Original Article

Gonioscopy-Assisted Transluminal Trabeculotomy versus Bent Ab Interno Needle Goniectomy in Patients with Open-Angle Glaucoma

Ahmet Yücel Üçgül[1], Rukiye Kılıç Üçgül[1], Zeynep Aktaş[2]

[1]Kırşehir Ahi Evran University, Training and Research Hospital, Department of Ophthalmology, Kırşehir, Türkiye
[2]Atılım University Faculty of Medicine, Department of Ophthalmology, Ankara, Türkiye

Abstract

Objectives: To compare the efficacy and safety of gonioscopy-assisted transluminal trabeculotomy (GATT) and bent ab interno needle goniectomy (BANG) in patients with open-angle glaucoma (OAG).

Materials and Methods: This retrospective comparative study included 65 eyes diagnosed with OAG that underwent GATT (34 eyes) or BANG (31 eyes). Intraocular pressure (IOP) was measured using Goldmann applanation tonometry at baseline and during follow-up visits. Success was categorized as qualified (IOP ≤21 mmHg with ≥20% reduction) and complete (same criteria without medication). Complications and the need for further surgery were recorded.

Results: Preoperative mean IOP was 32.9±6.1 mmHg for GATT and 31.8±5.4 mmHg for BANG. At the final visit, mean IOP was reduced to 15.8±4.5 mmHg in the GATT group (51.9% reduction) and 17.9±5.7 mmHg in the BANG group (43.7% reduction). The complete success rate was 88.2% for GATT and 61.3% for BANG. Early failures were more frequent in BANG, while GATT showed fewer but later failures. Both procedures had minimal complications, with transient hyphema being the most common.

Conclusion: In this study, GATT provided greater and more sustained IOP reduction and higher long-term success rates compared to BANG, making it a more reliable option for managing OAG.

Keywords: Open-angle glaucoma, bent ab interno needle goniectomy, gonioscopy-assisted transluminal trabeculotomy

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Address for Correspondence: Ahmet Yücel Üçgül, Kırşehir Ahi Evran University, Training and Research Hospital, Department of Ophthalmology, Kırşehir, Türkiye
E-mail: ahmet.yucel.ucgul@gmail.com **ORCID-ID:** orcid.org/0000-0001-9945-793X
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Introduction

Glaucoma is a degenerative condition of the optic nerve that can lead to permanent vision impairment if not treated. Among its various forms, open-angle glaucoma (OAG) is the most widespread, affecting millions of people worldwide, and its prevalence continues to rise with the aging population.[1] The primary therapeutic goal in glaucoma management is to reduce intraocular pressure (IOP) to prevent further optic nerve damage. First-line treatments typically involve topical medications or laser trabeculoplasty.[2] However, topical therapy in particular is associated with drawbacks, including poor patient adherence, ocular surface toxicity, and long-term cost burden.[3,4]

When IOP cannot be adequately controlled through medical or laser treatments, surgical options become essential. Conventional procedures like trabeculectomy and aqueous shunt implantation are known for their effectiveness in reducing IOP but are often linked to considerable postoperative complications such as hypotony, infections, and bleb-related problems.[5] These drawbacks have driven the advancement of minimally invasive glaucoma surgery (MIGS) techniques, which focus on achieving substantial IOP reduction while offering improved safety and faster recovery times.[6]

Two notable MIGS procedures are gonioscopy-assisted transluminal trabeculotomy (GATT) and bent ab interno needle goniectomy (BANG). GATT involves a 360-degree trabeculotomy using a suture or microcatheter to open Schlemm's canal circumferentially, thereby enhancing aqueous outflow through the collector channels.[7] In contrast, BANG utilizes a bent 25- or 26-gauge needle to create a targeted goniotomy, excising a segment of the trabecular meshwork (TM) to facilitate aqueous drainage.[8] Both techniques have shown promising outcomes in reducing IOP and dependence on glaucoma medications while minimizing the risk of severe complications.

Despite these advancements, limited comparative data exist on the efficacy and safety of GATT and BANG in managing OAG.[9] Given the importance of optimizing surgical outcomes,

this study seeks to evaluate and compare the effectiveness of these procedures in lowering IOP, reducing the need for medications, and minimizing complication rates in patients with OAG.

