Outcomes of Fornix-based Versus Limbus-based Conjunctival Incisions for Glaucoma Drainage Device Implant

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Purpose: To determine the effect of conjunctival incision location on the long-term efficacy of nonvalved glaucoma drainage devices.

Materials and Methods: We conducted a retrospective review of patients ≥ 18 years of age with uncontrolled glaucoma [intraocular pressure (IOP) ≥ 18 mm Hg] who underwent glaucoma drainage device implantation. A comparison was made of a limbal-based (LB-BGI) versus fornix-based (FB-BGI) conjunctival flap during placement of a 350-mm^2 Baerveldt glaucoma implant (AMO, Santa Ana, CA) in subjects with at least 1 year of follow-up data. The primary outcome measure was IOP; secondary outcome measures were medication burden, visual acuity, and surgical complications.

Results: One hundred sixty eyes of 147 glaucoma patients were included. Two years after surgery, the IOP in the LB-BGI group was 14.3 ± 5.3 mm Hg and in the FB-BGI group 13.1 ± 4.7 mm Hg ($P = 0.47$). Overall success of IOP control was achieved at the final visit (range 1 to 5 y) in 90% of the LB-BGI group and 87% of the FB-BGI group ($P = 0.63$). The medication burden of the 2 groups at 1 and 2 years after surgery was not statistically significantly different. Worsening of visual acuity by more than 2 lines was not statistically different between the groups 2 years after the surgery and at the final visit ($P = 0.47$, $P = 0.60$, respectively). A greater number of eyes developed endophthalmitis and were more likely to undergo subsequent tube revision in the FB-BGI group, but the differences were not significant.

Conclusions: Both incision techniques were equally effective in controlling IOP. Each surgical approach has its advantages and this study suggests that either technique may be used safely and effectively.

Key Words: glaucoma, conjunctival incision, Baerveldt glaucoma implant

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Since their introduction in the 1970s, glaucoma drainage devices (GDDs) have generally been reserved for refractory cases of glaucoma. However, in the past decade, they have been used in earlier stages of glaucoma[1,2] and their use has nearly quadrupled over a 10-year period.[3] GDDs divert aqueous humor to an area remote from the limbus to promote the development of a bleb in healthier conjunctiva. Long-term success for GDDs has ranged from 50% to 88% in aphakia and or pseudophakia and from 61% to 100% in eyes with failed trabeculectomy surgery,[4–9] 75 to 100% for uveitic glaucoma, 44% to 100% for developmental glaucoma, and 22% to 78% for neovascular glaucoma.[10] Studies to date have not differentiated between the 2 conjunctival surgical approaches used when implanting this device.

The conjunctival flap created during insertion of a GDD can be limbus-based (LB) or fornix-based (FB). Each flap technique has its advantages and disadvantages. The LB incision provides better visualization during placement of the implant's plate and also results in a smoother conjunctival surface at the limbus, promoting patient comfort postoperatively. An LB incision also avoids the destruction of limbal stem cells, which may be deficient in some patients undergoing GDD surgery (eg, aniridia, chemical injury). However, surgical exposure is limited during tube insertion into the anterior chamber and extensive conjunctival scarring may preclude this type of approach. This technique also places an incision in the conjunctival fornix in close proximity to where one might expect the bleb to form, potentially affecting capsule formation and resistance to flow. In contrast, an FB incision allows easier visualization at the limbus during tube insertion and places the incision site away from the area of bleb formation; however, posterior visualization is more difficult, making placement of the implant's plate challenging unless a wide peritomy or radial relaxing incision is created.

The FB conjunctival flap is the more popular incision technique.[11] In the tube versus trabeculectomy (TVT) study, a multicenter, randomized clinical trial designed to prospectively compare the safety and efficacy of nonvalved tube shunt surgery versus trabeculectomy with mitomycin C, 82 of 107 (77%) patients randomized to the tube group had tubes placed via an FB conjunctival flap and 25 of 107 (23%) were placed via an LB conjunctival flap technique.[12] A comparison of outcome measures between these 2 surgical techniques was not assessed by the TVT investigators.

