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Rectangular Versus Triangular Scleral Flaps in Sub-Scleral Trabeculectomy

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Abstract

Trabeculectomy is the standard surgical procedure for management of uncontrolled open angle glaucoma. Several technical modifications for trabeculectomy were applied to improve the outcome and to increase its safety. To evaluate and compare the outcomes of the triangular versus the rectangular shaped scleral flaps in the surgery of sub scleral trabeculectomy in terms of intraocular pressure control, anterior chamber depth, postoperative astigmatism and complications. This study is a prospective comparative interventional and non-randomized study. It was carried out between February 2022 and September 2022. It was conducted on 20 eyes of 18 patients with uncontrolled POAG who were prepared for surgical treatment in the form of sub scleral trabeculectomy at Al-Zahraa University Hospital. Patients were divided into two equal groups: Group A: (10 eyes of 9 patients) were subjected to trabeculectomy with a rectangular scleral flap. Group B: (10 eyes of 9 patients) were subjected to trabeculectomy with a triangular scleral flap. Age $\pm$ SD in group A was 55.5 ± 9.1 years, while in group B it was 53.3 ± 11.7 years with a statistically non-significant difference between both groups. There were statistically non-significant differences between both groups as regards the changes in IOP and astigmatism. Also, there were statistically non-significant differences between both groups as regards postoperative complications. There was hypotony in 8 patients (80%) of group A, versus 7 patients (70%) in group B which resolved on its own within a week by using frequent steroids. There was a tight scleral suture in 1 patient (10%) in group A, and was not reported in group B. There was shallow AC in 3 patients (30%) in group A, versus 5 patients (50%) in group B which resolved on its own within a week. Over-filtration was not reported in group A, while it was reported in group B in 2 patients (20%) which resolved on its own within a week by using tight bandage. Both triangular and rectangular scleral flaps in trabeculectomy are safe and effective as regards post-surgical IOP control, bleb characteristics and complications.

Keywords: Glaucoma, Trabeculectomy, Scleral flap, Intra ocular pressure.

1. Introduction

Glaucoma is second only to cataract as a leading cause of global blindness, and is the leading cause of irreversible visual loss, largely due to primary open-angle glaucoma (POAG). It was postulated that in 2020, about 80 million people have glaucoma worldwide, and this number is expected to increase to over 111 million by 2040 [1].

Increased intraocular pressure (IOP) is the major risk factor of glaucoma, and existing glaucoma therapies are exclusively aimed to lowering IOP [2].

The gold standard in glaucoma surgery remains subscleral trabeculectomy (SST). It is a penetrating filtration procedure that effectively reduces IOP by allowing aqueous drainage through a sclerostomy, with full-thickness penetration of the anterior chamber, establishing a connection with the subconjunctival space [3]

Trabeculectomies were first described by Cairns (1968) [4] and have since undergone several technical modifications. Surgeons may now operate for limbal or fornix-based conjunctival flaps, adjuvant antimetabolite therapy, releasable sutures, etc. [5].

Scleral flap shapes are a key factor in influencing aqueous outflow and subsequent IOP reduction, especially in the early postoperative period. The most common approach for scleral flap shape, per a survey of American Society of Cataract and Refractive Surgery (ASCRS) members, is the use of a rectangular flap. However, there are considerable variations [6]

Binibrahim and Bergström, (2017) [7] reported in a review of trabeculectomies performed by residents, the majority operated is the triangular scleral flaps (50%), followed by trapezoidal (28%), rectangular (10%), unknown (10%), and square (2%).

This study aims to evaluate and compare the outcomes of the triangular versus the rectangular shaped scleral flaps in the surgery of subscleral trabeculectomy in terms of intraocular pressure control, anterior chamber depth, postoperative astigmatism and complications.

2. Patients and Methods

This study is a prospective, non-randomized, comparative, and interventional study. It was carried out between February 2022 and September 2022. It was held at Al-Zahraa University Hospital. It included 20 eyes of 18 patients with uncontrolled POAG. Patients were prepared for surgical treatment in the form of subscleral trabeculectomy.

Patients were divided into two equal groups: Group A: It included 10 eyes of 9 patients. They were subjected to trabeculectomy with a rectangular-shaped scleral flap. Group B: It included 10 eyes of 9 patients. They were subjected to trabeculectomy with a triangular-shaped scleral flap.

2.1 Inclusion Criteria:

1. Age: 35 or older.
2. Patients with uncontrolled POAG scheduled for filtration surgery.
3. Clearance of contraindications for glaucoma surgery.

2.2 Exclusion Criteria:

1. Closed angle glaucoma, secondary glaucoma, congenital or juvenile glaucoma, and normal-tension glaucoma.
2. Clinically significant cataract where a combined surgery was indicated.
3. POAG is controlled by medical treatment.
4. Refractory glaucoma, as neovascular glaucoma, glaucoma after retinal detachment and uveitic glaucoma.
5. History of prior intraocular surgeries or laser treatment.
6. History of significant ocular trauma.
7. Patients with corneal pathology such as corneal ecstatic disorders, previous

corneal herpes infection, corneal dystrophies, and corneal scars.

2.4 Preoperative Assessment

2.4.1 Full history taking

A detailed medical and surgical history, including:

1. History of prior ocular inflammation or infection.
2. History of the number and types of anti-glaucoma medications.
3. History of bleeding disorders or consumption of anti-coagulative medications.
4. History of ocular trauma.

2.4.2 Complete ophthalmological examination, including:

1. Uncorrected and best corrected visual acuities using a landolt's C chart. The results were converted into LogMar scoring.
2. Autorefractometry, using the NIDEK Autorefractor Keratometer ARK 501A.
3. Slit-lamp examination for the anterior segment.
4. Applanation tonometry.
5. Gonioscopy: using the Goldman 3-mirrors contact lens .
6. Indirect ophthalmoscopy.
7. Anterior chamber depth and central corneal thickness using the Optical Biometer AL-SCAN.

2.4.3 Investigations including:

1. Computerized visual field perimetry tests were performed using Zeiss Humphrey Visual Field Analyzer.
2. OCT was also performed using Spectral-Domain Optical Coherence Tomography and Optical Coherence Tomography Angiography.

2.4.4 General medical evaluation

A general medical evaluation was done prior to ocular surgery in the form of preoperative laboratory tests (complete blood picture, bleeding profiles, liver & kidney functions, viral markers, random blood glucose and conjunctival swab) and internal medicine consultation.
Topical β blockers were stopped one day before surgery. Acetazolamide tablets three times/day were prescribed a day before surgery. Topical broad-spectrum antibiotics were started 3 days prior to surgery.

2.4.5 Consent:

An informed consent was signed by each patient prior to participation in the study. The consent included advantages and disadvantages, risks of possible complications and the periodical follow-up visits for 3 months after surgery.

