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A novel releasable wick suture for early intraocular pressure control in Baerveldt tube surgery

Authors:
Tung T. Hoang[1,2]
Edward Lo-Cao[2]
Shenouda Girgis[2]
Ridia Lim[2,3]

Affiliations:
[1]Department of Ophthalmology, Hanoi Medical University and Hanoi Medical University Hospital, Hanoi, Vietnam

[2]Save Sight Institute, The University of Sydney, Sydney, Australia

[3]Glaucoma Unit, Sydney Eye Hospital, Sydney, Australia

Corresponding author:
Tung Hoang,
tung.hoang@sydney.edu.au

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Background: Early post-operative intraocular pressure (IOP) control following Baerveldt tube (BVT) implant is critical, especially in cases with advanced glaucoma.

Aim: This study aimed to review the efficacy and safety of a releasable wick suture for early control of post-operative IOP in patients implanted with a 350 mm2 BVT.

Setting: This study is a retrospective chart review of all patients implanted with BVT and a releasable 9–0 Vicryl wick placement, performed under one surgeon.

Methods: Efficacy data of IOP and number of glaucoma medications were collected pre-operatively and on post-operative day 1 and weeks 1, 4, 6, 8 and 12. Safety, visual acuity and wick removal data were also collected.

Results: The utilisation of a releasable wick suture with BVT implantation gives early post-operative IOP control and fewer medications day 1 post-operatively. The IOP and number of medications significantly decreased at each time point while the visual acuity did not significantly change compared to the pre-operative level after 12 weeks in the total population. Mean IOP of patients with wick removal increased in hypotony cases and decreased in high pressure cases. There was no difference in terms of safety profile between cases with wick remaining and wick removal.

Conclusion: The use of a releasable wick suture with BVT implantation gives early IOP control with fewer glaucoma medications in the first three post-operative months and the option of suture removal when IOP is too high or low.

Contribution: The study introduced a novel method for early IOP control after BVT implant.

Keywords: glaucoma; Baerveldt tube; releasable wick suture; non-valved glaucoma drainage device; intraocular pressure.

Introduction

The Baerveldt tube (BVT) implant (Johnson & Johnson Vision, Jacksonville, Florida) is an aqueous shunt with known intraocular pressure (IOP) lowering efficacy and is used widely in patients with a high risk of failure after trabeculectomy or with refractory glaucoma.[1] However, with the 6-0 Vicryl tube ligature in place, it usually takes a couple of months for the suture to dissolve and for aqueous to drain to the encapsulated plate, and reduce the IOP. Early post-operative IOP control can be difficult and poses a challenge, especially in advanced glaucoma.

Approaches to control early post-operative IOP with BVT include medical therapy, tube fenestration[2,3,4,5] and wick placement.[6,7] Medical therapy can be insufficient; tube fenestration can be unpredictable and subconjunctival healing can limit the anterior flow produced by fenestrations, leading to early IOP increase. Tube fenestrations typically lose efficacy at 3–4 weeks,[8] wick sutures can have a longer effect[7] but can be associated with hypotony. We hypothesise that we can increase the safety of the wick technique by releasing the suture if the wick effect is excessive in the early post-operative period and also improve the efficacy of the fenestration by suture removal if the wicking is ineffective. The purpose of this study was to review the efficacy and safety profile of our novel releasable wick suture technique.

Research methods and design

Surgical technique

Patients who had BVT implantation with a releasable wick placement, performed by or under the supervision of a single senior surgeon (R.L.), were identified by searching the electronic medical record of Sydney Eye Hospital and Hunter Street Eye Specialists (HSES) from January 01, 2014 to December 31, 2021.

All cases included in the study underwent the same surgical procedure. The patient was given a peribulbar, subconjunctival block and topical tetracaine. A stay suture was placed superiorly and temporally. A conjunctival peritomy with relaxing side incisions was used and the Tenon's layer was dissected posteriorly. The superior and lateral rectus muscles were isolated with muscle hooks. The BVT was flushed with Balance Salt Solution (BSS). A 3-0 nylon intraluminal stent suture was inserted into the silicone tube. The BVT was inserted under the superior and lateral rectus, and fixed onto the sclera 10 mm away from the limbus with a 7-0 Vicryl suture. The tube was ligated with a 6-0 Vicryl suture and occlusion was verified by flushing with BSS. A scleral pass was performed with 23G needle. The tube was inserted into the eye through the scleral pass, confirmed for the position inside and fixed onto the sclera with a 7-0 Vicryl suture. Early post-operative anterior subconjunctival aqueous drainage was created by one 9-0 Vicryl releasable wick suture (see Figure 1, which demonstrates the procedure).[9] The tube was covered by a scleral patch graft and the patch and conjunctiva were fixed and closed with 7-0 Vicryl sutures.