Capsule formation around a GDD implant results from a foreign body reaction to the implant: macrophages and giant cells accumulate at the implant surface followed by fibroblast proliferation and collagen deposition with capillary

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formation.[13] Stabilization of the implant to the scleral surface,[13] varying the timing and intensity of aqueous flow to the capsule,[14] size and shape of the implant,[15–17] and the use of antifibrotic agents[18] are all modifications that affect capsule fibrosis and subsequent IOP control. However, it is not known whether the proximity of the conjunctival incision affects capsule fibrosis and IOP control. We therefore conducted a retrospective study to compare the effects of LB versus FB conjunctival flaps on the efficacy of IOP control after GDD surgery. We hypothesized that the intraocular pressure (IOP) would be lower in the FB approach because the incision site is placed away from the site of bleb formation.

MATERIALS AND METHODS

The Institutional Review Board at the University of California, Davis approved a retrospective study protocol to evaluate all patients who had undergone a GDD procedure performed by 2 faculty surgeons (M.C.L. and J.D.B.) at the University of California, Davis Medical Center. Inclusion criteria included patients with primary and secondary glaucoma diagnoses (Table 1) refractory to maximal tolerated medical, laser or previous glaucoma surgery who were at least 18 years of age or older at the time of surgery, and who had undergone a nonstaged Baerveldt glaucoma implant (BGI) (Abbott Medical Optics, Inc. Santa Ana, CA) procedure between September 2000 and May 2007. Location of the implant was limited to the supero-temporal quadrant and IOP had to be greater than or equal to 18 mm Hg before GDD surgery. Patients with prior cornea, cataract, retinal incisional, or laser surgery were included as were patients undergoing combined surgery on the same day as implantation of the BGI.

Exclusion criteria were age less than 18 years, no light perception (NLP) vision, previous aqueous shunt surgery in the same eye, a GDD other than a BGI, instillation of silicone oil, or prior scleral buckling procedures. Subjects with scleral buckling procedures were excluded owing to extensive conjunctival scarring which could dictate which type of conjunctival incision was used and to the possible need for the smaller 250 mm^2 Baerveldt implant. Subjects with earlier trabeculectomy surgery were not excluded from this study.

Each patient received a 350 mm^2 BGI placed underneath the superior and lateral rectus muscles in the supero-temporal

TABLE 1. Baseline Characteristics

	LB-BGI	FB-BGI	*P*
Total eyes, n	69	91	0.72
Right eye, n	36	44	
Left eye, n	33	47	
Age (y), mean ± SE	62 ± 2.06	69 ± 1.74	0.0064
Sex			0.31
Male, n (%)	35	42	
Female, n (%)	26	44	
Race			
White, n (%)	45 (74.0%)	54 (62.8%)	0.16
African American, n (%)	7 (11.5%)	17 (19.8%)	0.18
Hispanic/Latino, n (%)	5 (8.2%)	9 (10.5%)	0.64
Asian, n (%)	2 (3.3%)	4 (4.7%)	1.0
Indian, n (%)	2 (3.3%)	2 (2.3%)	1.0
Medical history			
Diabetes mellitus, n (%)	12 (17.4%)	23 (25.3%)	0.24
Hypertension, n (%)	34 (49.3%)	57 (62.6%)	0.10
High cholesterol, n (%)	15 (21.7%)	24 (26.4%)	0.50
Coronary artery disease, n (%)	13 (18.8%)	14 (15.4%)	0.57
Cerebrovascular accident, n (%)	4 (5.8%)	5 (5.5%)	0.94
Baseline vision (logMAR)	0.65	0.94	0.03
Baseline intraocular pressure (mm Hg), mean ± SE	31.5 ± 1.31	28.7 ± 1.14	0.11
Baseline glaucoma medications, mean ± SE	2.97 ± 0.16	2.76 ± 0.14	0.34
Diagnosis			
POAG, n (%)	29 (42.0%)	37 (41.3%)	0.86
CACG, n (%)	3 (4.4%)	8 (8.8%)	0.29
PXG, n (%)	3 (4.4%)	4 (4.4%)	0.99
NVG, n (%)	8 (11.6%)	9 (9.9%)	0.73
Uveitic/Steroid, n (%)	17 (24.6%)	11 (12.1%)	0.05
Other, n (%)	9 (13.0%)	22 (24.2%)	0.09
Lens status			
Phakic, n (%)	20 (29.0%)	22 (24.2%)	0.50
PCIOL, n (%)	44 (63.8%)	49 (53.9%)	0.21
ACIOL, n (%)	2 (2.9%)	13 (14.3%)	0.03
Aphakic, n (%)	3 (4.4%)	7 (7.7%)	0.40
Previous glaucoma surgery			
Trabeculectomy	24	23	0.19
Trabeculectomy revision	9	3	0.03
Laser trabeculoplasty	11	17	0.64
Cyclophotocoagulation	2	1	0.57