Materials and Methods

The study was conducted in accordance with the principles of the Declaration of Helsinki and received ethical approval from the Ethics Committee for Scientific Research in Health Sciences of Kırşehir Ahi Evran University Faculty of Medicine (decision no: 2024-16/138, date: 10/08/2024). Prior to participation, informed consent was obtained from all individuals included in the study.

Patient Population

This retrospective comparative study included patients diagnosed with OAG who underwent either GATT or BANG between November 2022 and February 2024 at Ahi Evran University Training and Research Hospital. The eligibility criteria included adult patients with a confirmed diagnosis of primary open-angle glaucoma (POAG), pseudoexfoliation glaucoma (PXG), or pigmentary glaucoma. All participants had a preoperative IOP of 21 mmHg or higher, despite being on maximum tolerated medical therapy. Exclusion criteria consisted of a history of prior glaucoma surgery, significant corneal pathology that obstructed angle visualization, or undergoing cataract surgery during the follow-up period. Patients with advanced or end-stage glaucoma (mean deviation [MD] worse than -12 dB on visual field [VF] testing) were also excluded from the study. In cases where both eyes underwent surgery, only the right eye was included in the analysis to maintain statistical independence and avoid intra-subject correlation.

All surgeries in this study were performed by a single glaucoma surgeon (A.Y.Ü.). Patients were allocated to either GATT or BANG using a sequential allocation approach. Early in the study period, patients primarily underwent GATT. When the BANG technique was later described and adopted, subsequent patients were allocated to BANG. This method creates a historically controlled case series, where the patient allocation was influenced by the chronological introduction of the BANG procedure.

Surgical Technique

GATT was performed under local anesthesia using a standard operating microscope. A 2.2-mm temporal clear corneal incision was made to access the anterior chamber. The anterior chamber was filled with a cohesive viscoelastic agent (Protectalon 1.4%, VSY Biotechnology, Leinfelden-Echterdingen, Germany) to maintain space and protect the intraocular structures. Under direct gonioscopic visualization using a Volk TVG surgical goniolens, a 23-gauge microvitreoretinal blade was used to create a small goniotomy in the nasal TM, exposing Schlemm's canal. A 5-0 Prolene suture with a blunted tip was inserted through the goniotomy into Schlemm's canal. The suture was carefully advanced circumferentially along the canal for 360 degrees. If resistance was encountered, the device was redirected in the opposite direction to achieve complete cannulation. Once the suture traversed the full circumference of Schlemm's canal, the distal end was grasped with microsurgical forceps, and the proximal end was pulled to create a 360-degree trabeculotomy by unroofing the TM. After completing the trabeculotomy, the viscoelastic was removed from the anterior chamber by irrigation-aspiration. The anterior chamber was then reformed with balanced salt solution (BSS). Care was taken to tamponade any blood reflux by maintaining appropriate IOP. At the end of the procedure, the corneal incision was hydrated to ensure a watertight seal, and a combination steroid and antibiotic drop (Moxidexa 5 mg/1 mg, Abdi İbrahim Pharmaceuticals, İstanbul, Türkiye) was administered.

BANG was carried out under local anesthesia with the patient positioned supine. A 2.2-mm temporal clear corneal incision was created to access the anterior chamber. The chamber was then filled with a cohesive viscoelastic agent (Protectalon) to preserve space and stabilize the ocular structures during the procedure. A 25-gauge hypodermic needle was manually bent at approximately a 30-degree angle close to its distal tip to facilitate precise engagement with the TM. Under direct gonioscopic visualization of the nasal angle using a Volk TVG surgical goniolens, the bent needle was introduced through the corneal incision and advanced toward the nasal TM. The needle tip was engaged with the TM, and a 90-degree goniotomy was performed by excising a segment of the TM. The needle was carefully swept along the targeted area to remove the TM, ensuring that Schlemm's canal was opened without damage to adjacent tissues. After completing the goniotomy, the viscoelastic was removed from the anterior chamber by gentle irrigation-aspiration. BSS was used to reform the anterior chamber and maintain appropriate IOP. The corneal incision was hydrated to achieve a watertight seal, and a combination antibiotic and steroid drop (Moxidexa) was applied.

