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Efficacy and safety of ab-externo radiofrequency sclerostomy in management of open-angle glaucoma

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Purpose. *To evaluate the efficacy and safety profile of an innovative ab-externo technique in the management of uncontrolled open angle glaucoma (OAG) through creating filtering tracts subconjunctivally.* ***Material and methods.*** *This is a randomized clinical trial including 40 eyes (40 patients) divided into 2 equal groups, group (A), underwent ab-externo radiofrequency sclerostomy and group (B), underwent ab-externo radiofrequency sclerostomy with subconjunctival injection of mitomycin C. Intraoperative and postoperative complications, visual acuity, intraocular pressure (IOP) and bleb status were evaluated for 6 months.* ***Results.*** *The mean preoperative IOP was 28 ± 3.5 mm Hg reduced to 21.9 ± 5.2 mm Hg (p = 0.001) in group (A) and was 29.4 ± 3.4 mm Hg reduced to 20.8 ± 6.3 mm Hg (p = 0.001) in group (B), 6 months postoperatively. Both groups showed a significant percent reduction of IOP 15.1 ± 17.3%, 27.1 ± 22.4% in groups (A) and (B) respectively with group (B) showing lower values on days 1, 7, 14, 30, 90 and 180 but was not statistically significant. The number of anti-glaucoma medications was significantly reduced in both groups. Heat radiation to the cornea from radiofrequency waves was obvious in early cases — 5 (25%) in group (A), and 3 (15%) in group (B) that was reversible within the first 3 months postoperatively. Shallow anterior chamber and choroidal detachment were the most encountered early postoperative complication, which all managed conservatively.* ***Conclusion.*** *Ab-externo radiofrequency sclerostomy offers a promising minimally invasive, quick and simple procedure in management of early and moderate cases of OAG with effective reduction of IOP and number of glaucoma medication.*

Keywords: glaucoma; minimally invasive glaucoma surgery; radiofrequency; open-angle glaucoma; mitomycin-C
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Эффективность и безопасность радиочастотной склеротомии ab-externo в лечении открытоугольной глаукомы

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Цель *работы — оценить профиль эффективности и безопасности инновационной ab-externo методики лечения неконтролируемой открытоугольной глаукомы (ОУГ) путем создания субконъюнктивальных фильтрационных путей.* ***Материал и методы.*** *Рандомизированное клиническое исследование включало 40 глаз (40 пациентов), разделенных на 2 равные группы: группу А с ab-externo радиочастотной склеростомией и группу В с ab-externo радиочастотной склеростомией в сочетании*

с субконъюнктивальной инъекцией митомицина С. Интраоперационные и послеоперационные осложнения, остроту зрения, внутриглазное давление (ВГД) и состояние фильтрационной подушки оценивали в течение 6 мес. ***Результаты.*** *Среднее дооперационное ВГД, составлявшее в группе А 28±3,5 мм рт. ст., снизилось через 6 месяцев после операции до 21,9 ± 5,2 мм рт. ст. (p=0,001), а в группе В с 29,4 ± 3,4 мм рт. ст. до 20,8 ± 6,3 мм рт. ст. (p = 0,001). Обе группы показали значительное процентное снижение ВГД: на 15,1 ± 17,3% и 27,1 ± 22,4% в группах А и В соответственно, при этом в группе В уровень ВГД был ниже в 1, 7, 14, 30, 90 и 180 дни наблюдения, чем в группе А, но различие было статистически не значимым. Количество антиглаукомных препаратов значительно уменьшилось в обеих группах. Признаки теплового воздействия радиочастотных волн на роговицу, отмеченные на ранних сроках в 5 (25%) и 3 (15%) случаях в группах А и В соответственно, полностью исчезли в течение первых 3 мес после операции. Снижение глубины передней камеры и отслойка хориоидеи были наиболее частыми ранними послеоперационными осложнениями, которые лечили консервативно.* ***Заключение.*** *Ab-externo радиочастотная склеростомия представляет собой минимально инвазивную, быструю и простую процедуру для лечения ранних и среднетяжелых случаев ОУГ, позволяющую эффективно снизить ВГД и количество антиглаукомных препаратов.*

Ключевые слова: глаукома; малоинвазивная хирургия глаукомы; открытоугольная глаукома; радиочастота; митомицин-С
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A wide variety of different procedures were developed to decrease intraocular pressure (IOP), however their principle was to establish a fistula between the anterior chamber and the subconjunctival space to permit the aqueous humour to exit the eye with less resistance [1]. Since the introduction of trabeculectomy by J. Cairns in 1968 [2], it has been surgical procedure of choice in the treatment of glaucoma to which other new techniques are compared. More recently, microinvasive glaucoma surgery (MIGS) has emerged as a new treatment for open-angle glaucoma (OAG) allowing for minimal tissue disruption, a more favorable risk profile, and faster recovery as compared to conventional trabeculectomy or glaucoma drainage device implantation [3]. Subconjunctival filtering tracts surgeries aim at creating subconjunctival filtration (bleb formation) without opening the conjunctiva [4–6] and showed a promising results regarding its efficacy on IOP control.