2.5 Surgical Techniques

1. All surgeries were performed under peribulbar anesthesia.
2. Sterilization using 10% betadine for the eye lids and surgical field. The conjunctival cul-de-sac was sterilized using 5% betadine.
3. Application of sterile drapes.
4. Application of lid speculum.
5. The location of the surgical site was at 12 O'clock in all cases.
6. A corneal traction suture by 8/0 silk suture was done at the upper cornea for exposure of the superior part of the bulbar conjunctiva and to keep the eye in a downward position (Fig. 1).
7. Fashioning of a fornix based conjunctival flap using a Westcott scissor and a non-toothed forceps (Fig. 2).
8. Meticulous subconjunctival and episcleral hemostasis using a wet field cautery.

9. Formation of a half-thickness scleral flap using a crescent knife or number 15 blade (Fig. 3 & 4):

In group A, a rectangular 5x4mm half-thickness scleral flap was formed. In group B, a triangular 4x4x4mm half-thickness scleral flap was formed.

- Application of MMC: Cellulose sponges soaked with MMC (0.2 mg/ml) were applied using thin small pieces of micro sponges between the sclera and Tenon capsule and above the scleral flap for 2 minutes (Fig. 5)

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- The sponges were then removed, and a copious irrigation of MMC with 250 ml sterile saline solution was then applied to the cornea and conjunctiva.

10. Aqueous humor filtration:

- Corneal side port with MVR or 15 super sharp blades was performed for gradual ocular decompression. Anterior chamber reformation with a viscoelastic material (Methyl Cellulose) was done as required during surgery.

- A sclerotomy: Excision of a trabecular meshwork block (about 1.5x1.5 mm) was done using a blade and scissors (Fig. 6).

- A peripheral iridectomy was done at 12 O'clock (Fig. 7).

11. Two sutures to the rectangular flap and one or three sutures to the triangular flap were applied using 10/0 nylon sutures (Fig.8). Suturing the conjunctiva with interrupted watertight 8/0 vicryl sutures (Fig. 9).
12. Suturing the conjunctiva with interrupted water tight 8/0 vicryl sutures (Fig. 9).
13. An antibiotic eye ointment was applied to the fornix and an eye patch was then applied.

Figure (1): Corneal stay suture by virgin silk suture at the upper cornea

Figure (2): Fashioning of a fornix based conjunctival flap

Figure (3): Rectangular shape half scleral flap

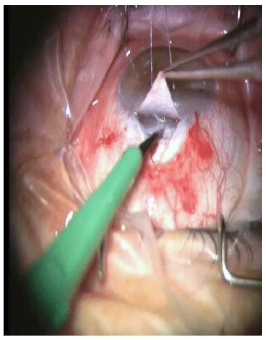

Figure (4): Triangular shape half scleral flap

Figure (5): Application of MMC

Figure (6): Sclerotomy

Figure (7): Peripheral iridectomy.

Figure (8): Suturing scleral flap

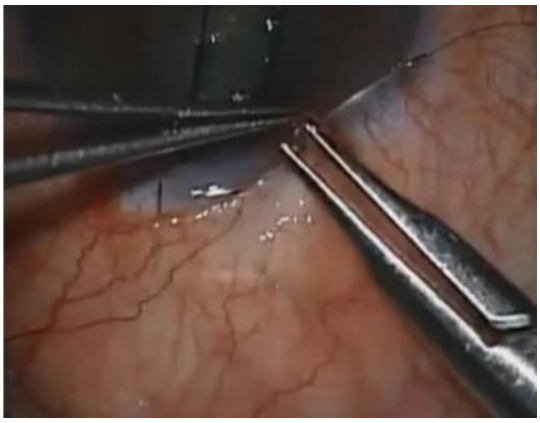

Figure (9): Suturing the conjunctival flap.

2.6 Postoperative Medications:

- Topical corticosteroid in the form of 1% prednisolone acetate eye drops was initially administered 5 times daily, then was tapered as the clinical course dictates.
- Topical antibiotics in the form of 0.5% moxifloxacin hydrochloride eye drops (5 times daily).

Cycloplegic eye drops in the form of 1% cyclopentolate hydrochloride eye drops (Twice daily for one week).

2.7 Postoperative Follow Up:

All patients were scheduled to be examined after 1 day, 1 week, 6 weeks and 3 months postoperatively.
P-value $\geq$ 0.05 was considered insignificant.

At each follow up visit they were subjected to:

- UCVA & BCVA.
- Autorefractometry.
- Slit-lamp examination.
- Goldman applanation tonometry.
- Anterior chamber depth using the Optical Biometer AL- SCAN.

2.8 Statistical analysis:

Data were analyzed using Statistical Program for Social Science (SPSS) version 24. Quantitative data were expressed as mean ±SD. Qualitative data were expressed as frequency and percentage. Mean (average): the central value of a discrete set of numbers, specifically the sum of values divided by the number of values. Standard deviation (SD): is the measure of dispersion of a set of values. A low SD indicates that the values tend to be close to the mean of the set, while a high SD indicates that the values are spread out over a wider range.

The following tests were done:

- **Independent sample T test:** when comparing between two means (for normally distributed data).

- **Mann Whitney U test:** when comparing between two means (for abnormally distributed data).

- **Chi-square test:** was used when comparing between non-parametric data.

2.8.1 Probability (P-value)

P-value < 0.05 was considered significant.
P-value $\leq$ 0.001 was considered as highly significant.

3. Results

This study is a prospective comparative interventional, non-randomized study. It was carried out from February 2022 until September 2022. The study was conducted on 20 eyes of 18 patients who attend the Ophthalmology Department of Al-Zahraa University Hospital with uncontrolled
(IOP). They were prepared for surgical treatment in the form of subscleral trabeculectomy.
Patients were divided into two equal groups:

- Group A: [10 eyes of 9 patients]. They were subjected to trabeculectomy with a rectangular shaped scleral flap.
- Group B: [10 eyes of 9 patients]. They were subjected to trabeculectomy with a triangular shaped scleral flap.

3.1 Demographic data

As shown in Table .1, there was a statistically non-significant difference (p-value = 0.646) between groups A & B as regard Age. It was 55.5 ± 9.1 years in group A, while it was 53.3 ± 11.7 years in group B. There was also a statistically non-significant difference (p-value = 0.653) between groups A & B as regard sex. In group A, there were 4 males (40%) and 6 females (60%) while in group B, there were 5 males (50%) and 5 females (50%).

3.2 Clinical data

3.2.1 Best Corrected Visual Acuity (BCVA)

As shown in Table .2, there was a statistically non-significant difference between Pre- and Post-BCVA in group A (p-value = 0.244) and in group B (p-value=0.289).

3.2.2 Preoperative and postoperative IOP assessment:

As shown in Table 3 and fig. 10, there was a statistically non-significant difference between group A & group B as regards preoperative IOP (p-value=0.931), at the 1st week (p-value = 0.234), at the 6th week (p-value=0.393), and at 3 months postoperatively (p-value=0.579).
There was a statistically non-significant difference between groups A & B as regards the change in IOP preoperatively and 3months postoperatively (p-value = 0.798).
We observed a statistically highly significant decrease of IOP up to the end of follow up period of 3 months postoperatively as compared with preoperative IOP in groups A and B. (p-value< 0.001).

