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Original research

Comparison of the long-term outcomes of resident versus attending performed trabeculectomy

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Abstract

Purpose: To compare the long-term outcomes obtained by residents and attending surgeons performing trabeculectomy.
Methods: After reviewing medical records of the patients, 41 residents performing trabeculectomy under supervision of attendings were compared to 41 attendings performing trabeculectomy. The primary outcome measure was the surgical success defined in terms of intraocular pressure (IOP) $\leq$ 21 mmHg (criterion A) and IOP $\leq$ 16 mmHg (criterion B), with at least 20% reduction in IOP, either with no medication (complete success) or with no more than 2 medications (qualified success). IOP, number of glaucoma medications, surgical complications, and visual acuity were analyzed as secondary outcome measures.
Results: Mean age of the patients was 59.5 ± 8.6 years in the resident group and 59.6 ± 12.31 years in the attending group ($P = 0.96$). Furthermore, mean duration of the follow-up was 62.34 ± 5.51 months in the resident group and 64.80 ± 7.80 months in the attending group ($P = 0.10$). The cumulative success according to criterion A was 87.8% in the resident group and 85.3% in the attending group ($P = 0.50$). Moreover, according to criterion B, it was 87.8% and 83% in the resident and attending groups, respectively ($P = 0.62$). Repeated glaucoma surgery was required in 12.2% and 2.4% of the patients in the resident and attending groups, respectively ($P = 0.09$). Rate of complications was 12.2% and 4.8% in the resident and attending groups, respectively ($P = 0.23$).
Conclusion: There were comparable results with respect to success rates and complications between residents and attending surgeons performing trabeculectomy in the long-term follow-up.
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Keywords: Glaucoma; Trabeculectomy; Intraocular pressure

Introduction

Glaucoma is the second leading cause of blindness globally. In addition, it is usually controlled by intraocular pressure (IOP)-lowering medications. However, surgical intervention becomes warranted in certain situations such as poor compliance with medications, progressive disease despite maximum medical therapy, or both.[1]

Trabeculectomy has long been established as the gold standard in glaucoma filtering surgery and has almost been an effective procedure in glaucoma for lowering the IOP. Nevertheless, it is associated with numerous short-term and long-term complications, including, but not limited to, bleb leaks and infections, accelerated cataract progression, choroidal effusions or hemorrhage, and prolonged or permanent visual impairment from hypotonic maculopathy.[2−5]

The technique of surgery and having a long-term experience in the management of glaucoma patients are the main factors in decreasing the failure rate and the complications of trabeculectomy. These experiences can be taught and transferred to the residents in their training period by closely supervising them during and after the surgery. In this regard,

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each residency program has its own strategy to reach these goals.

For instance, in the United States, each resident is required to perform a minimum of 5 glaucoma filtration/shunting surgeries as primary surgeon before graduation.[6]

According to previous studies, it appears that resident-performed glaucoma surgeries have acceptable outcomes in comparison to those performed by glaucoma specialists.[7–9]

In the present study, we aimed to compare the long-term success rates and complications of resident- versus attending-performed trabeculectomy in a resident-based hospital. The results of these kinds of studies can contribute to understanding the weaknesses and strengths of the residency training program. Moreover, we can clarify the final results of the surgery for the patients and inform and reassure them that the quality of services in the resident-based hospitals is high. This will encourage the patients to refer more to these university hospitals, leading to increasing the number of surgeries done by residents, improving their skills in surgical management of glaucoma patients, and ultimately assisting the training centers in graduating more confident residents.

Methods

In this retrospective cohort study, the medical records of 132 eyes of 132 patients with a history of trabeculectomy [60 cases were performed by the attending glaucoma specialist (N.N.), and 72 cases were performed by the third- and the fourth-year residents under the supervision of the same attending surgeon at a resident-based hospital] were evaluated from February 2008 to February 2010. This study followed the tenets of the Declaration of Helsinki and the Ethics Committee of the Rassoul Akram hospital approved the study protocol. The inclusion criteria were a history of first time trabeculectomy and at least 5 years of follow-up. The exclusion criteria were age less than 30, a history of previous glaucoma, intraocular surgery except uncomplicated phacoemulsification, or history of any surgeries unrelated to the trabeculectomy or its complications including phacoemulsification or deep vitrectomy during the follow-up period. All patients in attending group were selected from the private clinic (Markazi Clinic, Tehran, Iran) of the attending physician (N.N.), and all patients in resident group were selected from Rassoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. By reviewing the medical records, pre- and postoperative data required for this study were collected. The cases in the resident and attending groups were also matched based on age and subtype of glaucoma. By considering the inclusion and exclusion criteria, 41 out of 72 cases (56.94%) in the resident group and 41 out of 60 cases (68.33%) in the attending group were finally enrolled in the present study.

