) in 41 (72%), more than HM but less than finger counting (FC) at 3 meters (Log MAR 13-2.6) in 10 (17.8%, seven in buckling group and three in vitrectomy group), and more than FC at 3 meters but less than 1/10 (Log MAR 1-1.3) in two (3.5%, one in each group). Two patients (3.5%) in the buckling group had a VA of 1/10-3/10 (Log MAR 0.5-1) and one (1.8%) in this group had a VA of 3/10-5/10 (Log MAR 03-0.5).

Final post-operative VA at six months was HM or less (Log MAR > 2.9) in 8 patients (3 after buckling and five after vitrectomy). VA was between HM and FC at 3 meters (Log MAR 13-2.6) in 13 (6 after buckling and 7 after vitrectomy), between FC at 3 meters and 1/10 (Log MAR 1-1.3) in 10 (17.8%, five in each group), between 1/10 and 3/10 (Log MAR 0.5-1) in 11 (19.6%, 6 after buckling and 5 after vitrectomy), between 3/10 and 5/10 (Log MAR 03-0.5) in 6 (10.7%, one after buckling and 5 after vitrectomy), and 5/10 or more (Log MAR 0.3) in 8 (14.3%, five after buckling and 3 after vitrectomy).

The correlation between the type of surgical intervention and success in achieving anatomic attachment is presented in table 1: 30.8% failure in buckling group and 36.7% in vitrectomy group; the difference proved to be statistically insignificant using the Chi-square test.

The results regarding visual improvement in two treatment groups have been presented in table 2. Visual improvement occurred in 76.9% in scleral buckling group, which proved to be statistically significant by Mc Nemar's test ($p<0.001$) and also in 83.3% in vitrectomy group ($p<0.001$). The difference between the results in two groups was not statistically significant by Chi-square test. There was no correlation between intra-operative complications and anatomic success or occurrence of PVR. (Table 3).

Intra-operative complications (two weeks after the operation) and final VA were not correlated and were comparable in two treatment groups (Table 4).

Table 1. Success (anatomic attachment) in two treatment groups

Treatment group \ Success (anatomic attachment)	achieved	Not achieved	Total
Scleral buckling	18 (69.2%)	8 (30.8%)	26
Deep vitrectomy	19 (63%)	11 (36.7%)	30

Table 2. Visual improvement in two treatment groups

Treatment group \ Visual improvement	Achieved	Not achieved	Total
Scleral buckling	20 (76.9%)	6 (23%)	26
Vitrectomy	25 (83.31%)	5 (16.7%)	30

Pre-operative and intra-operative ocular conditions, together with the percentage of decrease in anatomic success in the two groups, are presented in table 5. None of these variables were correlated with anatomic success in either group, but the presence of high myopia, total RD, and a posterior chamber IOL (PCIOL) was more significantly associated with a lower success rate in vitrectomy group, while iatrogenic breaks and anterior chamber IOLs (ACIOL) were more significantly associated with a lower success rate in scleral buckling group.

Failure in visual improvement (percent), together with pre-operative and intra-operative ocular conditions in the two groups, are presented in table 6. Presence of a PCIOL reduces visual improvement in the vitrectomy group by 20%, while vitreous incarceration (27. 1 %), iatrogenic break (29.2%), aphakia (11.2%) and media opacity (15.4%) reduce visual improvement in the scleral buckling group. The correlation between visual improvement and pre-operative and intra-operative conditions of the eye was comparable between the two treatment groups, and the difference was not statistically significant.