Main Outcome Measures

The primary outcome measure was postoperative IOP reduction. IOP was measured using Goldmann applanation tonometry at each follow-up visit. To ensure consistency, all measurements were taken during morning hours (between 8:00 and 11:00 AM) to minimize diurnal variation. IOP was recorded preoperatively and at the following postoperative time points: 1 day, 1 week, 1 month, 3 months, 6 months, 12 months, and the final follow-up visit. The final visit was defined as the visit at which surgical failure was detected for patients who experienced surgical failure, and as the last follow-up visit for those who did not. Success was categorized as qualified success and complete success. Qualified success was defined as an IOP of 21 mmHg or lower with a reduction of at least 20% from baseline, with or without the use of medications, and no need for additional glaucoma surgery. Complete success was defined as achieving the target IOP without the use of any glaucoma medications or additional surgical interventions. Secondary outcome measures included changes in the number of glaucoma medications required postoperatively, visual acuity assessed using the logarithm of the minimum angle of resolution (logMAR) scale,

and the incidence of complications. Visual acuity was evaluated preoperatively and at each follow-up visit. Furthermore, MD values in automated VF testing were extracted for analysis. Retinal nerve fiber layer (RNFL) thickness was measured using spectral-domain optical coherence tomography, focusing on global RNFL thickness. Complications such as early IOP spikes, hyphema, and the need for further glaucoma surgery were also documented. An IOP spike was defined as a pressure increase exceeding 30 mmHg within the first week postoperatively.

Statistical Analysis

Data analysis was carried out using SPSS software (version 22.0; IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean values with corresponding standard deviations, while categorical variables were represented as percentages. Group comparisons between GATT and BANG were performed using independent-samples t-test for continuous variables exhibiting normal distributions, whereas the Mann-Whitney U test was applied for non-parametric data. Categorical variables were assessed using the chi-square test or Fisher's exact test, as appropriate. To evaluate the cumulative likelihood of achieving both qualified and complete surgical success over the follow-up period, Kaplan-Meier survival analysis was employed. A p value of less than 0.05 was deemed indicative of statistical significance.

Results

The study included a total of 65 eyes, with 34 in the GATT group and 31 in the BANG group. The mean age was 60.6±13.0 years in the GATT group and 61.1±12.2 years in the BANG group. Both groups had a similar sex distribution, with 47.1% females in the GATT group and 45.2% in the BANG group. The mean glaucoma duration was 7.4±4.1 years in the GATT group and 5.7±3.8 years in the BANG group (p=0.725). The mean follow-up duration was 13.4±4.3 months for GATT and 11.8±3.8 months for BANG, which did not differ significantly between the groups. Phakic and pseudophakic eyes were evenly distributed, and PXG was the most common diagnosis, accounting for 58.8% of cases in the GATT group and 48.4% of those in the BANG group. Table 1 provides a comprehensive overview of the baseline demographic and clinical profiles of the study participants.

The preoperative IOP was similar between the groups, averaging 32.9±6.1 mmHg in the GATT group and 31.8±5.4 mmHg in the BANG group. Postoperative outcomes revealed substantial IOP reductions in both groups. At postoperative 1 month, the mean IOP decreased to 14.4±5.2 mmHg in the GATT group, representing a 56.2% reduction, and to 19.1±6.0 mmHg in the BANG group, representing a 39.9% reduction. The difference between the two groups at this time point was statistically significant (p=0.002). At 3 months, the mean IOP was 14.1±4.4 mmHg in the GATT group, a 57.2% reduction, compared to 16.6±3.8 mmHg in the BANG group, a 47.8% reduction (p=0.025). At 6 months, the reduction in IOP remained more pronounced in the GATT group, with mean values of 14.6±4.1 mmHg compared to 16.3±2.7 mmHg in the BANG group, but the difference did not reach statistical significance (p=0.064). By the final follow-up, the GATT group demonstrated a mean IOP of 15.8±4.5 mmHg, corresponding to a 51.9% decrease from baseline. In contrast, the BANG group exhibited a mean IOP of 17.9±5.7 mmHg, reflecting a 43.7% reduction. The difference in final IOP between the groups was not statistically significant (p=0.108). Table 2 shows the efficacies of the two surgical techniques in detail.