There were 7 postoperative follow-up visits within 6 months after the surgery for all patients, including the 1st, 7th, 14th, 30th, 60th, 90th, and 180th days. A window of $\pm$10 days was allowed for all time points of visits after the 1st month. After 6 months, follow-up visits were scheduled according to the clinical judgment of surgeon. Follow-up visits were performed both by residents and attending in the residents group and by the attending glaucoma specialist in the attending group. In each visit, the examination included measurements of best corrected visual acuity and IOP, slit-lamp biomicroscopy, assessment of anterior chamber cell and flare, bleb evaluation, and funduscopy. Type and number of IOP lowering medications, complications, and any postoperative interventions were also recorded.

The primary outcome measure was the surgical success defined in terms of IOP measurement by the following two criteria: (A) $5 \leq$ IOP ≤ 21 mmHg with at least $\geq$20% reduction in IOP without glaucoma medication (complete success) or with no more than 2 medications (qualified success), and (B) similar to previous criteria with the exception of 16 mmHg being the maximum IOP cut-off point. The cumulative success was defined as the sum of complete and qualified success. The surgery was classified as failure when: neither complete nor qualified success was met in at least 2 consecutive visits 3 months after the surgery, vision became no light perception, or reoperation was required due to the failure to achieve the target pressure. Bleb needling or minor interventions such as resuturing of the conjunctiva were not considered a failure.

Surgical technique

All surgeries were carried out under either general or retrobulbar anesthesia. Each patient underwent a fornix-based trabeculectomy with the similar technique in both resident and attending groups. The surgeries in the resident group were performed under the direct supervision of an experienced attending glaucoma surgeon. The surgery was consisted of the use of a half-thickness trapezoidal scleral flap (3×2 mm) in the supranasal quadrant. For all eyes after peritomy and creation of the scleral flap, mitomycin C (MMC) 0.02% (0.2 mg/mL) was applied, using multiple thin sponges under the scleral flap and between the sclera and tenon capsule for 2–3 min. The sponges were then removed, and the surgical field was irrigated with copious amounts of balanced salt solution. Sclerectomy was conducted with a Kelly-Descemet punch, and peripheral iridectomy was created with a Vannas scissors (Katena Products, Inc., Denville, New Jersey, USA). The scleral flap was closed with two 10-0 nylon sutures by the releasable technique. At the end of the surgery, the conjunctiva was closed with 10-0 nylon sutures. In all trabeculectomy surgeries which were performed by residents, the attending surgeon, supervised the resident in all steps of the surgery. At each step the attending may have intervene by his discretion. From the first day after the surgery, all patients were treated with ciprofloxacin eye drop (4 times a day for 2 weeks) and betamethasone eye drops every 2 h for 2 weeks that were tapered off slowly over 6–8 weeks. Releasable sutures were removed by considering the morphology of the bleb, the IOP, and the assigned target pressure. Subsequent to the surgery, IOP lowering medication was added if necessary based on the targeted IOP. In addition to the resident in charge of the surgery, the attending surgeon was also directly involved in all postoperative visits. Ocular Massage was performed

during each visit on those patients with signs of localizing bleb or rising IOP. The technique also was taught to the patient for doing self massage between visits.

Statistical analysis

Variables for statistical analysis included age, best corrected visual acuity, success rates, IOP, and number of medications. Snellen best corrected visual acuity was converted into logMAR scale to draw a comparison. Statistical analysis was accomplished, using SPSS software version 20 (SPSS, Inc., Chicago, Illinois, USA). For the purposes of analysis, the data were reported as mean ± SD and frequency. The Student *t*-test or Mann–Whitney test was utilized to compare the quantitative variables between the resident and attending groups; furthermore, Chi-square test was applied to categorical variables in order to determine the statistical significance. Kaplan–Meier survival analysis and also Log Rank test were employed to determine the probability of surgical success and comparison between two groups based on the two criteria (A and B). The statistical significance was determined by a two-tailed test P value ≤ 0.05.

Results

In our retrospective study, 41 eyes in the resident-performed trabeculectomy group were compared with 41 eyes in the attending-performed trabeculectomy group.