The cases that were included were aged 18 years or older, diagnosed with uncontrolled glaucoma, and implanted with BVT 350 mm^2 employing the releasable wick suture. Patients with incomplete data or loss of follow-up were excluded. Only one eye of a patient was selected for the study. Baseline data included age, sex, ethnicity, laterality, type of glaucoma, lens status, surgical history, medication number, IOP, visual acuity (VA) (logMAR), location of tube insertion and placement. Efficacy data included IOP, IOP per cent change, medication number, VA, incidence of high or low IOP from post-operative visits day 1 (D1), week 1 (W1), week 4 (W4), week 6 (W6), week 8 (W8) and week 12 (W12). Safety data included hypotony, wound dehiscence or leak, hyphema, IOP spike and additional surgery. Cases with wick removal were separated for analysis with same efficacy and safety data.

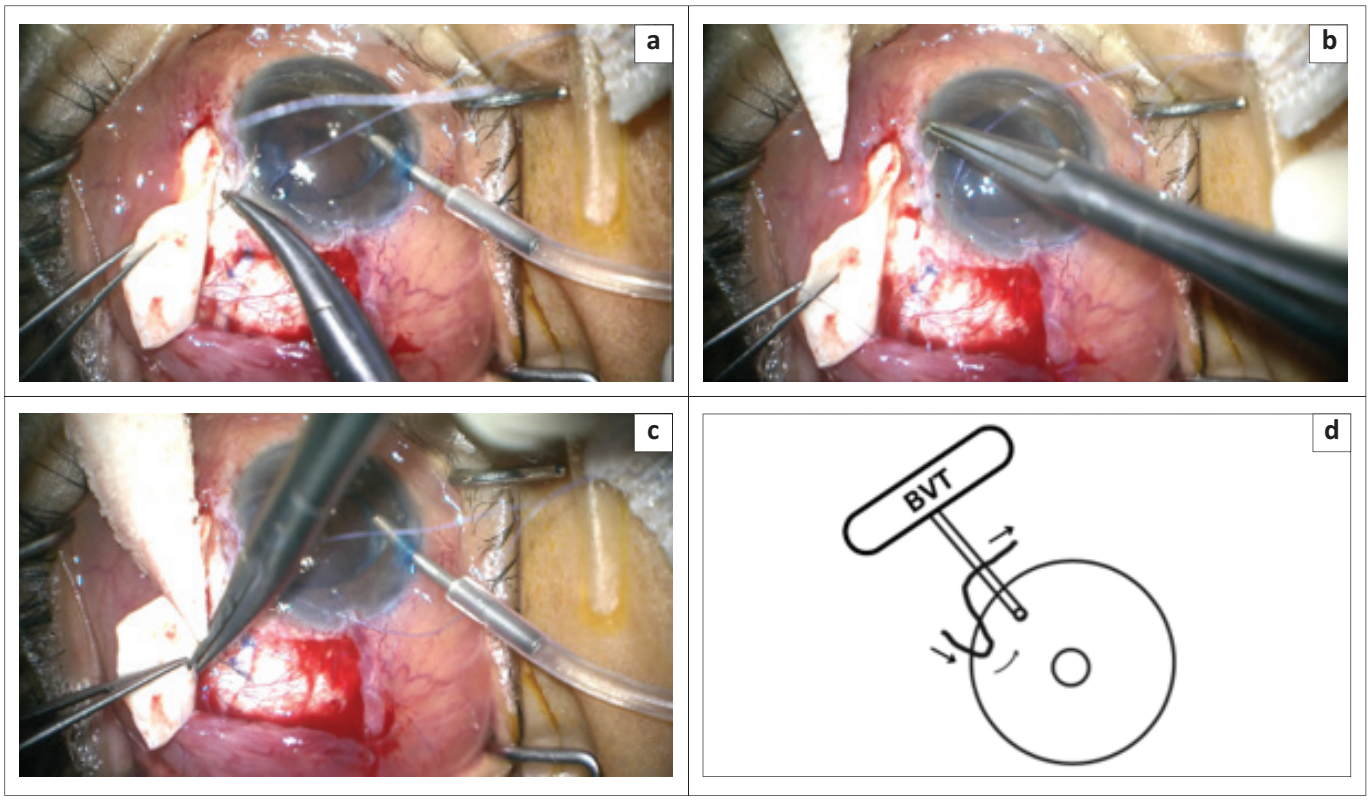
Definition of success was considered if post-operative IOP was reduced to below 21 mmHg. Success was defined as qualified or complete based on whether this was reached with or without anti-glaucoma medication. Failure was defined when IOP was above the pre-defined value or further surgery was required to reduce IOP.