The principle of radiofrequency surgery is to use high frequency radio waves so the cutting effect is performed without manual pressure or crushing tissue cells thus resulting in tissue healing without fibrous contractile scar tissue [7], hence its efficacy combined in variable techniques in glaucoma management [8–11].

In this study, we evaluated the efficacy and the safety profile of creating filtering tracts subconjuctivally that pass through the sclera and limbus into the anterior chamber (ab-externo) using radiofrequency power through a needle electrode and their effect on lowering the IOP in cases with uncontrolled OAG throughout 6 months follow up. The idea is to enhance aqueous drainage to subconjunctival space through this created filtering tract, bypassing the area of resistance. This new approach is supposed to show promising and nearly comparable results to conventional trabeculectomy with a more preservation of conjunctival integrity, less time surgery, tissue manipulation and faster recovery.

MATERIAL AND METHODS

This is a prospective randomized, interventional, comparative, clinical trial conducted at Kasr Al Ainy — Cairo University Hospitals. The study was performed on 40 eyes of 40 patients recruited from the glaucoma subspecialty outpatient clinics of Cairo University Hospitals during the period from February 2018 till July 2019.

The sample size was calculated assuming a study power of at least 0.8 and an alpha error of 0.05 to detect a difference in IOP between both techniques of 4 mmHg with SD of 4. An estimate of 34 eyes (17 eyes in each group) was considered adequate.

Randomization was used during the study based on a single sequence of random assignments by using a shuffled deck of cards: even — group (A), odd — group (B).

The study was approved by the Research Ethics Committee of the Faculty of Medicine, Cairo University. Data collection conformed to all local laws and was compliant with the tenets of the Declaration of Helsinki. A written informed consent was obtained from all participants.

Patients having uncontrolled primary OAG (POAG) aged between 35–70 years old, with IOPs not reaching the target pressure despite the administration of maximally tolerated medications or had poor compliance to treatment, were included in this study. Exclusion criteria were: presence of significant cataract and cases with refractory glaucoma as well as cases with narrow angle configuration. Forty eyes of 40 patients were randomly recruited and divided into 2 groups. Group (A) included 20 eyes of 20 patients who had ab-externo radiofrequency sclerostomy only. Group (B) included 20 eyes of 20 patients who had ab-externo radiofrequency sclerostomy with subconjunctival injection of MMC at the site of sclerostomy.

All patients meeting the inclusion criteria were subjected to full history taking and clinical ophthalmological examination with emphasis on IOP measurements using a calibrated Goldmann applanation tonometer (GAT), Gonioscopy using an Ocular Sussman 4-mirror lens and a dilated fundus examination using the +60 and +90 D Volk lens to evaluate the optic nerve head and macula respectively. Ellman Surgitron FFPF Radiofrequency device (Ellman international, USA), was used to create the ab-externo radiofrequency (RF) sclerostomies. It employs low power radio waves transmitted from the tip of an active incising electrode (Empire micro incision needle electrode (TEE303) which is straight and 4 cm in length. It has a regular tip with 230 μm in diameter to perform more efficient and safer incisional surgery.

Surgical intervention was performed by different surgeons using peribulbar anaesthesia with lidocaine 2%. After insertion of a lid speculum, application of 5% povidone iodine to the conjunctival sac with irrigation was done. Occasionally, corneal traction suture with 8/0 vicryl, or superior rectus bridle suture with 4/0 silk was taken when needed if the patient had deep set eyes. In group (A), no MMC was applied, in group (B), after draping

the eye, 0.2 ml of 0.02% MMC was injected subconjuctival superiorly with an insulin syringe. Paracentesis was done at 9 o'clock through it a viscoelastic cohesive substance (sodium hyaluronate 1%, Healon) was injected to act as insulator to RF thermal effect and also to restore anterior chamber (AC) depth. Conjunctival mobility was tested to ensure mobile conjunctiva without scarring. Healon GV was injected with insulin syringe 28 G subconjunctivally in the superonasal quadrant about 6–8 mm from the limbus. Regarding the preparation of Ellman Surgitron device (RF wave), the power switch was firstly turned on at the desired energy (90 W -3.8 MHz) and the power was ranged from 0.5–1.5, allowing 15 sec warm up before activating, then a fully filtered cut waveform was selected for pure micro-smooth cutting. After this, the 230 μm RF needle electrode was passed through the hole in conjunctiva penetrating subscleral tissues towards the limbus. During the actual cutting, a smooth uninterrupted motion with even light pressure was used then directing the tip downwards towards the AC. After withdrawal of the tip, the aqueous followed along with the visco-elastic, raising an enlarging conjunctival bleb, then another track was fashioned superotemporally, thus two tracks were formed anterior to the corneo-scleral trabeculae.