Table 3. Intra-operative complications, anatomic success and PVR in two treatment groups

Treatment group	Determinant \ Intra-operative complications	Anatomic success			PVR		
		Present (%)	Absent (%)	Total	Present (%)	Absent (%)	Total
Scleral buckling (26)	Present	4 (80)	1 (20)	5	1 (20)	4 (80)	5
	Absent	14 (66.7)	7 (33.3)	21	5 (23.8)	16 (76.2)	21
Deep vitrectomy (30)	Present	4 (58.1)	3 (42.9)	7	2 (28.6)	5 (71.4)	7
	Absent	15 (65.2)	8 (34.8)	23	3 (13)	20 (87)	23

Table 4. Intra-operative complications (2 weeks) in relation to final visual improvement in the two treatment groups

Treatment group	Final visual intra-improvement operative complications	Present (%)	Absent (%)	Total
Scleral Buckling (26)	Present	10 (77.9)	3 (23.1)	13
	Absent	10 (77.9)	3 (23.1)	13
Deep Vitrectomy (30)	Present	14 (87.5)	2 (12.5)	16
	Absent	12 (85.7)	1 (14.3)	14

Table 5. Decrease in anatomic success (percentage) and pre-operative ocular conditions in the two treatment groups

Treatment group	Preoperative pathology												
	Myopia (12)	Total RD (21)	Macular involvement (51)	Break found pre- operatively (24)	Vitreous incarceration (16)	Hx of vitreous loss (25)	Break found intra- operatively (14)	Iatrogenic break (8)	Aphakia (20)	PCIOL (29)	ACIOL (7)	Media opacity (31)	Peripheral retinal pathology (31)
Scleral buckling	11.4	___	36.4	4.7	3	___	___	20.8	15	4.7	20.8	___	___
Deep vitrectomy	45.3	28.2	37.9	___	1.1	___	___	4.2	___	20	___	5.6	___

Table 6. Failure in visual improvement (percent) and pre-operative ocular conditions in two treatment groups

Preoperative pathology / Treatment group	Myopia (12)	Total RD (21)	Macular involvement (51)	Break found pre-operatively (24)	Vitreous incarceration (16)	History of vitreous loss (25)	Break found intra-operatively (14)	Iatrogenic break (8)	Aphakia (20)	PCIOL (29)	ACIOL (7)	Media opacity (31)	Peripheral retinal pathology (31)
Scleral buckling	___	11.2	___	3.6	27.1	___	___	29.2	11.2	___	___	15.4	___
Deep vitrectomy	3.1	16.8	17.2	___	___	___	7.9	___	___	20	4	___	___

DISCUSSION

Treatment modalities for retinal detachment have undergone major revisions during the last century. Since closed vitrectomy was introduced by Machemer in 1971, its indications in treating retinal detachment has increased in number continuously, from 1% in 1979 to 63% in 1999. As vitrectomy leads to cataract formation in phakic eyes, it has gained more popularity among surgeons for treating RD in aphakic and pseudophakic eyes during recent years. Newer generations of surgical microscopes with wide field viewing system, and modern illumination instruments have made it possible to accurately evaluate the retina up to ora serrata and detecting breaks directly in these areas, which is among the many advantages of performing a vitrectomy (9-13). Other advantages of performing a vitrectomy to treat retinal detachment include: eliminating vitreous traction and CME (10-12), ability to perform direct laser-therapy around the breaks (10), removing RPE cells and macrophages from the vitreous cavity and reducing the incidence of PVR (4%), lesser post-operative changes in refraction and avoiding a myopic shift (10-12) clearing the media (10) more precise localization of retinal breaks using Shclieren phenomenon. Some studies suggest that using a buckle in some RD patients who have had vitrectomy might increase success rate (94-100%) 9, 10, but the sample size in these studies have not been statistically adequate. Disadvantages of primary vitrectomy in RD patients include: higher costs (11), delay in visual improvement (6-8 weeks) (10,11), post-operative IOP rise (10), necessity of face-down positioning and limitations in air travel (10-12), risk of inducing a macular hole (2%) complications of draining retinotomy, risk of sympathetic ophthalmia (1/800) and endophthalmitis. If all the breaks are not found and closed during the primary vitrectomy, failure is inevitable.

Complications of scleral buckling in RD patients include: hemorrhage into vitreous or sub-retinal space (during drainage), hematoma, retinal and vitreous incarceration, release of RPE cells into vitreous cavity and increasing risk of PVR, post-operative refractive changes and myopic shift, pain, chemosis, diplopia, infection and inflammation.