Data analysis

Statistical analysis was conducted with Stata IC (version 16.1). Paired *t*-test was used for longitudinal assessment. Level of significance was a *P*-value < 0.05.

Ethical consideration

Ethical approval to conduct this study was obtained from the Royal Australian and New Zealand College of Ophthalmologists Human Research and Ethics Committee (reference no.: 147.22). This study is a retrospective chart review of patients undergoing BVT surgery with the



Source: Hoang T. Lim Releasable Wick Placement for Early IOP Control in Baerveldt Tube Implant Surgery. [Video]. 2025 [cited 2025 Jan 23]. Available from: https://youtu.be/QAedBL9OEdA
BVT, Baerveldt tube.

FIGURE 1: Releasable wick suture technique description: (a) The needle was advanced through the limbus from inside. (b) The needle was returned back to form the releasable loop. (c) The needle was put through the silicone tube in front of the ligature suture. (d) Illustration of the three-step releasable wick placement.

releasable wick suture technique at Sydney Eye Hospital and Hunter Street Eye Specialists. No patient consent form was obtained because of the chart review nature of the study. The study followed tenets of Helsinki declaration, ethically approved by New South Wales Health and Royal Australian and New Zealand College of Ophthalmologists.

Results

The study is a retrospective audit of consecutive cases of BVT insertion performed with this technique by or under the supervision of the chief surgeon (R.L.) at two centres between 2014 and 2021. The 3-month follow-up results are reported. We reviewed an aggregation of 142 records. In all, 66 patients had incomplete data or were lost to follow-up, thus 76 patients were included in this review.

Study population

Of the 76 patients included for analysis in this study, 31 were female (41%) and 45 were male (59%). The ethnicities included were: 76% Caucasian people, 22% Asian people and 1% other. The ages of the patients ranged from 21 to 92 years and the average age was 67 years. The types of glaucoma were: 42% open angle glaucoma, 17% uveitic glaucoma, 4% chronic angle closure glaucoma and 38% had other types of glaucoma (Table 1).

Previous glaucoma surgery was performed in 36%; 32% had previous trabeculectomy with mitomycin-C, 7% had previous Xen or Hydrus implantation and 1% had previous deep sclerectomy. The tube was placed in the anterior chamber in 75%, sulcus in 18% and pars plana in 7% of participants. All of the patients had an intraluminal 3-0 nylon suture. No intraluminal sutures were removed in the 3 month follow-up period. All the patients had a 6-0 Vicryl ligature tube tie, which dissolves typically between 6 and 8 weeks.

General group

Intraocular pressure and number of medications reduction

The baseline and follow-up IOPs with corresponding number of medications are shown in Table 2. The day 1 IOP on no medications is shown compared to baseline IOP in a scatterplot (see Figure 1-A1) demonstrating that 46% of patients had an IOP between 10 mmHg and 20 mmHg on day 1 on no glaucoma treatment. On day 1 post-operatively, 82% of patients had an IOP < 25 mmHg on no glaucoma treatment. The paired *t*-test confirmed that the IOP and medication reduction was statistically significant at each time point compared to baseline ($P = 0.000$).

Visual acuity stability

In the total group, using the paired *t*-test, the mean VA decreased from logMAR 0.84 pre-operatively to logMAR 1.41 on post-operative day 1 ($P = 0.000$), then increased to logMAR 0.75 at 12 weeks ($P = 0.000$) (Table 2). In the wick not removed group, using the paired *t*-test, the mean VA decreased from logMAR 0.78 pre-operatively to logMAR 1.40 on post-operative day 1 ($P = 0.000$). In the wick removed group, using the Wilcoxon signed-rank test, the mean VA decreased from logMAR 1.13 pre-operatively to logMAR 1.50 on post-operative day 1 ($P = 0.05$).