ACIOL indicates anterior chamber intraocular lens; CACG, chronic angle closure glaucoma; NVG, neovascular glaucoma; PCIOL, posterior chamber intraocular lens; POAG, primary open angle glaucoma; PXG, pseudoexfoliation glaucoma.

quadrant approximately 9 mm posterior to the limbus. The implant was secured to the sclera with either 8-0 or 9-0 nylon suture through the implant's anchoring holes. The knots were rotated into the implant's anchoring holes to prevent erosion of the knot through overlying conjunctiva. Owing to the nonvalved nature of the implant, the tube portion was ligated in both groups with either a 7-0 or 8-0 polygalactin (Vicryl, Ethicon, Inc., Somerville, NJ) suture followed by confirmation of occlusion. The option for tube fenestration was at the discretion of the surgeon. The tube was placed into the anterior chamber through a 23-gauge needle tract and was secured to the sclera with 8-0 or 9-0 nylon suture. Tutoplast allograft pericardium (Tutoplast, IOP Inc, Costa Mesa, CA) was used to cover the tube. At the end of the operation, both groups received subconjunctival injections of antibiotic and corticosteroids. Postoperative care included administration of topical prednisolone acetate 1% and a topical antibiotic, either polymyxin B sulfate/trimethoprim sulfate 10,000 units/1mg/mL solution or ofloxacin 0.3%. Topical corticosteroids were used for a minimum of 6 weeks, whereas topical antibiotics were used for 7 to 10 days.

The LB conjunctival flap was created by making an incision through conjunctiva and Tenon's capsule at least 8 mm posterior to the limbus in the superotemporal quadrant. Closure of the incision was performed with 9-0 polygalactin (Vicryl) suture in a running locking fashion through Tenon's fascia followed by a running suture technique through conjunctiva with the same suture material.

The FB conjunctival flap was created by making an incision through conjunctival at the limbus with a peritomy extending 4 to 6 clock-hours of the limbal circumference. The incision was radialized in the inferotemporal quadrant. Closure of the conjunctiva was performed with 8-0 or 9-0 polygalactin (Vicryl) anchoring sutures at the wings of the conjunctival incision. Closure of the radialized incision was performed in a running fashion. The conjunctiva along the length of the limbus was not sutured closed.

There were no specific indications for choosing either an LB or FB conjunctival flap except for surgeon preference for each approach. In our cohort, 97% of the LB surgery was performed by 1 surgeon (J.D.B.) and 92% of the FB surgery was performed by the other surgeon (M.C.L.).

Baseline characteristics of the study population were collected for each treatment group, including age, sex, ethnicity, type of glaucoma, comorbid medical conditions, and the number of antiglaucoma medications.

Outcome measures between the 2 groups included IOP, number of glaucoma medications, and visual acuity. Surgical complications were noted, including hypotony, suprachoroidal hemorrhage, endophthalmitis, iritis, cataract, corneal edema, diplopia, and shunt erosion.

Clinical data were gathered at baseline (the visit before GDD surgery), the day of surgery, postoperative day 1, postoperative week 1, 4, postoperative month 3, 6, 9, 12 and then at 6-month intervals.

Our definitions of success and failure were similar to those of the TVT Study.[19] Complete success of surgery was defined as an IOP of $\leq$21 mm Hg or IOP reduced by 20% without the use of antiglaucoma medications, without additional glaucoma surgery and without a devastating complication (NLP vision, endophthalmitis) at last follow-up. Qualified success was defined in the same manner but with IOP controlled with the use of antiglaucoma medications and without additional glaucoma surgery or no devastating complication at last follow-up. Failure was defined as IOP not less than 21 mm Hg or failure to decrease IOP by 20% from baseline, IOP$\leq$ 5 mm Hg on 2 consecutive follow-up visits after 3 months, vision declining to NLP, or the need for further surgery or laser to control IOP.