3.2.3 Preoperative and postoperative ACD assessment

• As shown in Table .4 and Fig. 11, there was a statistically non-significant difference between groups A & B as regards preoperative ACD (p-value=0.034), at the 1st week (p-value =0.065), at the 6-week (p-value= 0.065), and at 3 months postoperatively (p-value=0.190).
• There was a statistically significant decrease in ACD at the 1st and 6th week postoperatively in both groups, but the decrease was higher in group B than group A, and they returned to normal at the end of follow-up period 3 months postoperatively.

3.2.4 Preoperative and postoperative K reading assessment

• As shown in Table 5, Fig. 12, Fig. 13 and Fig. 14, there was a statistically non-significant difference between groups A & B as regards K2 and mean K readings.

• There was a statistically significant increase in K1 readings at the 1st and 6th week postoperatively in both groups, but the increase was significantly higher in group A than group B (P-values were =0.036 and 0.03 respectively) and they return to normal at the end of follow up period 3months postoperatively (P-value=0.22).

There was a statistically non-significant difference between groups A & B as regards the change in astigmatism (p-value =0.160).

3.2.5 Preoperative and postoperative assessment in group A

• As shown in table 6 and fig 15 at the end of the follow-up period at 3 months postoperatively, there was a statistically highly significant decrease in IOP at 3 months postoperatively when compared with the preoperative level in group A (p-value< 0.001).

• There were statistically non-significant differences between preoperative and 3 months postoperative levels of ACD, K 1, K2 and mean K reading (P-values were; 0.280, 0.953, 0.280 and 0.862 respectively).

3.2.6 Preoperative and postoperative assessment in group B

• As shown in Table 7 and fig 16 at the end of the follow-up period at 3 months postoperatively, there was a statistically highly significant decrease in IOP at 3 months postoperatively when compared with the preoperative level in group B (p-value< 0.001).

• There were statistically non-significant differences between preoperative and 3 months postoperative levels of ACD, K 1, K2 and mean K reading (p-values were; 0.325, 0.937, 0.337 and 0.557respectively).

3.2.7 Postoperative complications

As shown in Table 8 and Fig 17, there was a statistically nonsignificant difference between group A & group B as regards postoperative complications. There was hypotony in 8 patients (80%) of group A, versus 7 patients (70%) in group B, which resolved on its own within a week by using frequent steroids. There was a tight scleral suture in 1 patient (10%) in group A, and was not reported in group B. There was shallow AC in 3 patients (30%) in group A, versus 5 patients (50%) in group B, which resolved on its own within a week. Over-filtration was not reported in group A, while it was reported in group B in 2 patients (20%) which resolved on its own within a week by using tight bandage.

In our study, we found a significant reduction in antiglaucoma medications to one eye drop in one patient in group A(mean=0.333±SD=0.062) and two patients in group B (mean = 0.053±SD=0.081).

Table (1): Comparisons of studied groups as regards age.

		Group A (N = 10)		Group B (N = 10)		Stat. test	P-value
Age (years)	Mean	55.5		53.3		T = 0.46	0.646 NS
	±SD	9.1		11.7			
Sex	Male	4	40%	5	50%	X^2 = 0.2	0.653 NS
	Female	6	60%	5	50%		

X2: Chi-square test. T: independent sample T test. NS: p-value > 0.05 is considered non-significant.

Table (2): Comparison of BCVA (pre & post) in both groups.

		Group A (N = 10)	Group B (N = 10)
Pre-BCVA (Log MAR)	Mean	0.66	0.59
	±SD	0.29	0.28
Post-BCVA (Log MAR)	Mean	0.54	0.49
	±SD	0.26	0.26
Stat. test	T	1.18	1.08
	p-value	0.244 NS	0.289 NS

T: independent sample T test. NS: p-value > 0.05 is considered non-significant.

Table (3): Comparisons of the studied groups as regards preoperative and postoperative IOP.

		Group A (N = 10)	Group B (N = 10)	T	P-value
IOP (mmHg) Preoperative	Mean	25.4	25.3	0.08	0.931 NS
	±SD	2.5	2.6		
IOP (mmHg) 1st week postoperative	Mean	10.5	9.2	1.23	0.234 NS
	±SD	3.2	1.0		
IOP (mmHg) 6 weeks postoperative	Mean	11.5	10.4	MW = 38	0.393 NS
	±SD	2.3	1.0		
IOP (mmHg) 3 months postoperative	Mean	11.4	10.9	MW = 42.5	0.579 NS
	±SD	2.0	1.5		
Change IOP	Mean	14.0	14.4	0.26	0.798 NS
	±SD	3.6	3.3		

T: independent sample T test. S: p-value < 0.05 is considered significant. NS: p-value > 0.05 is considered non-significant

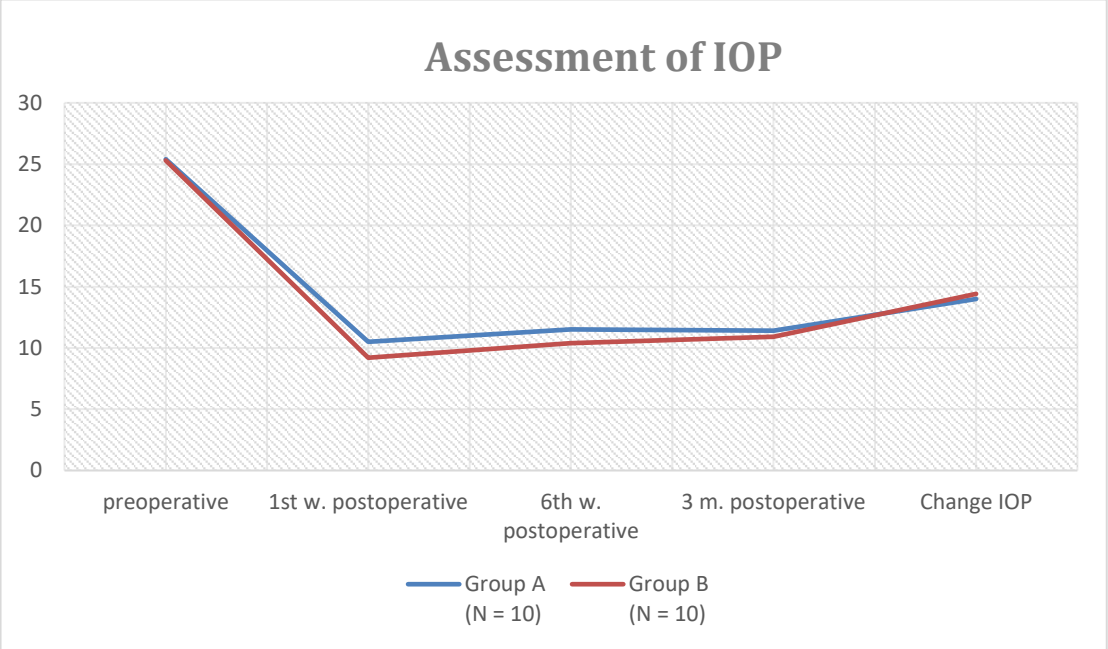

Figure (10): Comparisons of the studied groups as regards preoperative and postoperative IOP.

Table (4): Comparisons between both groups as regards preoperative and postoperative ACD assessment.