Wick removal group

A total of 12 patients had the wick suture removed. The main reasons for suture removal were hypotony (3/12) or elevation

TABLE 1: Baseline characteristics of patients.

Variable	Total ($N = 76$)				Wick removed patients ($n = 12$)			
	n	%	Mean	s.d.	*n*	%	Mean	s.d.
Age (years)	-	-	67.0	16.0	-	-	62.0	23.0
Sex (male)	45	59	-	-	7	58	-	-
Race								
Caucasian people	58	76	-	-	9	75	-	-
Asian people	17	22	-	-	3	25	-	-
Type of glaucoma								
Primary open angle	31	42	-	-	4	33	-	-
Uveitic glaucoma	13	17	-	-	3	25	-	-
Pseudoexfolative	8	11	-	-	3	25	-	-
Chronic angle closure	2	4	-	-	0	0	-	-
Pigmented dispersion	1	1	-	-	0	0	-	-
Others†	21	21	-	-	2	17	-	-
Lens status								
Pseudophakic	66	87	-	-	11	92	-	-
Phakic	7	9	-	-	0	0	-	-
Surgical history								
Prior Trabeculectomy	25	33	-	-	3	25	-	-
Angle based surgeries‡	5	7	-	-	0	0	-	-
Baseline IOP	-	-	26.3	9.3	-	-	30.3	11.7
Baseline medication	-	-	3.5	1.2	-	-	3.2	1.9

IOP, intraocular pressure; s.d., standard deviation.

†, others refer to post vitrectomy surgery glaucoma, post keratoplasty glaucoma, post-trauma glaucoma, congenital glaucoma; ‡, angle based surgeries include Xen implant and Hydrus stent implant.

TABLE 2: Pre-operative, post-operative intraocular pressure, medication and visual acuity compared to baseline.

Variable	Pre-operative	POD1	POW1	POW4	POW6	POW8	POW12
IOP (mmHg)							
Mean	26.30	13.10	12.7	17.4	16.60	12.70	13.10
s.d.	9.30	9.90	8.2	6.2	9.60	6.20	4.80
IOP % change from baseline	0.00	-50.30	-51.6	-34.0	-36.80	-51.60	-50.30
No. medications							
Mean	3.50	0.30	0.5	1.0	1.50	1.10	0.8
s.d.	1.20	0.70	1.1	1.2	1.40	1.20	0.90
Visual acuity (logMAR)	0.84	1.41	1.1	0.9	0.94	0.81	0.75

IOP, intraocular pressure; s.d., standard deviation; POD, post-operative day; POW, post-operative week.

of IOP (9/12). Looking at both wick and wick removal group, numerical hypotony of 7 mmHg occurred in 47.4% of cases. Of these, 19.4% had wick suture removal. The IOP of wick removed group for hypotony increased from 3.6 mmHg to 6.3 mmHg immediately after removal, rose to 19.5 mmHg at week 6 post-operation then decreased to 6.5 mmHg at week 8. The IOP of wick removed group for elevated IOP decreased from 24.9 mmHg to 7.9 mmHg immediately after removal, rose to 18.6 mmHg at week 6 post-operative then decreased to 14.5 mmHg at week 8.

Success outcomes

Success rates at different levels of IOP are shown in Table 1-A1. We performed further analyses according to previous surgical history. The rate of complete success was higher in eyes that did not undergo previous incisional glaucoma surgery at 47.8% compared to those patients who had undergone previous incisional glaucoma surgery at 40.0%. This difference was not statistically significant.

Complications

Complication rates are reported in Table 2-A1. No cases of tube erosion, corneal oedema nor bleb-related infection occurred in our group.

Re-operations

Re-operations were required in 16 patients, 11 in the wick group and 5 in the wick removed group. The surgeries were anterior chamber washout for post-operative hyphema, vitrectomy for persistent choroidal effusion, tube revision, tube occlusion and a case of tube removal. The timing of reoperation was on week 1 post-operation for anterior chamber wash out and tube revision on week 1 and in the fourth month post-operation.

Discussion

This study examined efficacy and safety of a releasable wick suture technique in 76 patients undergoing BVT implant surgery.

Our study demonstrated significant reduction of IOP and number of medications over 12 weeks, which were comparable to other studies on BVT with wick placement (Table 3).[6,7]

TABLE 3: Comparison of primary surgical outcomes following Baerveldt implantation with wick placement.