Both procedures resulted in a significant reduction in the number of glaucoma medications used postoperatively. In the GATT group, the mean number of medications decreased from 3.4±0.6 preoperatively to 0.3±0.9 at the final follow-up, whereas in the BANG group, the mean number of medications decreased from 3.3±0.7 to 0.9±1.2. This reduction was statistically greater in the GATT group (p=0.036).

Preoperative visual acuity was similar between the groups, with a mean logMAR of 0.15±0.23 in the GATT group and 0.16±0.24 in the BANG group. At the final follow-up, visual acuity remained stable, with a mean logMAR of 0.18±0.24 in the GATT group and 0.21±0.28 in the BANG group (p=0.603).

A subgroup analysis of PXG patients revealed no significant differences in final IOP levels between pseudophakic and phakic patients (p=0.421). Both groups demonstrated significant medication reduction (p=0.285), and the surgical success rates were comparable (p=0.537).

MD on VF testing and central RNFL thickness values were comparable at baseline. The mean preoperative MD was -7.5±3.7 dB in the GATT group and -6.8±3.5 dB in the BANG

Table 1. Baseline demographical and clinical characteristics of the patients

	GATT group (n=34)	BANG group (n=31)	Total (n=65)	p
Mean age (years)	60.6±13.0	61.1±12.2	60.8±12.5	0.879[a]
Age range (years)	29-81	40-80	29-81	
Female, n (%)	16 (47.1)	14 (45.2)	30 (46.2)	0.878[b]
Glaucoma duration (years)	7.4±4.1	5.7±3.8	6.6±4.0	0.725[c]
Mean follow-up time (months)	13.4±4.3	11.8±3.8	12.7±4.1	0.108[a]
Lens status, n (%)				0.859[b]
Phakic	15 (44.1)	13 (41.9)	28 (43.1)	
Pseudophakic	19 (55.9)	18 (58.1)	37 (56.9)	
Diagnosis, n (%)				0.622[b]
POAG	13 (38.2)	14 (45.2)	27 (41.5)	
PXG	20 (58.8)	15 (48.4)	35 (53.8)	
PG	1 (2.9)	2 (6.5)	3 (4.6)	

[a]Independent samples t-test, [b]Chi-square test, [c]Mann-Whitney U test. GATT: Gonioscopy-assisted transluminal trabeculotomy, BANG: Bent ab interno needle goniectomy, POAG: Primary open-angle glaucoma; PXG: Pseudoexfoliation glaucoma, PG: Pigmentary glaucoma

Table 2. Efficacy data of the two different surgical procedures				
	GATT (n=34)	**BANG (n=31)**	**Total (n=65)**	**p**
Visual acuity (logMAR)				
Preoperative	0.15±0.23	0.16±0.24	0.16±0.23	0.966[c]
Last visit	0.18±0.24	0.21±0.28	0.20±0.26	0.603[c]
Further glaucoma surgery, n (%)	3 (8.8)	5 (16.1)	8 (12.3)	0.463[b]
Early IOP spike, n (%)	3 (8.8)	0 (0)	3 (4.6)	0.091[d]
IOP (mmHg)				
Preoperative	32.9±6.1	31.8±5.4	32.4±5.8	0.424[a]
Month 1	14.4±5.2	19.1±6.0	16.6±6.1	**0.002**[a]
Month 3	14.1±4.4	16.6±3.8	15.2±4.3	**0.025**[a]
Month 6	14.6±4.1	16.3±2.7	15.4±3.6	0.064[a]
Month 12	14.5±2.9	16.2±2.2	14.8±2.8	0.278[a]
Final	15.8±4.5	17.9±5.7	16.8±5.2	0.108[a]
Number of medications				
Preoperative	3.4±0.6	3.3±0.7	3.3±0.6	0.252[c]
Final	0.3±0.9	0.9±1.2	0.6±1.1	**0.036**[c]
Central RNFL thickness (µm)				
Preoperative	79.0±13.1	77.8±15.7	78.5±14.3	0.737[a]
Final	74.8±13.0	70.9±14.2	72.9±13.5	0.249[a]
Mean deviation in VF				
Preoperative	-7.5±3.7	-6.8±3.5	-7.2±3.6	0.362[c]
Final	-9.2±4.1	-8.0±3.4	-8.6±3.8	0.208[c]