Table 1 shows the patients' demographic characteristics, with no significant difference between the two groups. Table 2 indicates the patients' preoperative and postoperative characteristics, and Table 3 demonstrates the success rates in each group. The cumulative success at the last visit according to criterion A was 87.8% and 85.3% in the resident and attending groups, respectively ($P = 0.50$). In addition, according to criterion B, it was 87.8% and 83% in the resident and attending groups, respectively ($P = 0.62$). The cause of failure was IOP less than 5 mmHg in one case in each group, and other failures (4 cases in the resident group and 5 cases in the attending group) were due to inadequate control of IOP. The earliest failures were detected 6 months and 2 years after the surgery in the resident and attending groups, respectively.

The second glaucoma surgery was performed in 12.2% (5 cases) of patients in the resident group (repeat trabeculectomy in 3 cases and Ahmed Glaucoma Valve insertion in 2 cases) and in 2.4% (repeat trabeculectomy in one case) of patients in the attending group ($P = 0.09$). There was no significant intraoperative complication in both groups. The rate of postoperative complications was higher in the resident group compared to the attending group (12.2% versus 4.8%) ($P = 0.23$). Additionally, there was also more surgical intervention for management of complications in this group (Table 4). In addition to mentioned complications in Table 4 which needed surgical intervention there were also 1 case with early postoperative leakage and 1 case with low-lying choroidal detachment that spontaneously resolved with conservative treatment in a few days. Fig. 1 presents Kaplan Meier analysis for the cumulative success according to criteria A, and the Log Rank analyses shows no significant difference between two groups ($P = 0.90$).

It should also be noted that only 3 cases in the attending group and 1 case in the resident group had 7 years of follow-up.

Discussion

Trabeculectomy was first introduced by Cairns[10] in 1967 and later modified by Watson in 1970.[11] Since then, it has become the accepted method of surgical treatment for various types of glaucoma. Trabeculectomy involves creating a drainage channel to redirect the flow of aqueous out of the eye. Adjunctive antimetabolites, such as 5-fluorouracil and MMC, are commonly employed to enhance success after trabeculectomy.[12,13] Some studies show that the success rate of trabeculectomy with MMC with 3 month-to-3-year follow-up ranges from 62% to 93%[14–16]; however, the majority of these surgeries have been performed by experienced surgeons.

According to previous studies, it appears that resident-performed glaucoma surgeries have more acceptable outcomes in comparison with those performed by glaucoma specialists.[7–9]

Table 1
Demographic characteristics of patients.

Group		Resident performed trabeculectomy	Attending performed trabeculectomy	*P* value
Number		41	41	
Age (mean ± SD) years		59.5 ± 8.6	59.6 ± 12.31	0.96
Laterality (right eye)		39%	48.8%	0.25
Gender (male)		51.2%	56.1%	0.41
Follow-up (months)/range		62.34 ± 5.51 (60–84)	64.80 ± 7.80 (60–84)	0.11
Preoperative best corrected visual acuity (logMAR)		0.94 ± 0.79	0.85 ± 0.85	0.51
Preoperative intraocular pressure (IOP)		25.58 ± 7.35	27.51 ± 6.10	0.20
Preoperative number of medications		2.70 ± 0.74	2.92 ± 0.64	0.16
Previous cataract surgeries		12.2%	17.1%	0.75
Type of glaucoma	Primary open angle glaucoma	29.3%	43.9%	0.38
	Chronic angle closure glaucoma	58.5%	46.3%	
	Pseudoexfoliation glaucoma	12.2%	9.8%	

SD: Standard deviation.

Table 2
Comparison of preoperative and postoperative best corrected visual acuity, intraocular pressure (IOP), and anti-glaucoma medications in resident or attending performed trabeculectomy.

Group	Variable	Preoperative	Postoperative (last visit)	*P* value
Resident performed trabeculectomy	Best corrected visual acuity (logMAR)	0.94 ± 0.79	0.87 ± 0.83	0.67
	Intraocular pressure (IOP) (mmHg)	25.58 ± 7.35	10.92 ± 2.63	0.00
	Anti-glaucoma medications	2.70 ± 0.74	0.48 ± 0,97	0.00
Attending performed trabeculectomy	Best corrected visual acuity (logMAR)	0.85 ± 0.85	1.00 ± 1.11	0.31
	Intraocular pressure (IOP) (mmHg)	27.51 ± 6.10	11.24 ± 5.08	0.00
	Anti-glaucoma medications	2.92 ± 0.64	0.51 ± 0.97	0.00

Table 3
Success rates of surgeries in each group at last visit (more than 5 years of follow-up).