Fig. 1. A — diffuse, posterior filtering bleb, B — showing anterior segment OCT of the same patient at 6 months post-operative — showing bleb (red arrow) and the 2 filtration tracts in the sclera (yellow stars)
Рис. 1. А — диффузная задняя фильтрационная подушка (ФП), В — ОКТ переднего отдела глаза того же пациента через 6 мес после операции, показана ФП (красная стрелка) и два дренажных пути в склере (желтые звездочки)

Testing the filtration through the 2 tracts with injection of balanced salt solution (BSS) through the paracentesis was done. The paracentesis was hydrated leaving the healon in the AC to keep it formed and the conjunctival hole was sutured only in group (B) by one 10/0 nylon suture. Video illustrating the surgical steps of Ab-externo RF sclerostomy is attached (SD1).

Postoperatively, topical moxifloxacin 0.5% eye drops were routinely used for the first 2 weeks and topical prednisolone acetate 1% eye drops were prescribed with gradual tapering over 8 weeks.

The patients were postoperatively examined at days 1, 7, 14, 30, 90, 180 by an experienced ophthalmologist who was masked to the type of surgical intervention performed. All postoperative data were documented; AC depth, AC reaction, bleb grading and IOP were measured using GAT under sterile precautions. CDVA was assessed if possible. Anterior segment optical coherence tomography (AS-OCT) or ultrasound biomicroscopy (UBM) were done when needed postoperatively to confirm ostium patency and bleb filtrationn (fig. 1, 2).

Parameters of efficacy were determined from the percentage of lowering of the IOP. And that for safety was determined from the change in the best corrected visual acuity (BCVA) or the occurrence of sight threatening complications.

Complete success was defined as IOP ≤ 21 mm Hg without any anti-glaucoma medication; qualified success was defined as IOP ≤ 21 mm Hg using ≤ 2 anti-glaucoma medications at the end of the follow up period or if needling is required and failure was considered when ≥ 2 anti-glaucoma medications or a redo surgery were required to control IOP [12].

Our study enrolled 40 eyes of 40 patients with OAG who were subjected for glaucoma surgery. They were recruited into 2 groups, group (A) included 20 eyes of 20 patients who had ab-externo radiofrequency sclerostomy. Twenty patients completed 3 months of follow up but only 16 patients completed 6 months of follow up. The other 4 patients were subjected to other glaucoma procedure due to uncontrolled IOP. Group (B) included 20 eyes of 20 patients who had ab-externo radiofrequency sclerostomy with subconjunctival injection of 0.2 ml of 0.02% MMC. Twenty patients completed 3 months of follow up but only 19 patients completed 6 months of follow up. The other patient was subjected to other glaucoma procedure due to uncontrolled IOP at the 4th month postoperative.

Fig. 2. Showing low diffuse ischemic blebs in patient of group (B) at 6 months post-operative
Рис. 2. Показаны небольшие диффузные ишемические ФП у пациента группы Б через 6 мес после операции

A total of 40 eyes from 40 patients (25 males, 15 females) were included in this study. The mean age was 55.40 ± 11.40 years and 57.2 ± 8.2 years in groups (A) and (B) respectively. In group (A) 9 eyes had POAG (45%) and 11 eyes had 2ry OAG (55%) (5 pseudophakic, 3 pseudo exfoliation, 2 silicone induced and 1 angle recession). However in group (B), 12 eyes had primary OAG (60%) and 8 eyes had 2ry OAG (8%) (3 pseudophakic, 2 pseudo exfoliation and 3 silicone induced).

There was no statistically significant difference in the demographic & preoperative data of both study groups.

Statistics. The data were coded and entered using the statistical package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA). Data were summarized

using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the non-parametric Mann — Whitney test. For comparison of serial measurements within each patient the non-parametric Friedman test and Wilcoxon signed rank test were used. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. Survival curves were plotted by the Kaplan — Meier method and compared using the log-rank test. p-values less than 0.05 were considered as statistically significant.