A power calculation was performed before the study. Assuming a difference of 2 mm Hg in IOP between groups and a standard deviation of 2 mm Hg, a minimum of 75 subjects in each group would allow an 86% chance of detecting this difference at $\alpha = 0.05$. Assuming a difference of 4 mm Hg between groups with the same standard deviation, the power of the study would be 99%.

All statistical analyses used data from all eyes and subjects who satisfied the study's inclusion criteria. For continuous outcome measures, residual errors were scrutinized for the validity of the assumptions of normality (using Wilk-Shapiro tests) and homoscedasticity (using Levene tests). Data were transformed as necessary to satisfy these assumptions. To account for the use of more than 1 eye from a given subject, mixed model analysis of variance procedures were used to evaluate the statistical significance of continuous variable outcomes. For the outcomes of complete and qualified success of IOP control and for other dichotomous responses, a mixed, logistic generalized linear model[20] was used. The time until treatment failure was compared between groups using a Kaplan-Meier analysis and the log-rank statistic. In all instances, statistical significance was claimed whenever $P < 0.05$.

RESULTS

A retrospective review of charts resulted in the identification of 372 eyes from 337 patients who underwent an aqueous shunt procedure over a 5-year period. One hundred sixty eyes from 147 patients were included in the study. A majority of excluded eyes were due to limited follow-up data, age less than 18 years old, use of a valved GDD, and alternate location of GDD placement.

Baseline characteristics of study patients are shown in Table 1. Sixty-nine eyes underwent LB surgery and 91 eyes underwent FB surgery. Age and vision was statistically significantly different between groups with age being greater and vision being worse in the FB-BGI group. Glaucoma diagnoses were similar in both groups of patients and likely did not influence the outcomes. No significant differences existed between groups for IOP and the number of antiglaucoma medications used before GDD surgery.

The baseline (last IOP measured before GDD implanation) and subsequent IOP for the treatment groups are illustrated in Fig. 1. Both surgical techniques produced a significant reduction in IOP. Preoperatively, the mean IOP in the LB-BGI was 31.5 $\pm$ 10.9 mm Hg and in the FB-BGI was 28.7 $\pm$ 10.9 mm Hg ($P = 0.10$). The mean IOP in the LB-BGI group 1 and 2 years after the surgery was 14.4 $\pm$ 4.4 mm Hg and 14.3 $\pm$ 5.3 mm Hg, respectively. The mean IOP in the FB-BGI group 1 and 2 years after the surgery was 12.8 $\pm$ 5.7 mm Hg and 13.1 $\pm$ 4.7 mm Hg, respectively. A general additive statistical model was used to adjust for age differences between groups and no significant difference existed in the mean IOP between conjunctival incision groups at 1 and 2 years of follow-up ($P = 0.86$ and $P = 0.47$, respectively).

The overall treatment success rate for IOP control in each group was excellent at 1 year and at the final visit

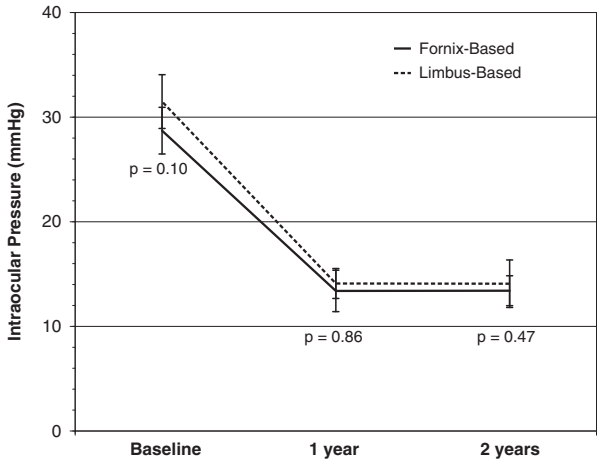

FIGURE 1. Baseline and follow-up intraocular pressure (mm Hg) for each group. Bars represent the 95% confidence interval. *P* values describe differences between groups and are adjusted for age.

(Table 2). Treatment failure at both time points was also fairly low.

Treatment failure was also analyzed using more stringent IOP criteria (Table 3). As expected, at lower IOP thresholds, failure rate increased but no statistically significant differences were found between the 2 groups.