[a]Independent samples t-test, [b]Chi-square test, [c]Mann-Whitney U test, [d]Fisher's exact test. GATT: Gonioscopy-assisted transluminal trabeculotomy, BANG: Bent ab interno needle goniectomy, logMAR: Logarithm of the minimum angle of resolution, IOP: Intraocular pressure, RNFL: Retinal nerve fiber layer, VF: Visual field

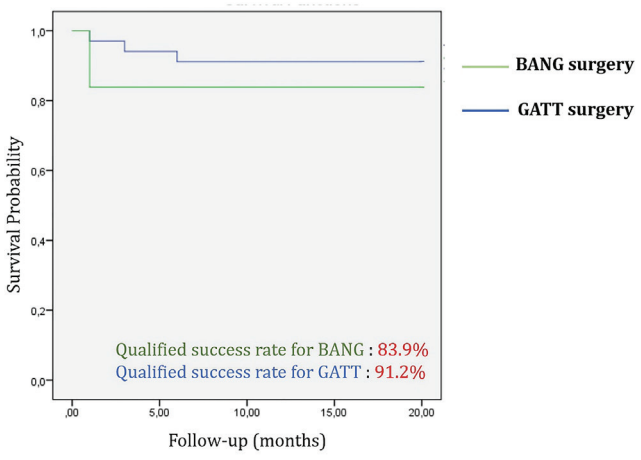

Figure 1. Kaplan-Meier analysis of qualified surgical success in gonioscopy-assisted transluminal trabeculotomy (GATT) and bent ab interno needle goniectomy (BANG). Qualified success was defined as IOP ≤21 mmHg and 20%≥ IOP reduction from baseline without further glaucoma surgery. Qualified success rates did not differ significantly between the groups (p=0.361, Breslow test)
IOP: Intraocular pressure

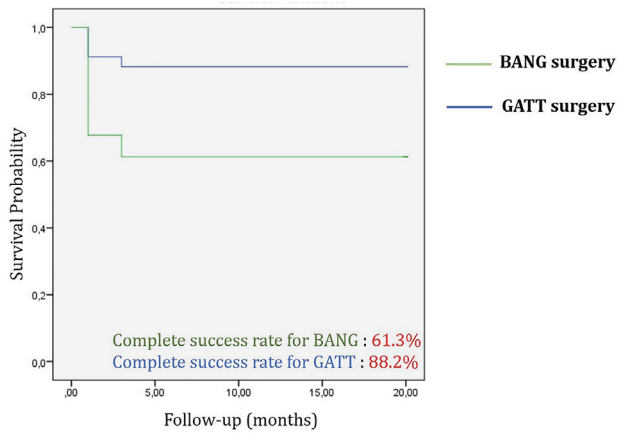

Figure 2. Kaplan-Meier analysis of complete surgical success in gonioscopy-assisted transluminal trabeculotomy (GATT) and bent ab interno needle goniectomy (BANG). Complete surgical success was defined as IOP ≤21 mmHg and 20%≥ IOP reduction from baseline without any further antiglaucoma medication or glaucoma surgery. The rate of complete success was significantly higher for GATT than BANG (p=0.012, Breslow test)
IOP: Intraocular pressure

group (p=0.362). The final MD values were -9.2±4.1 dB for GATT and -8.0±3.4 dB for BANG (p=0.208).

Similarly, the baseline RNFL thickness was 79.0±13.1 µm in the GATT group and 77.8±15.7 µm in the BANG group (p=0.737). At the final visit, RNFL thickness was 74.8±13.0 µm for GATT and 70.9±14.2 µm for BANG (p=0.249).