		Group A (N = 10)	Group B (N = 10)	T	P-value
ACD (mm) preoperative	Mean	4.0	3.5	2.2	0.34 NS
	±SD	0.6	0.5		
ACD (mm) 1st week postoperative	Mean	3.4	2.8	1.96	0.065 NS
	±SD	0.7	0.5		
ACD (mm) 6 weeks postoperative	Mean	3.6	3.1	MW = 32.5	0.065 NS
	±SD	0.7	0.5		
ACD (mm) 3months postoperative	Mean	3.7	3.2	MW = 32.5	0.190 NS
	±SD	0.7	0.5		

T: independent sample T test. S: p-value < 0.05 is considered significant.

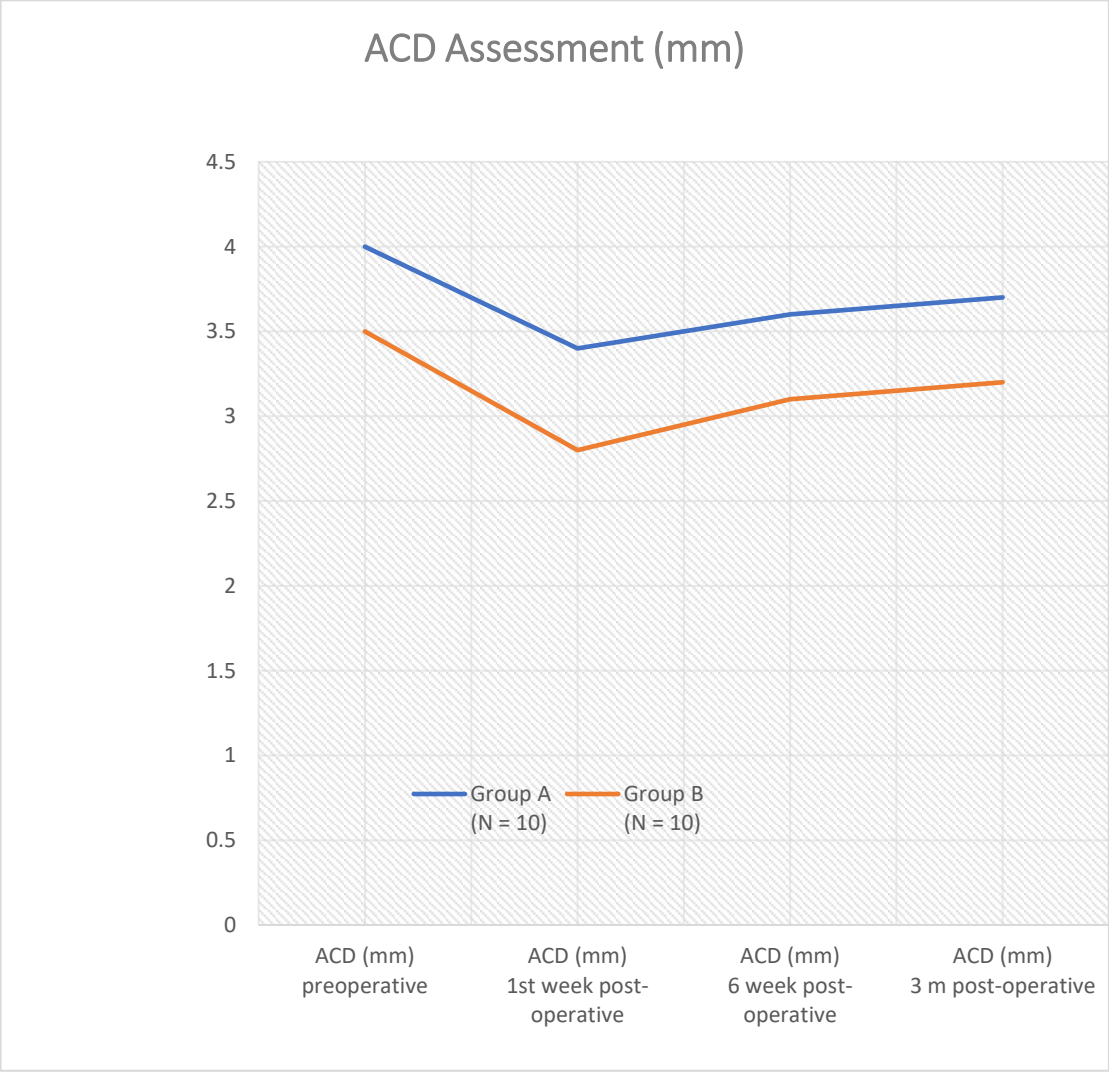

Figure (11): Comparisons between both groups as regards preoperative and postoperative ACD assessment.

Table (5): Comparisons between the studied groups as regards K readings preoperatively, at the 1st week, the 6th week, and at 3 months postoperatively.

		Group A (N = 10)	Group B (N = 10)	Test	P-value
K 1 Preoperative	Mean	44.2	42.0	2.05	0.055 NS
	±SD	3.0	1.4		
K 2 Preoperative	Mean	45.2	43.9	1.35	0.192 NS
	±SD	2.5	1.6		
Mean K Preoperative	Mean	45.0	42.9	1.9	0.073 NS
	±SD	3.2	1.2		
K 1 1st week postoperative	Mean	43.2	41.4	2.3	0.036 S
	±SD	1.9	1.7		
K 2 1st week postoperative	Mean	47.0	45.7	0.89	0.381 NS
	±SD	4.1	1.8		
K 1 6-week post-operative	Mean	44.0	42.0	T = 2.3	0.03 S
	±SD	2.4	1.3		
K 2 6 weeks postoperative	Mean	46.7	45.0	T = 1.48	0.154 NS
	±SD	3.2	1.6		
K 1 3months postoperative	Mean	44.3	42.0	T = 2.5	0.22 NS
	±SD	2.5	1.4		
K 2 3months postoperative	Mean	46.2	44.6	T = 1.49	0.152 NS
	±SD	3.1	1.6		
Mean K 3months postoperative	Mean	45.2	43.2	T = 2.09	0.051 NS
	±SD	2.8	1.1		
Change in astigmatism	Mean	0.48	0.66	1.46	0.160 NS
	±SD	0.35	0.20		

T: independent sample T test. S: p-value < 0.05 is considered significant. MW: Mann Whitney U test.
NS: p-value > 0.05 is considered non-significant.