Retrospective studies indicate an anatomic success rate of 79.8% after the first operation (88.8% overall) in patients treated for RD after cataract surgery during 1979-80. It is notable that only 1% of RD patients underwent primary vitrectomy during that time period, while this number increased to 63% in 1999. Considering the success rate of 84% after the first operation (93.6% overall), it is apparent that the success rate in these patients has not changed despite the shift from scleral buckling to vitrectomy (14). Overall, the success rate has been 64-100% after the first operation (9,11,15-21) and 82-100% after the second operation (11,20,22,23) after either scleral buckling or deep vitrectomy.

In our study, the primary re-attachment rate was 69.2% after scleral buckling and 63% after vitrectomy, and the final success rate after the second operation was 96.1% in buckling group and 93.3% in the vitrectomy group. In other studies, a final VA of 6/18 or more was achieved in 40-65% of macula-off patients after buckling or vitrectomy (16,18,19). Patients have achieved a VA of 20/50 or more after vitrectomy (19). Retrospective studies suggest a VA of 20/50 or more in 32-90% of the patients after buckling or vitrectomy (9,24) and occurrence of PVR in 0-20% (9,11,15,20,22-25). These studies did not detect a significant difference in visual improvement or anatomic success between these two treatment modalities. The most common post-operative complication has been a rise in IOP (40%) (16).

In this study, visual improvement (two or more lines) was accomplished in 76.9% after buckling and 83.3% after vitrectomy. The most common post-operative complication was a rise in IOP (14 cases; 20% of eyes), and PVR developed in eleven cases (19.6%).

The probability of visual improvement has been lower in patients with a history of vitreous loss, ACIOL, aphakia and extensive RD as well as those with a hazy media, which caused difficulty in examining the retina pre-operatively (26). We experienced a high (37%) failure rate in patients with macular involvement, treated either by scleral buckling or vitrectomy (table 5). Patients who develop an iatrogenic break intra-operatively or those with an ACIOL failed to achieve reattachment more frequently in the buckling group than the vitrectomy group. Presence of myopia, total RD and PCIOL increases the risk of failure in the vitrectomy group. This difference could be explained as follows: an iatrogenic break during buckling surgery causes vitreous traction and increases the risk of PVR, and consequently, the failure rate. Also, patients with ACIOL who have experienced vitreous loss and vitreous traction is present already, so vitrectomy is reasonably advisable in these patients rather than scleral buckling. On the contrary, in patients with total RD and PCIOL, detailed examination of the peripheral retina is not possible which will lead to a higher risk of failure if they undergo vitrectomy, and buckling might be a better option in these patients. The failure rate for myopic patients is three times higher in the vitrectomy group compared with the buckling group (table 5). We can not explain this finding now, and considering the low number of these patients (12) we prefer to wait for the final results of the study. In patients with vitreous incarceration, iatrogenic break or media opacity, failure to achieve visual improvement was more common in the buckling group, which could be explained by vitreous traction and CME in first two cases (table 6). In this study, a post-operative myopic shift occurred only after scleral buckling, while there was one case of endophthalmitis after vitrectomy. The difference in the post-operative incidence of CME and macular pucker was not statistically significant between the study groups. Persistent muscle imbalance was observed only in one patient after scleral buckling. Obviously, scleral buckling leads to a lesser improvement in VA in eyes with media opacity due to inflammation or intraocular hemorrhage, even if anatomic reattachment is accomplished. Patients with macular involvement or a PCIOL experienced visual improvement less frequently in the vitrectomy group compared with the buckling group. We can not explain this difference at this time, given the limited number of patients, and we prefer to wait for the final results.

In conclusion, success rates of scleral buckling and vitrectomy in treating aphakic and pseudophakic retinal detachments are equal. The present study shows a failure rate of one third, irrelevant to the treatment modality used. Failure to achieve visual improvement and PVR occurred in one fifth of the patients. Further investigation is recommended to improve these results. We suspect that performing these operations in the setting of a training hospital has led to our lower than expected success rates. Vitrectomy seems to be a more reasonable option in eyes with media opacity eliminating adequate view of the retina. Using an encircling band might improve the results in these eyes; this could be verified in another clinical trial.

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