Kaplan-Meier survival analysis indicated higher success rates in the GATT group compared to the BANG group. The qualified success rate, defined as achieving an IOP of 21 mmHg or lower with at least a 20% reduction from baseline with or without medication, was 91.2% in the GATT group and 83.9% in the BANG group (p=0.361) (Figure 1). The complete success rate, defined as achieving the same IOP target without the use of medications, was 88.2% for the GATT group and 61.3% for the BANG group (p=0.012) (Figure 2). All patients requiring further surgical intervention due to uncontrolled IOP underwent trabeculectomy (3 patients [8.8%] in the GATT group and 5 patients [16.1%] in the BANG group). The need for a second surgical intervention was observed primarily within the first 6 months postoperatively (at 1, 3, and 6 months in the GATT group and at 1 month in the BANG group).

Both procedures resulted in minimal complications. Early IOP spikes were noted in 3 patients (8.8%) in the GATT group and none in the BANG group, with no significant difference (p=0.090). Hyphema was observed in all patients, with varying degrees in both groups. It resolved spontaneously within a week in most cases, except for 2 GATT patients who required anterior chamber washout by postoperative week 3.

Discussion

This study explored the therapeutic outcomes and safety considerations of GATT and BANG in treating patients with OAG, highlighting important differences in IOP reduction trends and surgical success rates between the two procedures. Both GATT and BANG significantly reduced IOP and the need for glaucoma medications, reinforcing their viability as MIGS techniques. However, the magnitude, stability, and durability of these outcomes differed notably between the groups. The GATT group demonstrated a substantial and sustained reduction in IOP throughout the follow-up period. At the first postoperative month, the mean IOP in the GATT group dropped from a baseline of 32.9±6.1 mmHg to 14.4±5.2 mmHg, reflecting a 56.2% reduction. This marked decrease remained consistent, with the final IOP stabilizing at 15.8±4.5 mmHg, corresponding to a 51.9% reduction overall. This stability in IOP reduction suggests that the 360-degree trabeculotomy performed in GATT effectively enhances aqueous outflow through Schlemm's canal, providing extensive and long-lasting improvement in outflow facility. The Kaplan-Meier analysis showed a qualified success rate of 91.2% and a complete success rate of 88.2% for GATT, indicating that the procedure achieves reliable IOP control with a reduced dependency on medications.

In contrast, the BANG group exhibited a less pronounced and less stable IOP reduction trend. The mean IOP decreased from 31.8±5.4 mmHg preoperatively to 19.1±6.0 mmHg at the first postoperative month, representing a 39.9% reduction. Over time, the IOP reduction plateaued, with the final mean IOP stabilizing at 17.9±5.7 mmHg, corresponding to a 43.7% reduction. The limited extent of TM excision in BANG, which addresses only a 90-degree segment, may account for the lower efficacy compared to the 360-degree approach of GATT. This partial goniotomy likely leaves residual outflow resistance, preventing sustained IOP control. The Kaplan-Meier analysis reflected this difference, with the qualified success rate for BANG at 83.9% and the complete success rate significantly lower at 61.3%. This suggests that BANG patients are more likely to require ongoing medication to maintain target IOP levels.

Surgical failure rates also showed a divergent trend between the two groups. In the BANG group, failures tended to occur early in the follow-up period, likely due to initial healing responses or incomplete trabeculotomy. Once this early period passed, IOP control remained relatively stable, even as medication dependence increased. Conversely, the GATT group experienced fewer surgical failures, but these continued to emerge over time, suggesting a progressive decline in effectiveness. This ongoing failure trend may be due to the natural wound healing response that can lead to fibrosis or scarring of the TM and Schlemm's canal. This scarring may gradually reduce the outflow capacity restored by the 360-degree trabeculotomy, causing IOP to rise again and leading to surgical failure in some patients.