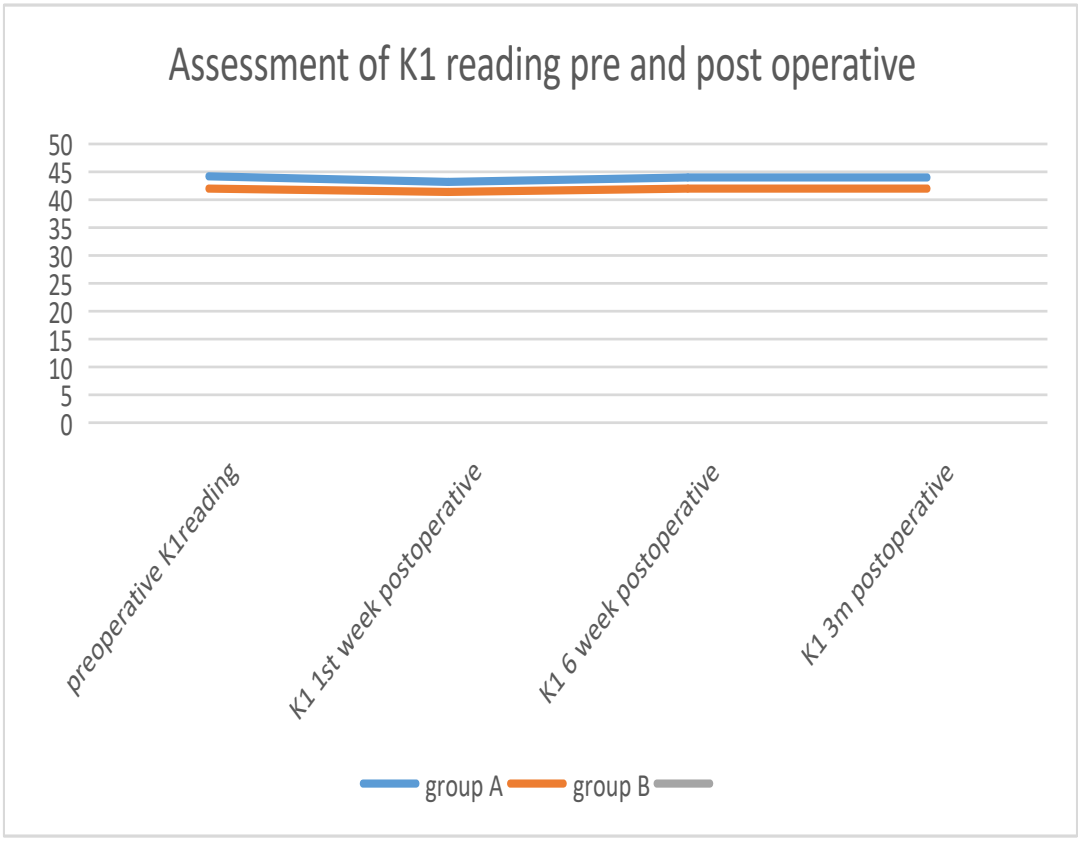

Figure (12): Comparisons between the studied groups as regards K1 reading.

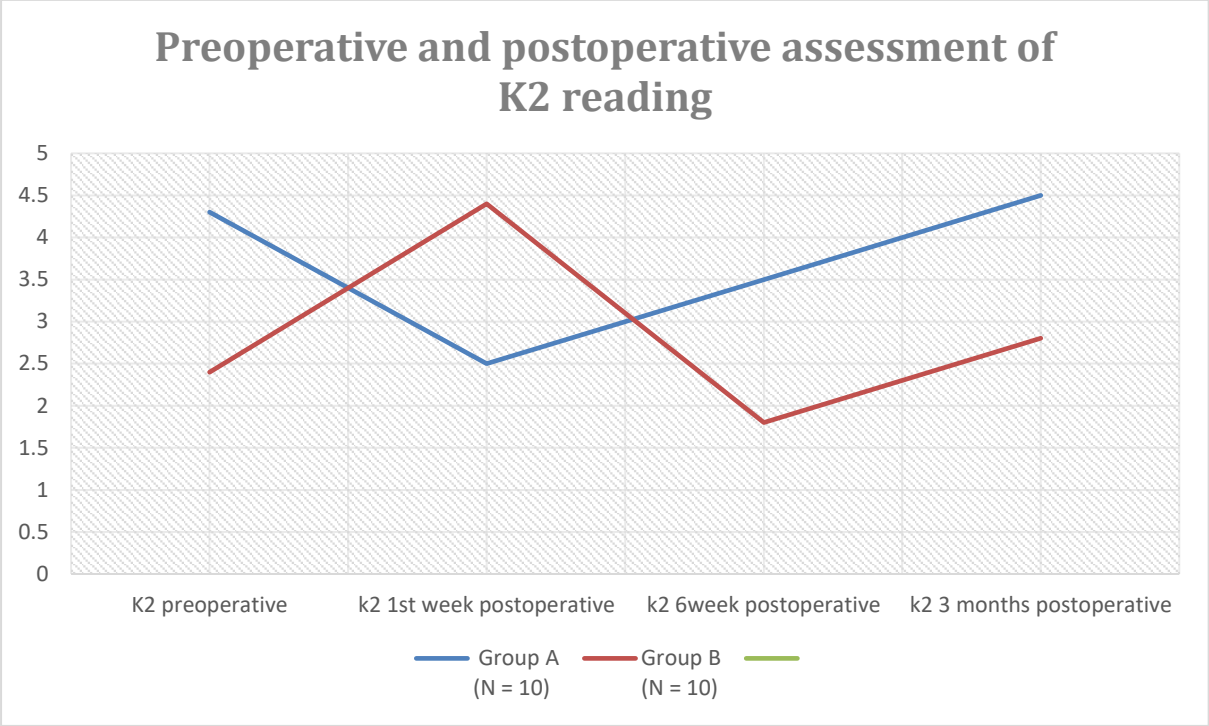

Figure (13): Comparisons between the studied groups as regards K2 reading.