Success		Resident performed trabeculectomy	Attending performed trabeculectomy	*P* value
Criterion A	Complete success	80.5%	70.7%	0.50
	Qualified success	7.3%	14.6%	
	Cumulative success	87.8%	85.3%	
	Failure	12.2%	14.7%	
Criterion B	Complete success	75.6%	65.9%	0.62
	Qualified success	12.2%	17.1%	
	Cumulative success	87.8%	83%	
	Failure	12.2%	17%	

Table 4
Complications needed surgical interventions in each group.

Group	Complication	Count	Intervention
Resident performed trabeculectomy	Malignant glaucoma	2	Anterior vitrectomy
	Conjunctival retraction	2	Resuturing
	Bleb encapsulation	1	Needling
Attending performed trabeculectomy	Wound leakage	1	Resuturing
	Cystic overhanging bleb	1	Bleb revision

Ophthalmology residency in our program is four years, and the residents are allowed to involve gradually in the intraocular surgeries from the second year. Trabeculectomy is performed only by the third- and fourth-year residents, and each resident is required to assist and observe the attending surgeon in at least 4 trabeculectomy before beginning toper form the surgery. Therefore, our program is different from that in the United States, which lasts for 3 years, and the residents can participate in the trabeculectomy from their second year of ophthalmology training. Patients' regular follow-up after the surgery and their adherence to the postoperative visits are even more important than the surgery itself. In this regard, before and after the surgery, patients are informed by the residents about the importance of the follow-up visits. In our study, during the first postoperative month, the resident, who was a primary surgeon and the attending surgeon together, visited the patients. After that critical month, sometimes due to the rotation of the resident to the other ophthalmology sections, the attending surgeon did the rest of the scheduled follow-up with the help of the new resident in the field.

In our study, with at least 5 years of follow-up, the cumulative success for reaching the IOP less than 22 or 17 was both 87.8% in the resident group and 85.3% and 83% in the attending group, respectively. Five patients (12.2%) in the resident group and 1 patient (2.4%) in the attending group required reoperation for glaucoma due to inadequate IOP control. The number of complications in the resident group was 5 (malignant glaucoma, conjunctival retraction, and bleb encapsulation) and 2 in the attending group (wound leakage and cystic overhanging bleb). Although the rate of repeated surgery and complications were not statistically different between the two groups, the differences can be clinically significant and also more repeated surgeries in resident group may partly be related to the adverse effect of some complications such as malignant glaucoma or conjunctival retraction on the site of filtration in the residents group. But surprisingly none of the cases with failure were among those with postoperative complications.

In a retrospective analysis of 50 eyes from 35 patients with Latin-American, African American, Asian, White, and Indian ethnicities with average follow-up period of 28.9 ± 17.6 months and pre-operative IOP of 23.2 ± 9.4 mmHg, Chan et al.[7] found that the success rate of trabeculectomy performed by the second- and third-year residents was 84% at the last

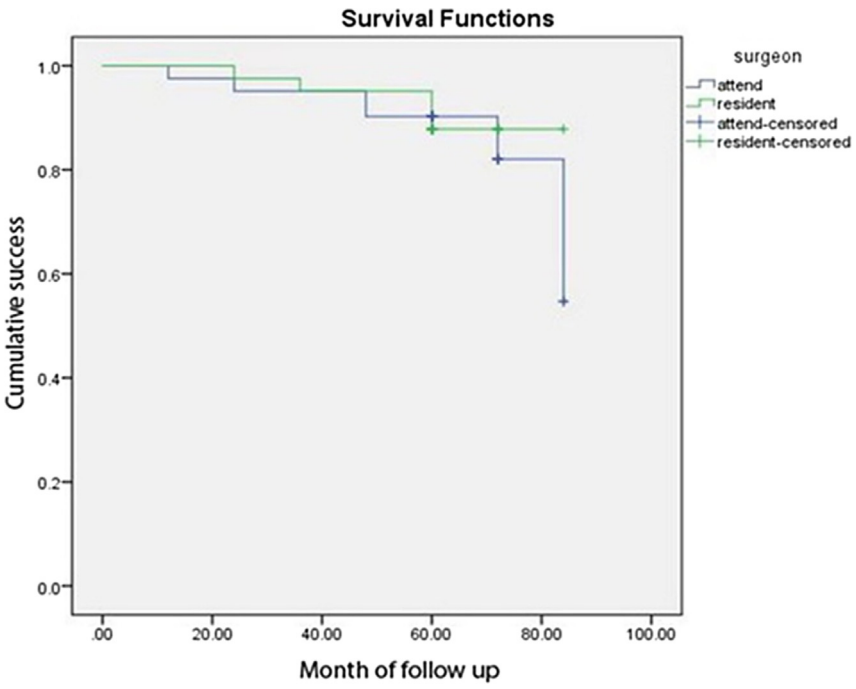

Fig. 1. Kaplan Meier analysis of patients for determining the survival rate of cumulative success according to criterion A in both groups.