Variable	Total group†				Wick released				Rothman, An, Herndon[6]								Swaminathan et al.[7]							
									No wick‡				Wick§				No wick¶				Wick ††			
	n	%	Mean	s.d.	Median	*n*	%	Mean	s.d.	Median	*n*	%	Mean	s.d.	Median	*n*	%	Mean	s.d.	Median	*n*	%	Mean	s.d.	Median
Baseline	76	-	-	-	-	12	-	-	-	-	37	-	-	-	-	38	-	-	-	-	37	-	-	-	-	92	-	-	-	-
IOP (mmHg)	-	-	26.3	9.3	-	-	-	30.3	11.7	-	-	-	21.2	5.6	-	-	-	24.0	7.3	-	-	-	21.2	5.6	-	-	-	22.4	8.7	-
No. medications	-	-	3.5	1.2	-	-	-	3.2	1.9	-	-	-	2.6	1.1	-	-	-	2.9	1.0	-	-	-	2.6	1.1	-	-	-	2.7	1.1	-
Snellen visual acuity	-	-	-	-	20/125	-	-	-	-	20/250	-	-	-	-	20/50	-	-	-	-	20/40	-	-	-	-	20/50	-	-	-	-	20/55
POD1																														
n	76	-	-	-	-	12	-	-	-	-	37	-	-	-	-	38	-	-	-	-	37	-	-	-	-	92	-	-	-	-
IOP (mmHg)	-	-	13.1	9.9	-	-	-	14.6	12.7	-	-	-	14.4	9.5	-	-	-	14.0	0.85	-	-	-	14.4	9.5	-	-	-	12.0	9.0	-
IOP % change from baseline	-	-50.3	-	-	-	-	-51.8	-	-	-	-	-29.5	-	-	-	-	-37.5	-	-	-	-	-29.5	-	-	-	-	-41.5	-	-	-
No. medications	-	-	0.30	0.73	-	-	-	0.00	0.00	-	-	-	0.00	0.00	-	-	-	0.00	0.00	-	-	-	0.00	0.00	-	-	-	0.02	0.20	-
POW5/POM1																														
n	76	-	-	-	-	12	-	-	-	-	26	-	-	-	-	28	-	-	-	-	26	-	-	-	-	45	-	-	-	-
IOP (mmHg)	-	-	17.4	6.2	-	-	-	17.2	5.7	-	-	-	15.2	8.4	-	-	-	16.0	9.8	-	-	-	15.2	8.4	-	-	-	13.4	7.6	-
IOP % change from baseline	-	-34	-	-	-	-	-43.2	-	-	-	-	-21.2	-	-	-	-	-26.9	-	-	-	-	-21.2	-	-	-	-	-35.8	-	-	-
No. medications	-	-	1.0	1.2	-	-	-	0.09	0.3	-	-	-	1.1	1.1	-	-	-	1.1	1.2	-	-	-	1.1	1.1	-	-	-	0.7	1.0	-

Note: Please see full reference list of this article for more information.
IOP, intraocular pressure; POD, post-operative day; POM, post-operative month; POW, post-operative week; s.d., standard deviation.
†, 1 releasable placement; ‡, 4 fenestrations; §, 3 fenestrations + 1 wick; ¶, 4 fenestrations; ††, 2 fenestrations + 2 wicks..

TABLE 4: Comparison of safety profiles.

Variable	Hoang, Lo-Cao, Girgis, Lim		Rothman, An, Herndon[6]				Swaminathan et al.[7]			
	Total†		No wick‡		Wick§		No wick¶		Wick††	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
n	76	100	37	100	38	100	37	100	92	100
Hypotony (IOP ≤ 7 mmHg)	32	42	7	19	17	45	7	19	30	33
Wound dehiscence or leak	2	2	5	13	1	3	5	13	8	9
Hyphema	8	10	3	8	1	3	3	8	26	28
IOP spike	22	28	0	0	1	3	0	0	3	3
Additional surgery	16	21	1	3	2	5	1	3	5	5

IOP, intraocular pressure; POD, post-operative day; POM, post-operative month; POW, post-operative week.
†, 1 wick; ‡, 4 fenestrations; §, 3 fenestrations + 1 wick; ¶, 4 fenestrations; ††, 2 fenestrations + 2 wicks.

Despite the post-operative fluctuation, the mean VA increased from logMAR 0.84 pre-operatively to logMAR 0.75 at 12 weeks ($P = 0.000$), which showed that our technique did not affect the short-term VA.