The outcomes of this study align with and expand upon the findings of previous research comparing GATT and BANG. Ayub et al.[9] reported that both GATT and BANG effectively reduced IOP in patients with primary POAG, but the extent of IOP reduction was greater with GATT. Our study similarly showed a more pronounced IOP reduction in the GATT group, with a 56.2% decrease at postoperative 1 month compared to 39.9% in the BANG group. Furthermore, Grover et al.[10] documented a mean IOP reduction of 44% at 12 months and 37.3% at 24 months following GATT, underscoring the procedure's ability to provide sustained IOP control. Rahmatnejad et al.[11] reported a 63.0% overall success rate at 12 months, with a significant IOP decrease from 26.1 mmHg to 14.6 mmHg, indicating variability in GATT outcomes. Moreover, Aktas et al.[12] compared outcomes in POAG and PXG, showing a higher success rate in PXG (97.6%) than in POAG (86.8%) in the first year after GATT. In contrast, BANG studies such as those by Bukke et al.[13] demonstrated only a 31.8% reduction in IOP at 12 months when combined with phacoemulsification. The superior efficacy of GATT may be attributed to its 360-degree trabeculotomy, which addresses the entire circumference of Schlemm's canal, whereas BANG's limited 90-degree goniotomy may leave residual resistance to aqueous outflow. These comparative results emphasize that GATT offers more comprehensive and durable IOP control, making it a preferable option for patients requiring substantial IOP reduction.

The surgical success rates and complication profiles observed in our study are consistent with findings in the existing literature. In our study, the GATT group achieved a complete success rate of 88.2%, which is close to the 85% success rate reported by Dar et al.[14] for patients with advanced glaucoma undergoing GATT. Additionally, Liu et al.[15] reported a 45% IOP reduction at 4 years with a cumulative failure rate of 53.9%, suggesting that while GATT is effective, failures can occur over the long term. In comparison, BANG studies like those by Bukke et al.[13] reported an overall success rate of 87.5% at 12 months when combined with phacoemulsification, though isolated BANG procedures often showed lower success rates. Complications such as transient hyphema were the most common adverse events in both GATT and BANG.

Our comprehensive analysis of IOP reduction trends, surgical success rates, and complication profiles over an extended follow-up period demonstrated superior and sustained efficacy of GATT in achieving long-term IOP control compared to BANG. These findings may offer valuable guidance for clinicians in tailoring surgical interventions according to individual patient needs and disease severity. The inclusion of detailed failure trends also underscores the importance of considering the extent of TM intervention when predicting long-term outcomes. Furthermore, this study highlights the clinical significance of early versus late surgical failures, helping to refine postoperative expectations and management strategies. By filling these gaps, our research enhances the understanding of MIGS efficacy and supports evidence-based decision-making in glaucoma management.

Study Limitations

This study has several limitations. The retrospective design and sequential allocation of patients introduce potential biases, limiting the validity of direct comparisons between GATT and BANG. The lack of true randomization and the single-surgeon setting may affect the generalizability of the results to broader populations and varying skill levels. The sequential selection of surgical techniques may have resulted in increased surgeon experience over time, potentially influencing the outcomes in favor of later-performed procedures. Additionally, the sample size is relatively small, and the follow-up period may not fully capture long-term outcomes or late failures. Future studies should include larger, multicenter, randomized controlled trials to minimize bias and enhance generalizability. Longer follow-up periods are needed to assess the durability of IOP control and the frequency of late failures.

Conclusion

This study shows that GATT achieves greater and more sustained IOP reduction compared to BANG in OAG. The higher long-term success rate with GATT highlights its reliability, providing valuable guidance for MIGS selection.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the principles of the Declaration of Helsinki and received ethical approval from the Ethics Committee for Scientific Research in Health Sciences of Kırşehir Ahi Evran University Faculty of Medicine (decision no: 2024-16/138, date: 10/08/2024).

Informed Consent: Prior to participation, informed consent was obtained from all individuals included in the study.

Declarations

Authorship Contributions

Surgical and Medical Practices: A.Y.Ü., Concept: A.Y.Ü., Z.A., Design: A.Y.Ü., R.K.Ü., Data Collection or Processing: A.Y.Ü., R.K.Ü., Analysis or Interpretation: A.Y.Ü., R.K.Ü., Z.A., Literature Search: A.Y.Ü., R.K.Ü., Writing: A.Y.Ü., R.K.Ü.

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