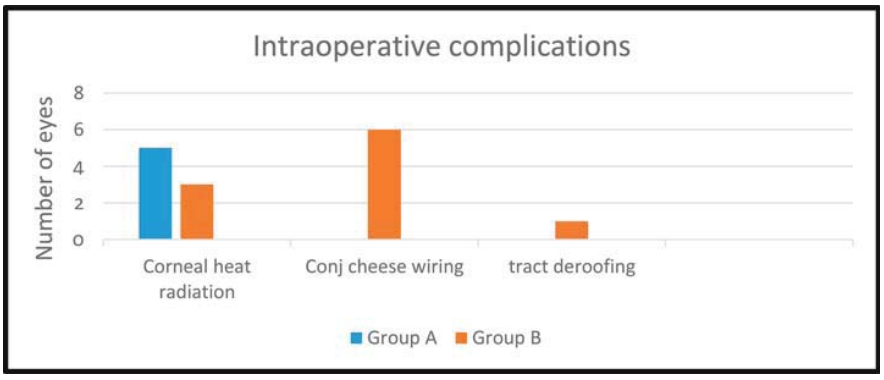

Fig. 3. Intraoperative complicationы and their indices in each group
Рис. 3. Интраоперационные осложнения и их количество в каждой группе

RESULTS

There was insignificant change in the Log MAR visual acuity in both groups, from 1.16 ± 0.5 to1.26 ± 0.5 in group (A) and from 1.4 ± 0.6 to 1.36 ± 0.7 in the group (B), p = 0.059 & 0.180 respectively.

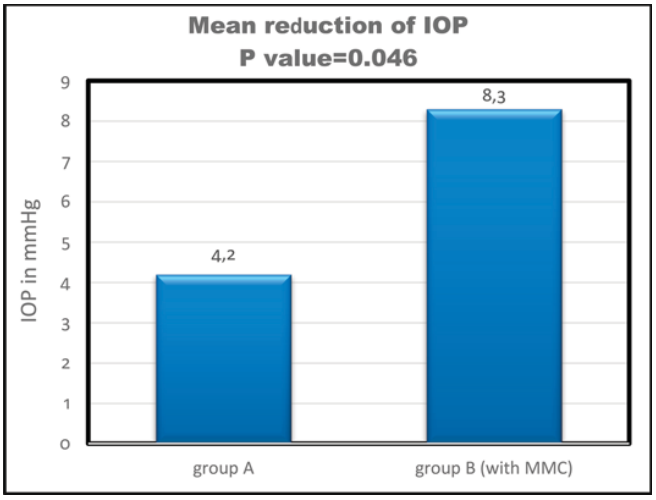

Fig. 4. Comparing IOP lowering effect in mmHg between group (A) and group (B)
Рис. 4. Сравнение эффекта снижения ВГД (мм рт. ст.) между группой А и группой Б

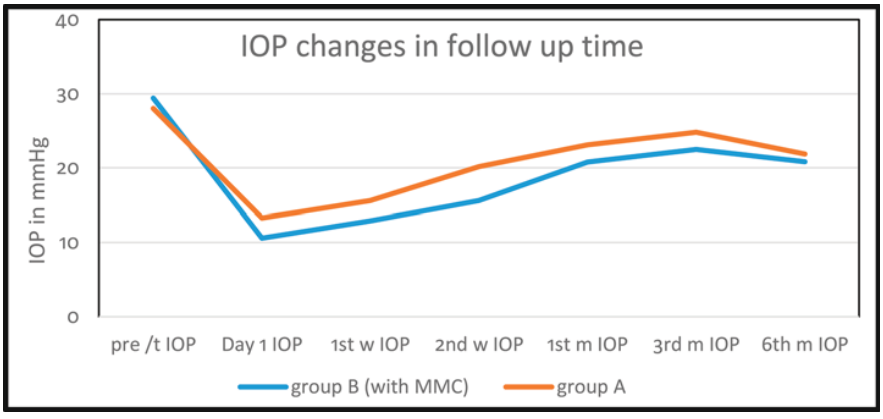

Fig. 5. Mean IOP values in groups A & B during the follow up time
Рис. 5. Среднее снижение ВГД в группах А и Б в период наблюдения: до операции, через 1 день, 1 и 2 нед, 1, 3 и 6 мес после операции

Intraoperative complications were illustrated in fig. 3.

Heat radiation to the cornea from the RF probe was reported in 5 patients (25%) in group (A), and 3 patients (15%) in group (B). Fortunately this corneal collagen shrinkage was reversible within the first 3 months postoperative and it did not affect the BCVA at the end of the follow up period. Conjunctival cheese wiring occurred in 6 patients in group B only (30%). They were sutured with 10/0 nylon sutures without affecting the postoperative course. Deroofing of the tract occurred accidently intraoperative in only 1 patient (5%) in group B as the patient had deep set eyes with prominent supraorbital ridge and was managed by suturing and contact lens for 2 weeks with uneventful postoperative recovery.