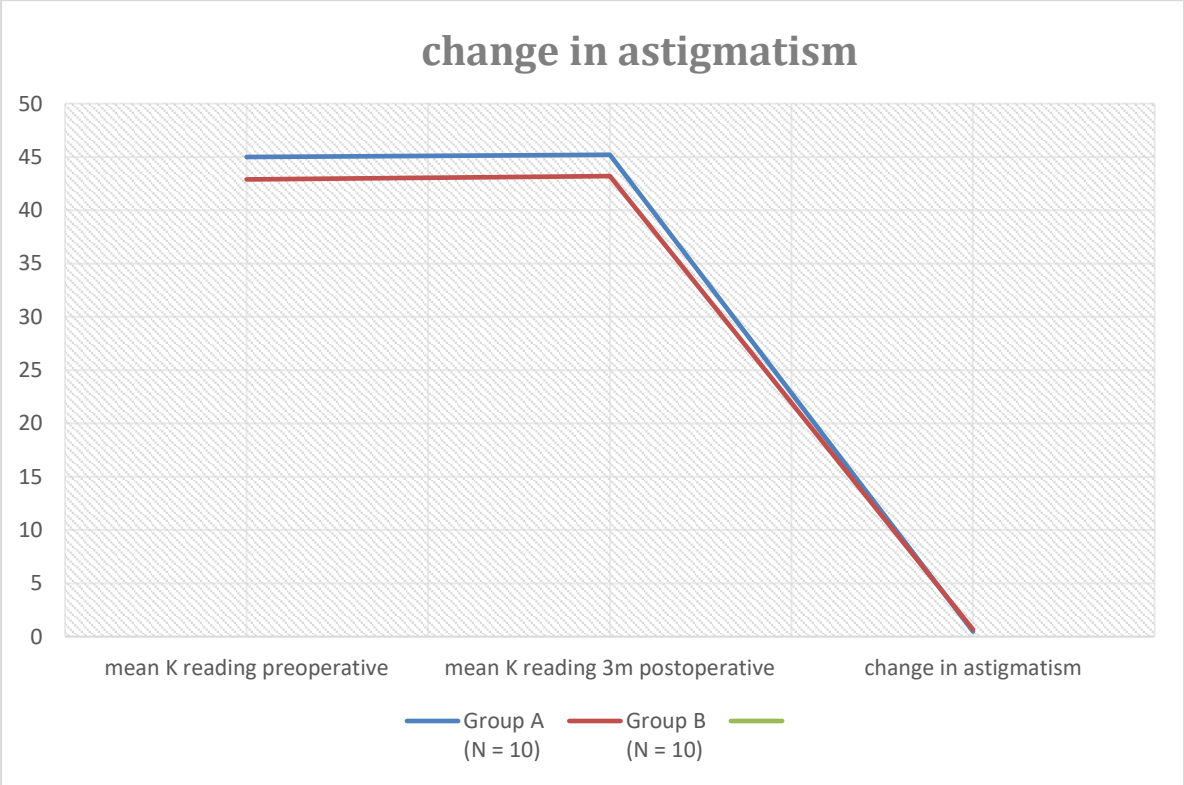

Figure (14): Comparisons between the studied groups as regards change in astigmatism

Table (6): Comparisons between preoperative and postoperative assessment in group A.

Group A		Preoperative (N = 10)	Postoperative (N = 10)	Test	P-value
IOP (mmHg)	Mean	25.4	11.4	MW = 0.0	< 0.001 HS
	±SD	2.5	2.0		
ACD (mm)	Mean	4.0	3.7	MW = 35.5	0.280 NS
	±SD	0.6	0.7		
K (R1)	Mean	44.2	44.3	T = 0.06	0.953 NS
	±SD	3.0	2.5		
K (R2)	Mean	45.2	46.2	T = 0.85	0.406 NS
	±SD	2.5	3.1		
Mean K	Mean	45.0	45.2	T = 0.17	0.862 NS
	±SD	3.2	2.8		

T: independent sample T test. HS: p-value < 0.001 is considered highly significant.
MW: Mann Whitney U test. NS: p-value > 0.05 is considered non-significant.

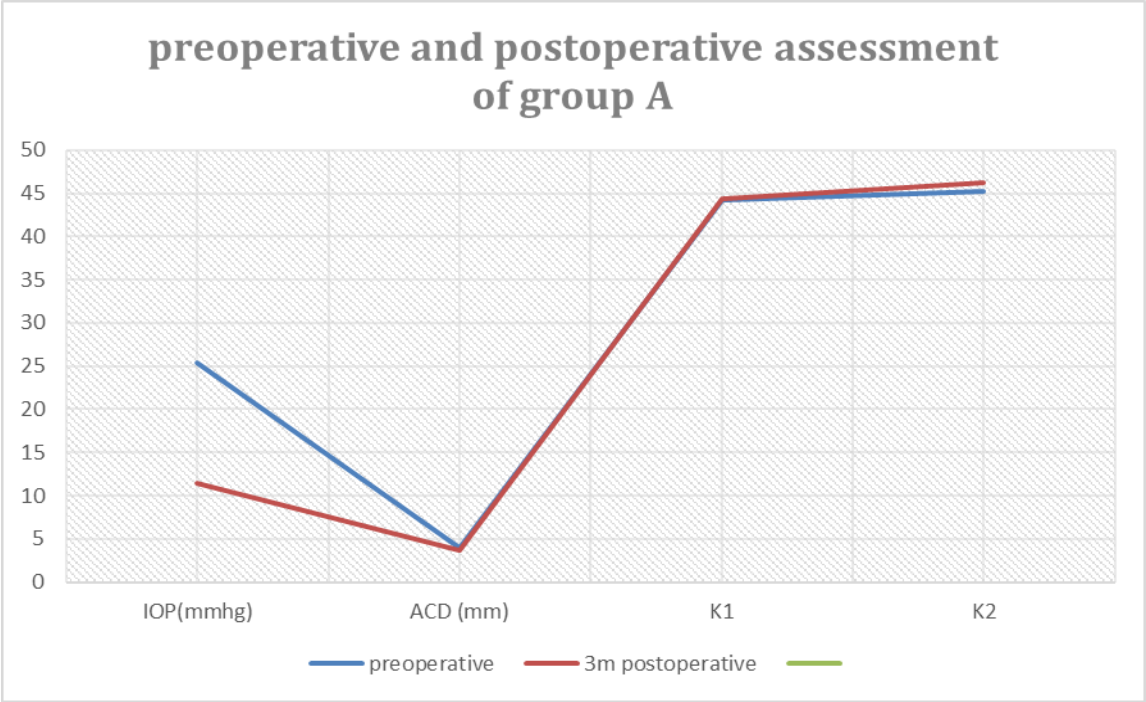

Figure (15): preoperative and postoperative assessment of group A.

Table (7): Comparisons between preoperative and postoperative assessment in group B.

Group B		Pre-op (N = 10)	Post-op (N = 10)	Test	P-value
IOP (mmHg)	Mean	25.3	10.9	MW = 0.0	< 0.001 HS
	±SD	2.6	1.5		
ACD (mm)	Mean	3.5	3.2	T = 1.01	0.325 NS
	±SD	0.5	0.5		
K (R1)	Mean	42.0	42.0	T = 0.08	0.937 NS
	±SD	1.4	1.4		
K (R2)	Mean	43.9	44.6	T = 0.98	0.337 NS
	±SD	1.6	1.6		
Mean K	Mean	42.9	43.2	T = 0.59	0.557 NS
	±SD	1.2	1.1		

T: independent sample T test.
MW: Mann Whitney U test.

HS: p-value < 0.001 is considered highly significant.
NS: p-value > 0.05 is considered non-significant.