According to our study, the percentage of IOP spike and reoperation seemed to be slightly higher than other approaches, whereas the prevalence of wound dehiscence, hyphema and hypotony were comparable (Table 4).[6,7]

We achieved a high qualified success rate with more than 50% having an IOP < 21 mmHg and approximately 40% having an IOP < 15 mmHg on medications, while the overall rate of failure was only less than 6% at 3 months after surgery. The rate of complete success was not significantly higher in eyes that did not undergo previous incisional glaucoma surgery (47.8%) compared to patients who underwent previous incisional glaucoma surgery (40%). A larger study is needed to verify this difference. In Primary Tube Versus Trabeculectomy Study, there was no significant difference in terms of IOP or rate of surgical failure at 5 years between two surgical groups.[10] BVT, on the other hand, were supported for refractory glaucoma in cases with prior cataract or failed filtering surgery in Tube Versus Trabeculectomy Study.[11]

What makes our technique different from others is ability to reverse the wick effect by wick removal in two different situations. In hypotony cases, removing the wick converts this to a fenestration only. Therefore, when the fenestration hole seals with the healing process, the IOP rises subsequently. On the other hand, in cases with IOP rise, we hypothesise that the wicking effect was ineffective because of debris, blood or fibrin and with wick removal, the sudden fluid flow through the fenestration initiates the flow and an anterior bleb forms, lowering the IOP.

Our study has some limitations. Due to the retrospective nature of the 142 patients, 66 patients had incomplete data or were lost to follow-up. Additionally, it is a non-comparative and non-randomised study.

Conclusion

Despite these limitations, this study shows that the employing a releasable wick suture with Baerveldt implantation offers early post-operative IOP control with fewer medications until bleb is fully encapsulated and the Vicryl ligature suture dissolves. The releasable form of wick placement provides the option of suture removal in case of an IOP spike or hypotony.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

T.T.H. conducted the research design, proposal writing, article writing and editing. E.L.-C. assisted with the research design, rendered data collection and edited the article. S.G. assisted in data collection, data analysis and article editing. R.L. also assisted with the research design, proposal writing and article editing.

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Data availability

The data that support the findings of this study are available from the corresponding author, T.T.H., upon reasonable request.

Disclaimer

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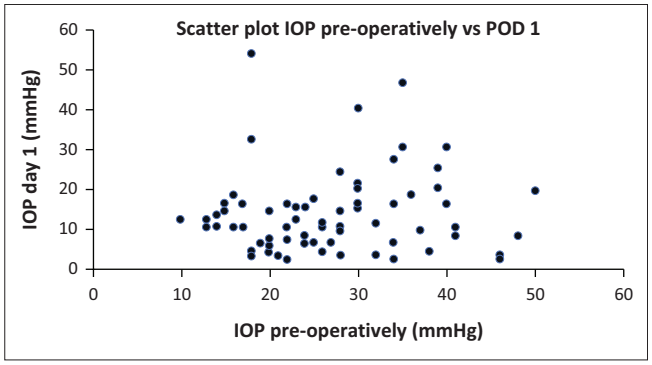
Appendix 1 starts on the next page →

Appendix 1



IOP, intraocular pressure; POD, post-operative day.

FIGURE 1-A1: The day 1 intraocular pressure (IOP) on no medications is shown compared to baseline IOP in a scatterplot demonstrating that 46% of patients had an IOP between 10 mmHg – 20 mmHg on day 1 on no glaucoma treatment.

TABLE 1-A1: Rates of success on no or on medications at 3 months following surgery.

Level of success	IOP < 21 mmHg (%)	IOP < 18 mmHg (%)	IOP < 15 mmHg (%)
Complete success	43.5	42.0	31.9
Qualified success	50.7	44.9	39.1

Note: The failure rate for all treatments is 5.8%.
IOP, intraocular pressure.

TABLE 2-A1: Safety profile of patients with wick and with wick removed.

Variables	Wick (N = 64)		Wick removed (N = 12)		P*
	n	%	*n*	%	
Hypotony (IOP ≤ 7 mmHg)	29	45	7	58	1.00
Wound dehiscence or leak	2	3	0	-	1.00
Hyphema	7	11	1	8	1.00
IOP spike	17	27	5	42	1.00
Additional surgery	11	17	5	42	1.00

IOP, intraocular pressure.
*, Fisher's exact test was used.