Postoperative changes in IOP. The IOP changes were recorded on days 1, 7, 14, 30, 90, 180. Both groups showed a significant percent reduction in the IOP from baseline with lower IOP values in group (B) on days 1, 7, 14, 30, 90 and 180 but were not statistically significant. No significant differences in the percent reduction of IOP between both groups during follow up time (p = 0.068), while the mean reduction in IOP was significantly higher in group (B) (p = 0.049) as shown in fig. 4.

The exact values of IOP and percent reduction in IOP are summarized in Table 1 and fig. 5. The need for postoperative anti-glaucoma medications was significantly reduced in group (A) from2.65 ± 0.50 to 1.75 ± 1.3 (p = 0.012) as well as in group (B) from 2.3 ± 0.5 to 1.45 ± 1.1 (p = 0.005) at the end of the follow up period with insignificant difference between both groups.

The complete success rate was 30% (6 eyes) in group (A) and 25% (5 eyes) in group (B) and the qualified success rate was 5% (1 eye) and 25% (5 eyes) in group (A) and (B) respectively. 13 eyes (65%) and 10 eyes (50%) were considered as failed cases in group A and B respectively.

Comparing the survival between the groups, with the Kaplan Meier curves, there was no statistically significant difference (p = 0.202). The survival analysis for the success rate is illustrated in fig. 6.

Visually significant cataract that required cataract extraction after the end of the follow up period occurred in 2 patients

(10%) in group A and in 1 patient (5%) in group B. This may be due to galloping cataract.

Comparing the intraoperative, early and late post-operative complications between the 2 groups, there is no statistically significant difference between them except for the conjuctival cheese wiring that was statistically significant higher in group (B) than group (A) (p = 0.020).

The postoperative complications are summarized in table 2.

Table 1. The exact values of IOP and percent IOP reduction in both groups during follow up period
Таблица 1. Значение ВГД и его процентное снижение в обеих группах в течение периода наблюдения

Parameters Показатели	Group A Группа А			Group B Группа Б			p value between both groups
	mean	SD	p value	mean	SD	p value	
n med# pre	2.65	0.49	0.012	2.30	0.47	0.005	0.060
n med post	1.75	1.29		1.45	1.10		0.398
pre /t IOP&	28.00	3.49	<0.001	29.40	3.44	<0.001	0.277
Day 1 IOP ВГД в 1-й день	13.30	15.22		10.60	13.17		0.487
1st w IOP ВГД через неделю	15.60	11.44		12.90	9.96		0.445
2nd w IOP ВГД через 2 нед	20.15	11.62		15.60	9.33		0.242
1st m IOP ВГД через 1 мес	23.10	10.75		20.80	9.19		0.565
3rd m IOP ВГД через 3 мес	24.80	8.04		22.50	7.02		0.398
6th m IOP ВГД через 6 мес	21.88	5.19		20.84	6.27		0.781
IOP lowering, % Снижение ВГД, %	15.12	17.26		27.09	22.40		0.068

Note. # — number of medication.
Примечание. # — количество препаратов, pre — до операции, post — после операции.

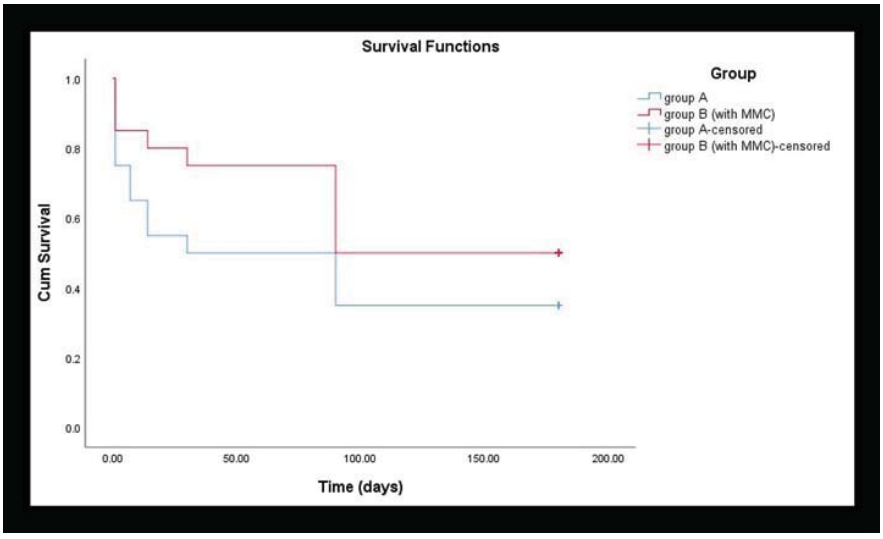

Fig. 6. Showing Kaplan — Meier curves of survival in groups A and B
Рис. 6. Кривые Каплана — Мейера успешности операции в группах А и Б