A Kaplan-Meier survival analysis was used to compare success rates between the 2 treatment groups (Fig. 2). The cumulative probability of success at 1, 2, 3, and 4 years in the LB-BGI group was 83.7%, 72.3%, 61.0%, 39.6%, respectively. The cumulative probability of success in the FB-BGI group at 1, 2, 3, and 4 years of follow-up was 81.4%, 63.6%, 55.2%, 49.8%, respectively. The overall success rate was not statistically significantly different at any time point ($P = 0.67$) by log-rank test.

The reasons for treatment failure are listed in Table 4. The most common cause for treatment failure was inadequate IOP control. Persistent hypotony was defined as IOP < 5 mm Hg after 3 months. One case required revision of GDD to correct the condition. Unique to the FB-BGI group were 3 eyes that developed endophthalmitis and 6 eyes that underwent subsequent tube revision both within 1 year of surgery. Ocular diagnoses in eyes with endophthalmitis were megalocornea with a history of uveitis, chronic angle closure glaucoma, and retinal vein occlusion. Two of the 3 eyes that developed endophthalmitis had previous trabeculectomy. However, it is impossible to comment on factors other than incision type that may have caused endopthalmitis in this study as the occurrence was so low.

TABLE 2. Treatment Success

	LB-BGI	FB-BGI	*P*
12 mo post-surgery			
Failure, n (%)	0 (0%)	1 (1%)	1
Overall success, n (%)	67 (100%)	90 (99%)	1
Qualified, n (%)	49 (73%)	56 (62%)	0.40
Complete, n (%)	18 (27%)	34 (37%)	0.47
Final visit			
Failure, n (%)	7 (10%)	12 (13%)	0.61
Overall success, n (%)	62 (90%)	79 (87%)	0.63
Qualified, n (%)	38 (55%)	53 (58%)	0.66
Complete, n (%)	24 (35%)	26 (21%)	0.40

TABLE 3. Failure Rate Using Different Intraocular Pressure Thresholds

	LB-BGI	FB-BGI	*P*
IOP > 17 mm Hg or not reduced by 20% below baseline	13 (18.8%)	21 (23.1%)	0.52
IOP > 14 mm Hg or not reduced by 20% below baseline	13 (18.8%)	22 (24.2%)	0.42

Patients with persistent hypotony (IOP < 5 mm Hg) are classified as failures. Inadequate IOP control criteria must be present on 2 consecutive follow-up visits after 3 mo to qualify as failure. *P* values describe differences between groups.

The reasons for tube revision were hypotony, tube-iris incarceration, tube-cornea touch, corneal edema, chronic iritis, and tube exposure.

Early complications (within 3 months of GDD implantation) are shown in Table 5. No statistically significant differences existed between groups.

A significant reduction in medication burden occurred in both treatment groups between baseline and 2 years after surgery ($P < 0.0001$ for both groups). Table 6 shows the number of glaucoma medications in the LB-BGI and the FB-BGI group at baseline and during follow-up. Medication burden was not statistically significantly different between groups at baseline, and at 1 and 2 years after surgery ($P = 0.90$ and $P = 0.74$)

Adjusting for age, the mean preoperative vision was better at baseline, 1 year of follow-up, and at the final visit in the LB-BGI group versus the FB-BGI group (Table 7). The mean preoperative vision measured by Snellen visual acuity was 20/80 and 20/150 (LB-BGI and FB-BGI, respectively). Changes in vision were evaluated by determining a decrease of 2 or more lines from baseline to 12 mo, baseline to 24 months, and baseline to last visit in each group. A worsening of 2 or more lines of Snellen visual acuity occurred in 19% (6 of 32 eyes), 28% (7 of 25 eyes), and 60% (26 of 43 eyes), respectively at each time point in the LB-BGI group. In the FB-BGI group, this occurred in 36% (16 of 44 eyes), 37% (14 of 38), and 42% (38 of 91 eyes), respectively at each time point. A statistically

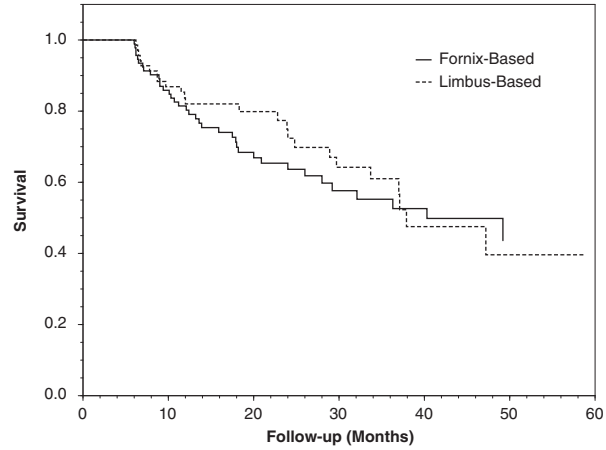

FIGURE 2. Kaplan-Meier analysis of probability of failure for IOP control (failures prior to post operative month 6 omitted).