follow-up. The subtypes of glaucoma were primary open angle (58%), mixed mechanism (20%), chronic narrow angle (6%), angle recession (6%), Pigmentary (4%), Uveitic (4%), and Pseudo-exfoliation (2%). In this study, the procedures included in their analyses were primary trabeculectomy (66%), revision trabeculectomy (8%), and combined extracapsular cataract extraction with trabeculectomy (24%). The trabeculectomies performed encompassed both fornix-based (36%) and limbal-based (64%) procedures. All cases except one included the use of intraoperative MMC, with concentrations and durations varying from 0.25 to 0.50 mg/mL and 30 s to 8 min, respectively. Intraoperatively, the scleral flap shape contained triangular (50%), trapezoidal (28%), rectangular (10%), square (2%), and unknown (10%). The operative scleral closures consisted of interrupted and releasable 10-0 nylon sutures, whereas the conjunctival closures had a variety of sutures and closures.

The definition of success in Chan's study was similar to our definition of cumulative success according to criterion A with the success rate of 87.8%.[7] In contrast to the diverse study subjects and subtypes of glaucoma in Chan's study, the selected cases in our survey were from the more uniform ethnicity and subtypes of glaucoma. Concerning the complications, 14% of the cases in Chan's study had persistent shallow anterior chamber and persistent choroidals that were significantly higher than those in our study. This difference can be pertinent to different subtypes of glaucoma, different surgical techniques in creating the conjunctiva, scleral flap, and closure of the conjunctival flap, or a higher concentration of MMC applied during the operation.

In a retrospective study with 85 eyes (85 patients), Kwong et al.[6] compared resident-performed trabeculectomy with attending-performed trabeculectomy with a mean follow-up duration of 45.2 ± 28.1 months (6 months–6 years). They found that the qualified success rate was 62.1%, while the complete success rate was 27.6% throughout 5 years of follow-up. The complication rate was 9.4%. The definition of qualified success in Kwong's study was nearly similar to our definition of cumulative success according to criterion B. The qualified success in Kwong's study was 62.1% and 65.5% in the resident-and attending groups; moreover, the cumulative success in our study was 87.5% and 83% at the last visit in the resident and attending groups, respectively. A part of this difference between the two studies could be attributed to the differences in the surgical techniques between these two studies such as using releasable sutures in our study and interrupted 10-0 nylon sutures in Kwong's study for closing the scleral flap. Furthermore, the differences in the etiology of glaucoma and the ethnicity of the study subjects should not be overlooked. The rate of complete success in our study, in both attending and resident groups (68.3%, 73.2%, respectively), as well as in the attending group (44.8%) of Kwong's study was higher than the resident group (22.6%) of Kwong's study. The probable reasons could be using multiple scleral flap closing sutures, less laser suture lysis, longer duration of the surgery, and more advanced disease stage in the resident group. The complication rate in the resident group in Kwong's study was slightly lower than that of our study (9.4% versus 12.2%). However, we should consider that Kwong et al. only reported serious postoperative complications requiring surgical intervention. In contrast to Kwong's study, where the residents performed surgeries on 64 patients and only 21 attending cases were matched, the number of patients in both groups in our study was equal. Additionally, Kwong et al. included diverse

subtypes of glaucoma (such as angle recession glaucoma, secondary angle closure glaucoma, Uveitic glaucoma, Juvenile onset glaucoma, and Neovascular glaucoma) and different ethnicities of study subjects. Nevertheless, we only included primary open-angle glaucoma, primary angle closure glaucoma, and Pseudo-exfoliation glaucoma in our study, which inherently had a better surgical outcome.

The strength of the present study was its long-term follow-up that was at least 5 years for each patient, and the exact matching of the number of patients in both groups. The main limitation of this study was its retrospective design. We also did not compare the bleb morphology in both groups or match the patients based on the severity and duration of disease, which may have affected the overall results and may account for a source of bias in our final conclusion. Although the success rate of the surgeries in both groups in this study was similar, according to the important role of postoperative managements and decisions in the success rate of trabeculectomy, we should not overlook the role of supervising attending. Prospective studies with larger numbers of patients, which include the aforementioned variables, could guide us toward better conclusions. In conclusion, in our study, with respect to success rates and complications, the resident-performed trabeculectomy was practically similar to the attending-performed trabeculectomy.

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