DISCUSSION

Since subscleral trabeculectomy (SST) had been described in 1968 [2], it is still considered the reference to which other operations are compared [13, 14]. However, it is usually described with significant complications that are related to scleral flap preparation and suture related problems [15]. Over the last decade, the introduction of MIGS has signaled a significant shift in the approach to glaucoma management. These changes include simplification of glaucoma surgical procedure and its post-operative care as well as decrease in the number of postoperative glaucoma medication [16]. The ongoing attention to innovations in glaucoma surgery reflects the lack of an ideal solution that would promise long-term IOP reduction and eliminate the necessity of supplementary pressure-reducing medication at low complication rates [17].

In this study, we aim to evaluate an innovative technique ab-externo sclerotomy in terms of efficacy and safety. This technique involves performing a subconjunctival filtering tracts in patients with uncontrolled OAG through using radiofrequency waves thus enhancing aqueous drainage through narrow tracts with the formation of a diffuse, posterior bleb.

In current study, intraoperative conjunctival manipulation was nearly eliminated, which in turn decreasing the risk of wound healing process and its sequel of scarring and fibrosis [18]. Formation of scleral filtration tracts was thought to control aqueous outflow in certain amount and direction thus decreasing the high incidence of overfiltration and hypotony that reported in conventional SST, also the simplicity in creating the scleral tracts saved more time and decreased the hazards related to flap fashioning. This innovative technique was found to be nearly sutureless avoiding all intraoperative and postoperative suture related problems.

I. Kumar et al. held a study in 2012 [19] in Russia, included 36 eyes with the follow up period of 6 months to evaluate the clinical efficiency of micro tract filtration (MTF) procedure, they used 100 μ fugo blade to create a subconjunctival filtration tract through the limbus into the AC with injection of 0.02% MMC subconjunctivally at the site of the tract.

Comparing I. Kumar's study to ours, we found that the mean preoperative IOP in Kumar's study (32.8 ± 6.4 mm Hg) was higher than our preoperative IOP (29.4 ± 3.4 mm Hg) which might explain why the lowering effect of Kumar's procedure (42.6 ± 15.2%) was higher than ours (27.1 ± 22.4%). I. Kumar's study achieved the complete success rate 66.7% compared to 30 and 25% in groups A and B respectively in the current study; this is related to the difference in definition of success criteria, as in I. Kumar's study, they considered the 30% reduction from baseline as success without taking into consideration the target IOP. In our study, success was defined as reduction > 20% with target IOP < 21 mm Hg. In the current study a statistically significant reduction of the number of the antiglaucoma medications in both

groups A and B had been reported. This issue was not declared in I.Kumar's study.

We reported lower rate of iris incarceration at the filtration site in our study (10% in group A and 15% in group B) compared to I. Kumar's study (36.1%) could be explained by the gradual decompression of the AC through paracentesis and injection of intracameral cohesive viscoelatic (Haelon). I.Kumar's study also reported using YAG laser to free the iris from the internal opening, thus enhancing their success rate.

D. Kumar and A. Agarwal [5] held a pilot study in 2016 that had the same surgical principle of current study, using a drilling device called Minimally Invasive Micro Sclerostomy (MIMS) and preoperative subconjunctival MMC 0.02%. They reported success rate of 95.5%, was higher than that of group B in the current study (50%). That could be explained by smaller number of cases included and difference in their success criteria that depended on the ability of their technique to successfully create a drainage channel without taking in consideration the target IOP.

In the current study we reported that in group B with MMC, there was a statistically significant higher IOP lowering effect (8.3 ± 7.26 mm Hg) and higher success rate (50%) than in group A (4.2 ± 4.67 mm Hg) and (35%) respectively. This might be referred to the anti-fibrotic role of MMC in minimizing the subconjunctival space scarring and fibrosis [20–22]. Also most of the cases had been included in group A were 2ry OAG (55%), in comparison to (40%) in group B, and most of the cases enrolled in group A had been performed at the beginning of the study during our early learning curve, and these probably contributed to the lower rate of success in group A.