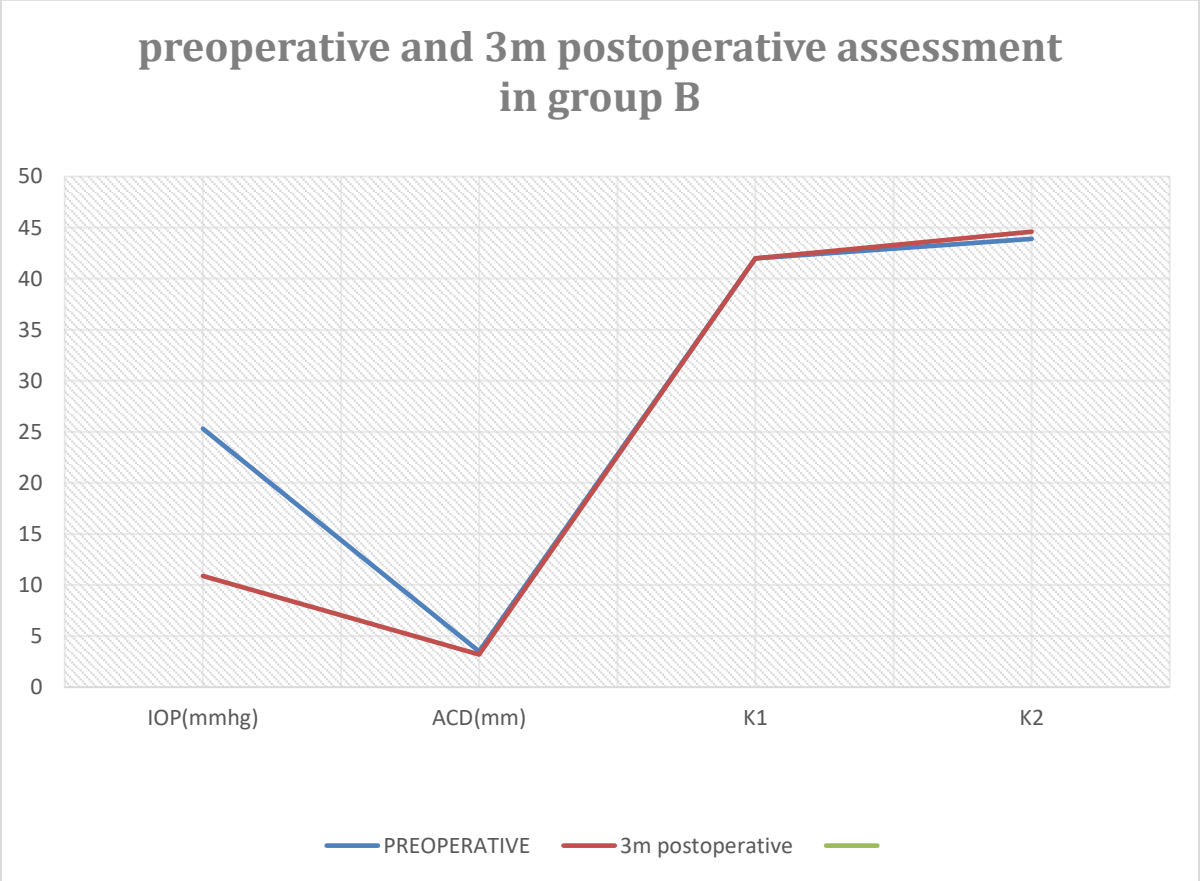

Figure (16): Preoperative and 3m postoperative assessment in group B.

Table (8): Comparisons of groups studied as regards postoperative complications.

	Group A (N = 10)		Group B (N = 10)		X^2	P-value
Hypotony	8	80%	7	70%	0.26	0.605 NS
Tight scleral suture	1	10%	0	0%	1.05	0.304 NS
Shallow AC	3	30%	5	50%	0.83	0.361 NS
Bleb over filtration	0	0%	2	20%	2.2	0.136 NS

X2: Chi-square test. NS: p-value > 0.05 is considered

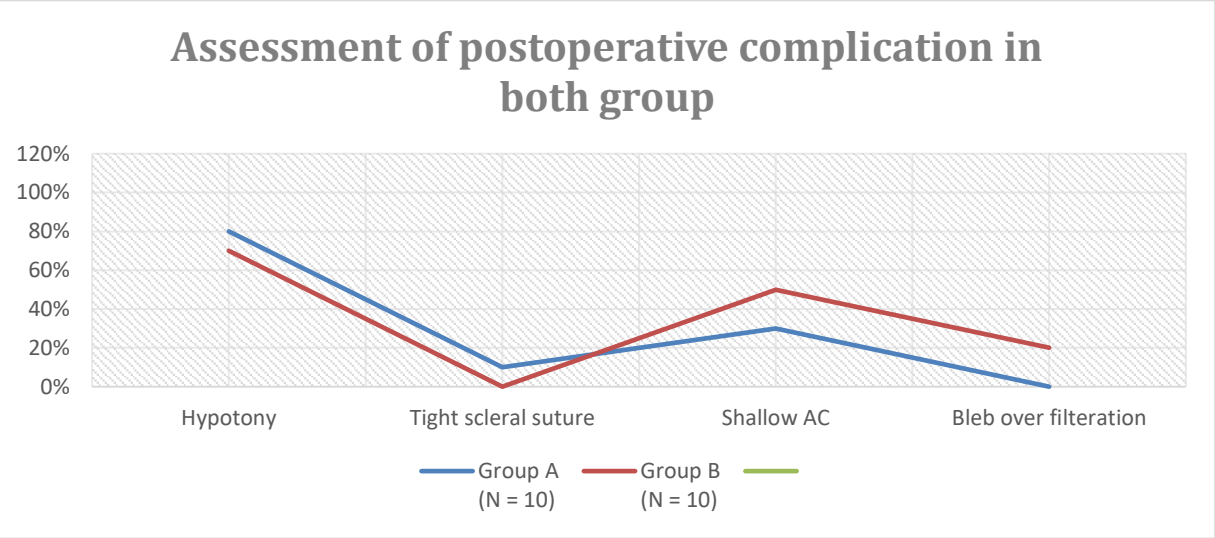

Figure (17): Assessment of postoperative complication in both groups

4. Discussion

The outflow of aqueous humor through a scleral flap depends upon multiple factors such as the formation of scleral tunnel, approximation of the scleral flap to the underlying scleral bed and its ability to lift to aid in drainage which depends on its elasticity as predicted by the scleral flap thickness, tension, position and tightness of the sutures placed [8]and [9]. Scleral flaps of adequate size and thickness are very important, since too thick or too thin flaps would result in resistance to aqueous outflow and flap dehiscence leading to uncontrolled pressure [10]

Our study was a prospective comparative interventional and non-randomized study. It included 20 eyes of 18 Patients with uncontrolled POAG. Patients were prepared for surgical treatment in the form of subscleral trabeculectomy. In group A, a 5x4 mm rectangular half thickness scleral flap was formed, while in group B a triangular 4x4x4 mm half thickness scleral flap was formed. The age of the included patients ranged between 40 years and 76 years. Their mean age $\pm$ SD was 55.5 ± 9.1 years in group A, while it was 53.3 ± 11.7 years in group B. As regards gender of

patients, in group A, there were 4 males (40%) and 6 females (60%) while in group B, there were 5 males (50%) and 5 females (50%). There were statistically non-significant differences between both groups as regard age and sex.

In our study, there were statistically nonsignificant differences between pre and postoperative BCVA in groups A and B. There was a statistically significant increase in K1 readings at the 1st and 6th week postoperatively in both groups, but the increase was significantly higher in group A than group B (P-values were =0.036 and 0.03 respectively)and they return to normal at the end of follow up period 3months postoperatively (P-value=0.22), There were statistically non-significant differences between groups A & B as regards post-operative K2 readings at 1 week, 6 weeks and 3 months.

There were statistically non-significant differences between preoperative and 3 months postoperative K 1, K 2 and mean K readings in group A and B.

There were statistically non-significant differences between groups A & B as regards the changes in astigmatism.

In agreement with our findings, Cunliffe et al., (1993) [11] reported that keratometry readings became stable 2-3 months postoperatively.