TABLE 4. Reasons for Treatment Failure

	LB-BGI (n =)	FB-BGI (n =)	*P*
Inadequate IOP control	5	6	0.67
Cyclophotocoagulation	3	2	0.59
Tube revisions	0	6	0.06
No Light Perception vision (NLP)	3	4	0.99
Endophthalmitis	0	3	0.14
Persistent hypotony*	1	3	0.19

*Persistent hypotony = IOP < 5mm Hg after 3 mo.

significant difference existed in the percent drop in more than 2 lines of vision between groups at 12 months (FB-BGI group had greater visual loss) but not at 24 months or at the last visit ($P = 0.05$, $P = 0.47$, $P = 0.60$, respectively). The reason for vision loss was not always specifically addressed in the medical records.

Secondary variables such as presence of earlier trabeculectomy surgery, tube fenestration, and lens status were examined to determine their effect on outcomes. The presence of a trabeculectomy did not influence IOP levels, vision, or number of eye medications used at years 1, 2, and at the final visit. When adjusting for the presence of a trabeculectomy, the vision was worse in the FB-BGI group at the final visit. The presence of tube fenestration was related to higher IOP at 1 year but not at 2 years or at the final visit. When adjusting for the presence of tube fenestration, no statistically significant difference was found between groups for IOP, vision, or number of medications. Lens status was not associated with IOP or vision outcomes. However, phakic eyes were associated with a greater number of eye medications. When adjusting for lens status, no statistically significant difference was found between groups for IOP, vision, and number of eye medications.

Postoperative shallow anterior chamber was the only complication associated with lens status. Specifically, phakic eyes were more likely to have postoperative shallow anterior chamber ($P = 0.003$). When adjusting for lens status, no statistically significant difference was found between groups for this complication.

DISCUSSION

This study reports the retrospective, nonrandomized results of a large single center series of consecutive nonvalved GDDs implanted with either an FB or LB conjunctival flap approach. No difference in long-term IOP control, number of IOP-lowering medications, or postoperative vision change was observed between either surgical technique.

IOP control measured in absolute terms as well as by definitions of success was equal in each conjunctival incision group even when adjusted for age differences. One may speculate that in the case of an LB conjunctival flap, placing the conjunctival incision over the GDD plate might lead to increased fibroblast activity and eventual scarring.[20] This concept has been described in trabeculectomy surgery as a "ring of steel" that forms at the posterior edge of a bleb and limits aqueous flow[21] and this may be due to scarring from close proximity to the conjunctival incision.[20] However, the results of our study suggest that bleb formation, remodeling, and eventual IOP control in the setting of GDD implantation may be dependent on factors other than the site of conjunctival incision. For example, previous investigators have suggested that different implant material can activate a macrophage response in varying degrees that will determine the overall foreign body response[13] and thus bleb formation. Implant size and geometry can reduce bleb surface tension leading to less capsular fibrosis and improved filtration.[17] The timing of tube opening and aqueous flow can influence capsular fibrodegeneration and resulting capsular wall thickness.[14] In an LB approach, it is possible that the GDD plate underneath the conjunctival incision separates this area from scleral tissue to prevent excessive scarring and adhesions.

No studies specifically addressing conjunctival incision site for GDD implantation have been published to date but studies researching the outcomes of FB versus LB conjunctival flap for trabeculectomy are available.[22–27] Proponents of the FB trabeculectomy argue that it results in a lower, diffuse bleb that is less cystic owing to wider application of antimetabolite and the elimination of posterior scarring.[20] However, of the four prospective randomized studies and 2 retrospective studies, four[22,23,26,27] found no difference between the 2 conjunctival approaches and 2 found superior IOP lowering with the FB approach. Two of the studies reported a higher likelihood of early postoperative aqueous leaks with FB incisions.[22,27] Thus, evidence is mixed as to which conjunctival incision is superior for trabeculectomy.