Table 2. Early and late postoperative complication and their percent in both groups
Таблица 2. Ранние и поздние послеоперационные осложнения и их процентная доля в обеих группах

Postoperative complication Послеоперационные осложнения	Group A Группа А		Group B (with MMC) Группа Б (с митомицином С)		p value
	count число	%	count число	%	
Early shallow AC* Раннее снижение глубины ПК*	10	50.0	6	30.0	0.197
Serous choroidal detachment† Серозная отслойка хориоидеи†	7	35.0	3	15.0	0.144
Early high IOP‡ Повышение ВГД на ранних сроках‡	7	35.0	4	20.0	0.288
Peripheral anterior synechia at ostium§ Периферическая передняя синехия у устья§	2	10.0	3	15.0	1
Hyphema‖ Гифема‖	0	0.0	1	5.0	1
Scleral melting# Расплавление склеры#	0	0.0	2	10.0	0.487
Cataract¶ Катаракта¶	2	10.0	1	5.0	1
Chronic hypotony and atrophia& Хроническая гипотония и атрофия&	0	0.0	1	5.0	1
Late disfiguring bleb Позднее изменение формы фильтрационнойподушки	1	5.0	1	5.0	1

Note. * — grade 1 and resolved spontaneously through the first week postoperatively. † — management was conservative using frequent topical steroids, atropine sulfate 1% & systemic oral prednisolone 1 mg/Kg/day, resolved within the first 3 postoperative weeks. ‡ — relieved by spontaneous absorption of the retained viscoelastic (Healon GV), § — 2 eyes (10%) group A and 3 eyes (15%) group (B) had iris at ostium site with early failure. ‖ — minimal and resolved spontaneously 3 days later. # — one eye was managed medically, the other eye was managed by conjunctival advancement flap.
Примечание. * — I степени и разрешилось спонтанно в течение 1-й недели после операции. † — ведение было консервативным с использованием частых топических стероидов, 1% сульфата атропина и системного перорального преднизолона 1 мг/кг/день, исчезло в течение первых 3 недель после операции. ‡ — облегчение за счет спонтанного всасывания оставшегося вискоэластика (Healon GV). § — в 2 (10%) глазах группы А и 3 (15%) глазах группы Б отмечено повреждение радужной оболочки в области устья. ‖ — минимальные и разрешились спонтанно через 3 дня. # — один глаз лечили консервативно, на втором глазу использовали лоскут конъюнктивы.

The high rate of failure reported in both groups (65%, 50% in groups A and B respectively) was related to failure of filtration as the filtering tract was found to be occluded in some cases by necrotic debris or incarcerated iris at the internal opening of the sclerostomy especially we did not perform a peripheral iridectomy nor used the YAG laser to free the iris.

Our technique can still be considered efficient in both groups as we had statistically significant reduction of both the preoperative IOP and the number of medications used by the patients. The overall success rate (35% in group A and 50% in group B) can still be comparable to the success rate of SST that ranges between 32% and 96% [23], on the other hand we did not report any sight threatening complications like suprachoroidal hemorrahge, blebitis or endophthalmitis.

CONCLUSION

In the current study, RF power was used to create subconjunctival filtering tracts. The procedure was quick, simple and minimally invasive in glaucoma management. It took about 2–3 minutes to finish the surgery. This may be of great concern in patients who are orthopneic and can't lie flat for long time so this technique can help to save their eyes. This technique was found to have a short learning curve that both the glaucoma specialist and the comprehensive ophthalmologist can master easily. Still the great benefit was the preservation of conjunctiva for further needed traditional filtering surgery.

LIMITATION OF THE STUDY

This study was limited by small sample size, short follow up period and improper selection of cases as this technique would be more convenient for patients with early mild or moderate POAG. There are very few studies that took up the concept of subconjunctival tract filtration and this led to lack of inspiration and guidance during our study. We recommend similar studies on larger number of patients with mild or moderate OAG with extended follow up period for more than one year to study its late effect on IOP.

Литература/References

1. Jinza K, Saika S, Kin K, Ohnishi Y. Relationship between formation of a filtering bleb and intrascleral aqueous drainage route after trabeculectomy: evaluation using ultrasound biomicroscopy. *Ophtalmic Res.* 2000 Sep–Oct; 32 (5): 240–3. doi: 10.1159/000055620
2. Cairns JE. Trabeculectomy: preliminary report of a new method. *Am J Ophthalmol.* 1968; 66: 673–9. PMID: 4891876