In concordance with our findings,[12] reported a study regarding the post-trabeculectomy induced astigmatism. They measured the refraction and the keratometric readings in 16 patients undergoing SST. Mean vertical corneal radius was reduced from 7.69 mm (preoperatively) to 7.56 mm at week 1 postoperatively. This WTR change in corneal astigmatism persisted at weeks 3 and 8 of follow-up but had returned to preoperative values at the final follow-up at 10 months. The horizontal corneal radius was increased at weeks 1 and 3 however, readings became normalized from week 8 onwards. They reported no differences in the axis of astigmatism [13] extended these findings when comparing corneal topography and keratometry in 8 eyes of 6 patients undergoing SST. They confirmed a WTR shift of 1.5 to 2.5 D of cylinder up to 12 weeks postoperatively. They further reported that the amount of induced steepening was underestimated by keratometry compared to topography [14]. examined 18 eyes of 16 patients at 1, 3, 6, and 12months following SST with the use of MMC. The concentration of MMC was 0.4 mg/mL and was applied for 2 to 5 min. They reported a mean WTR change in corneal astigmatism of 1.23 D at 3 months postoperatively, followed by a period of ATR astigmatism. Interestingly, changes in corneal astigmatism were still present at 6 and 12 months (0.94 D and 0.65D respectively), which was much longer than previously demonstrated without MMC.

[15], reported a larger study. They measured corneal astigmatism in 29 patients undergoing SST. They observed more complex changes. Although they confirmed an overall trend towards vertical steepening and WTR astigmatism, they identified 3 subgroups characterized by: 1) superior corneal steepening, 2) superior corneal flattening, and 3) irregular changes. They also demonstrated that in some patients, the topographic changes induced by surgery persisted for up to 12 months.

The etiology of surgically induced astigmatism following glaucoma surgery remains unknown. One possibility is that, when a piece of scleral tissue is removed during trabeculectomy, and then the scleral flap is sutured back; this allows the unsupported corneal edge of SST to sink slightly [12].

Several modifications to the surgical techniques have been proposed to reduce the amount of astigmatism induced during trabeculectomy. A smaller sclerostomy has been advocated to reduce wound gape and “sinking” due to tissue removal. This can be achieved by use of a standardized punch such as a Kelly punch, using a “one punch only” technique, or even implantation of an Ex-PRESS shunt. Care may be taken to ensure a narrow, short scleral flap and to

keep the limbal ring intact when making the radial cuts. Scleral flap sutures that are over-tight or of unequal tension should be avoided. Excessive cautery should be limited by reducing the energy, or use of a point-tip or wet field cautery, particularly at the limbus [16].

As with all trabeculectomy procedures, overhanging and intra-corneal dissection of the bleb should be avoided, as this may cause significant astigmatism and reduced visual acuity for a long-term. This may be assisted using a fornix-based rather than limbus-based conjunctival flap [17].

In our study, there were statistically non-significant differences between groups A & B as regards 1st week, 6 weeks, 3 months postoperative IOP and ACD (P-value > 0.05).

There was a statistical non-significant difference between groups A & B as regards the changes in IOP between preoperative and 3months posoperatively (P-value > 0.05).

We observed a statistically highly significant decrease of IOP up to the end of follow up period of 3 months postoperatively as compared with preoperative IOP in groups A and B.

The mean decrease in IOP noted in our study was similar to the results of studies conducted by [18] and [19] who reported a significant reduction in IOP.

The target pressure is always individualized according to the patient's individual characteristics. The goal of treatment with control of IOP being to help stabilize progressive glaucomatous visual field loss.

In our study we found a significant reduction in anti-glaucoma medications to one eye drop in one patient at group A and two patients in group B which is in agreement with [20], and [7], who conducted two different studies in Brazil and Sweden respectively. They reported a significant drop in the use of anti-glaucoma medications.

According to Brooks and Gillies (2000) [21] new surgical technologies for example shunts, canaloplasty, and endoscopic cyclophotocoagulation (ECP), have been developed to provide safe and effective control of intraocular pressure, but still conventional trabeculectomy has a unique role in glaucoma management.

Another study reported by [22] to assess the outflow of aqueous humor in relation to the formation of scleral flap and sclerostomy made during trabeculectomy. They reported that increasing the size of the scleral flap was linked to an increase in aqueous outflow. They also reported that square shaped scleral flap augmented the drainage of aqueous humor as compared to the triangular one of the same sizes. They also concluded that thinner scleral flaps enhanced the outflow of aqueous humor but may result in post-operative hypotony.

In another study, Samsudin et al. (2016) [23] reported that the pressure drop was greater across thinner flaps owing to less rigidity and resistance. A bigger scleral flap and lesser number of sutures led to a greater reduction in intraocular pressure.

In our study, there was a statistically significant difference between the pre and the postoperative values of ACD ($p < 0.001$). Eyes showed statistically significant decrease in ACD postoperatively. These results are in agreement with a study reported by Husain et al. (2013) [24] who investigated the changes in ACD over 5 years after trabeculectomy surgery in Asian patients with POAG. They analyzed results of 122 subjects. They reported that ACD was shallower compared to the baseline at all postoperative visits, with a mean decrease of 0.11 mm.

Man et al. (2015) [25] documented the anatomical effects of trabeculectomy on the anterior chamber depth in patients with PACG. Fifty eyes of 50 patients were included. The mean ACD $\pm$ SD decreased after trabeculectomy from $2{,}000.2 \pm 214.5$ microns to 1975.8 ± 218.2 microns ($P = 0.001$).

In our study, there was hypotony in 8 patients (80%) in group A, versus 7 patients

(70%) in group B. There was tight scleral suture in 1 patient (10%) of group A, and was not reported in group B. There was shallow AC in 3 patients (30%) of group A, and in 5 patients (50%) of group B. Over filtration was not reported in group A, while it was reported in 2 eyes (20%) in group B. Differences between groups A & B were statistically non-significant as regards postoperative complications.

Similar to our study, Sharma et al. (2009) [26] reported a comparison between rectangular and triangular shaped scleral flaps over a period of 12 months among patients of ages 40 to 76 years old. They reported that the IOP reduction was equally significant among both techniques with hypotony being reported in two patients who underwent triangular shaped scleral flap, and in one patient who underwent rectangular shaped scleral flap, which resolved on its own within a week. The findings of the aforementioned studies correlated with the observations made in our study with the exception that patients of primary open angle glaucoma were recruited in this study and categorized into two groups. However, the reduction in IOP among both the groups was significant and the rectangular technique turned out to be more effective in the significant reduction of IOP and maintenance of anterior chamber, although statistically was not significant.

On the contrary Hung (1985)[27], reported immediate hypotony following the use of triangular flaps. He also reported that hyphaema developed in 45.8% of triangular flaps, 17.3% of arc-shaped flaps, and 9.1% of rectangular flaps. Suboptimal blebs were observed with triangular and arc-shaped flaps. 9.6% of arc-shaped flaps were associated with flat blebs, and bleb leaks occurred in 4.2% of triangular flaps. They reported other less commonly observed complications included cataract progression, choroidal detachment, and shallow anterior chambers.

Conclusion

Both triangular and rectangular scleral flaps in subscleral trabeculectomy surgery are equally effective in terms of postoperative IOP control, bleb characteristics, anterior chamber depth, and postoperative astigmatism.

There is a non-significant statistical difference between both techniques as regards the success rate for controlling the IOP.

Recommendations

A randomized controlled trial on a bigger number of eyes for a longer period of time is recommended.

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