TABLE 5. Early Complications (Within 3 mo of GDD Implantation)

	LB-BGI (n =)	FB-BGI (n =)	*P*
Serous choroidal effusions	3	11	0.42
Suprachoroidal hemorrhage	3	5	0.41
Shallow anterior chamber	7	4	0.16
Conjunctival leak	1	0	1.0

TABLE 6. Baseline and Postoperative Number of Medications

Time	LB-BGI	FB-BGI	*P**
Baseline	3.03	2.8	0.21
1 y	1.4	1.4	0.90
2 y	1.6	1.3	0.74

**P* values describe differences between groups.

TABLE 7. Visual Acuity Results (logMAR)

	LB-BGI	FB-BGI	*P**
VA, Baseline	0.65	0.94	0.03
VA, 1 y	0.55	0.87	0.04
VA, 2 y	0.67	0.96	0.06
VA, Final visit	0.94	1.38	0.01

**P* values describe differences between groups and are adjusted for age.

Although no difference in IOP or number of medications was found between groups, the rate of specific complications differed between the two. A difference was seen in the rates of tube revision, with more revisions required among the FB-BGI patients though this was not statistically significant. It is difficult to ascertain if the FB flap was the reason for the difference as the reasons for revision were so varied.

None of the patients in the LB-BGI group developed endophthalmitis, whereas 3 (0.3%) patients in the FB-BGI group did within 1 year of tube-shunt surgery. Endophthalmitis is a well-known risk after trabeculectomy surgery,[28,29] but is less common in GDD surgery, possibly owing to the posteriorly located bleb and the fact that antimetabolite drugs are not commonly used. When endophthalmitis occurs after GDD surgery, it is usually associated with tissue break down and tube exposure or surgical revision.[30,31] In the early postoperative period, endophthalmitis after GDD surgery is relatively rare. The TVT study reported 1 case of endophthalmitis in the GDD group at 1 year of follow-up.[12] In our study, both techniques were completed with the same antibiotic prophylaxis (subconjunctival depot of cefazolin at the end of the case). One potential mechanism for endophthalmitis in FB-BGI is that the closure at the limbus may be more likely to allow microorganisms to gain intraocular access via the sclerostomy site through which the tube enters.

Though visual acuity was statistically significantly worse in the FB-BGI group at baseline, 1 year after surgery and at the final visit no statistically significant difference existed between groups for loss of 2 or more lines of Snellen visual acuity for any time point. Vision loss in this cohort of patients was similar to that reported in past studies of BGI outcomes in which 27% to 50% of subjects lost 2 or more lines of Snellen visual acuity.[8,32,33] In the TVT study, 46% of subjects who suffered postoperative complications lost this level of vision whereas only 24% without complications lost vision at this level.[12]

Secondary variables including earlier trabeculectomy, tube fenestration, and lens status were analyzed in relation to outcomes. Tube fenestration was related to higher postoperative IOP and phakic lens status was related to the use of more eye medications, however, when adjusting for these variables, no difference in IOP, number of eye medications, or vision was noted between groups. Earlier trabeculectomy was not associated with level of IOP, vision, or number of eye medications.

Owing to its retrospective nature, our study had some limitations. For example, the 2 study groups were not matched for underlying glaucoma diagnosis or other ocular disease. Errors in IOP measurement might arise among patients with corneal transplants or pseudophakic bullous keratopathy, each of which can lead to errors in tonometry; in eyes with uveitis IOP lowering can be due to aqueous hyposecretion and ongoing inflammation rather than the GDD surgery.

Retrospective studies which compare 2 surgical techniques are often hampered by selection bias. In our study, selection of incision site was based primarily on surgeon habits and preferences rather than a specific, clinically based decision. Because of this, we believe that surgical selection bias was minimized in our study.

The results of the present study cannot be generalized to the success of conjunctival incision technique with other glaucoma drainage implants because different implants were not compared in this study.

In conclusion, both surgical techniques are viable choices when implanting a GDD. Eyes receiving GDD implants have usually had earlier surgeries causing conjunctival scarring, and an incision at the limbus versus the fornix may offer different advantages in individual cases. The ability to use either technique is valuable to the surgeon as he or she decides on the best surgical approach in an individual patient.

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