3. Chen D, Sng C. Safety and efficacy of microinvasive glaucoma surgery. J Ophthalmol. 2017;2017:3182935. doi: 10.1155/2017/3182935
4. Onda E, Ando H, Jikihara S, Kitazawa Y. Holmium YAG laser sclerostomy ab externo for refractory glaucoma. *Int Ophthalmol*. 1996; 20 (6): 309–14. doi: 10.1007/BF00176883
5. Kumar D, Agarwal A. Minimally invasive micro sclerostomy may be alternative to trabeculectomy. Ocular surgery news website. May 03, 2016. https://www.healio.com/news/ophthalmology/20160503/minimally-invasive-micro-sclerostomy-may-be-alternative-to-trabeculectomy
6. Irfan S. Micro tract filtration a minimally invasive glaucoma surgical procedure by Fugo Plasma Blade. In: Proc. of Islamabad Congress of Ophthalmology. 2017; 15 (2): 48.
7. Garito JC, Ellman AG. Method for using an electrosurgical electrode in treating glaucoma, USA Patent # 5,755,716. May 26, 1996.
8. Kessing S, Heegaard S, Nissen O. Intrastromal diathermal keratostomy: a new micropenetrating clear-cornea glaucoma procedure. *J Glaucoma*. 2006 Oct; 15 (5): 437–45. doi: 10.1097/01.rti.0000213568.63538.79
9. Werth J, Gesser C, Klemm M. Diverse effectiveness of the Trabectome for different types of glaucoma. *Klin Monbl Augenheilkd*. 2015 Jan; 232 (1): 72–8. doi: 10.1055/s-0034-1383010
10. Abushanab M, El-Shiaty A, El-Beltagi T, Hassan S. The efficacy and safety of high-frequency deep sclerotomy in treatment of chronic open-angle glaucoma patients. *BioMed Research International*. 2019 Nov 16; 2019: 1850141. doi: 10.1155/2019/1850141
11. Mosaed S, Minckler DS. Aqueous shunts in the treatment of glaucoma. *Expert Review of Medical Devices*. 2010; 7 (5): 661– 6. doi: 10.1586/erd.10.32
12. Rotchford AP, King AJ. Moving the goals posts definitions of success after glaucoma surgery and their effect on reported outcome. *Ophthalmology*. 2010 Jan; 117 (1): 18–23.e3. doi: 10.1016/j.ophtha.2009.06.014
13. Matlach J, Hipp M, Wagner M, et al. A comparative study of a modified filtering trabeculotomy and conventional trabeculectomy. *Clinical ophthalmology (Auckland, N.Z.)*. 2015; 9: 483–92. doi: 10.2147/OPTH.S74853
14. Skalicky SE, Lew HR. Surgical outcomes of combined trabeculectomy-cyclodialysis for glaucoma. *J Glaucoma*. 2015 Jan; 24 (1): 37–44. doi: 10.1097/IJG.0b013e3182883c44
15. Watson PG, Jakeman C, Ozturk M, et al. The complications of trabeculectomy (a 20-year follow-up). *Eye (Lond)*. 1990; 4 (Pt 3): 425–38. doi: 10.1038/eye.1990.54
16. Brandão LM, Grieshaber MC. Update on Minimally Invasive Glaucoma Surgery (MIGS) and New Implants. *J Ophthalmol*. 2013; 2013: 705915. doi: 10.1155/2013/705915
17. Pajic B, Pallas G, Heinrich G, Böhnke M. A novel technique of ab interno glaucoma surgery: follow-up results after 24 months. *Ophthalmology*. 2006 Jan; 244 (1): 22–7. doi: 10.1007/s00417-005-0041-4
18. Papadopoulos M, Khaw PT. Improving glaucoma filtering surgery. *Eye*. 2001; 15: 131–2. https://www.nature.com/articles/eye200145.pdf
19. Kumar I, Frolov M, Makovetskaya I, Bozhok E, Dushina G. Clinical efficiency of Singh's microtrack filtration (MTF) procedure in surgical management of refractory glaucoma. September 2012 Conference: XXX ESCRS meeting https://www.researchgate.net/publication/299653887_Clinical_efficiency_of_Singh%27s_microtrack_filtration_MTF_procedure_in_surgical_management_of_refractory_glaucoma
20. Shetty RK, Wartluft L, Moster MR. Slit-lamp needle revision of failed filtering blebs using high-dose mitomycin C. *J Glaucoma*. 2005 Feb; 14 (1): 52–6. doi: 10.1097/01.ijg.0000146364.90506.7c
21. Maestrini HA, Cronemberger S, Matoso HD, et al. Late needling of flat filtering blebs with adjunctive mitomycin C: efficacy and safety for the corneal endothelium. *Ophthalmology*. 2011 Apr; 118 (4): 755–62. doi: 10.1016/j.ophtha.2010.08.020
22. Lim MC, Hom B, Watnik MR, et al. A comparison of trabeculectomy surgery outcomes with Mitomycin-C applied by intra-tenon injection versus sponge. *Am J Ophthalmol*. 2020 Aug; 216: 243–56. doi: 10.1016/j.ajo.2020.03.002
23. Edmunds B, Thompson J, Salmon J, Wormald R. The national survey of trabeculectomy. III. Early and late complications. *Eye (Lond)*. 2002 May; 16 (3): 297–303. doi: 10.1038/sj.eye.6700148

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