

# Graft-free Ahmed tube insertion: a modified method at 5 mm from limbus

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**Objective:** To determine the medium-term outcome of Ahmed implants inserted through a needle tract at 5 mm from limbus that eliminates the need for a donor scleral graft.

**Methods:** A retrospective case series of 19 patients undergoing Ahmed implant surgery for refractory glaucoma with a mean follow-up of 12 months. Primary outcome measures included control of intraocular pressure after surgery. Secondary outcome measure included the frequency of intraoperative and postoperative complications.

**Results:** Intraocular pressure was maintained between 6 and 21 mmHg throughout the study. There was no postoperative hypotony. There were no complications related to this modified technique.

**Conclusion:** Needle tract at 5 mm from limbus maintains implant's ability to control intraocular pressure and eliminates the need for a donor scleral graft or heterologous material.

**Keywords:** surgical technique, Ahmed implant, refractory glaucoma, donor scleral graft, tube shunt device

## Introduction

Glaucoma drainage devices are helpful in the management of glaucomas that do not respond well to conventional medical and surgical therapy, in eyes with prior multiple surgeries, and in eyes with neovascular glaucomas. Shunts seem to have advantages over standard surgery in uveitis-related glaucomas. In summary, although the primary indication for aqueous shunts is when prior medical or surgical therapy has failed, they may be used as primary surgical therapy for selected conditions such as trauma, chemical burns, or pemphigoid (level III evidence).<sup>1</sup> Based on level I evidence, aqueous shunts offer a valuable alternative to standard filtering surgery or to cyclodestructive therapy for many refractory glaucomas. The failure rate is approximately the same rate as for trabeculectomy with adjunctive antifibrotic agents, and in favorable cases, shunts may continue to function to control intraocular pressure (IOP) for more than two decades.<sup>2</sup>

Molteno first described the use of his implant in 1969.<sup>3</sup> Other drainage devices are the Ahmed valve, Baerveldt device, and Krupin valve.<sup>4</sup> These devices drain aqueous humor from the anterior chamber through a tube to a posterior plate. The aqueous humor crosses the pseudocyst around the plate by passive diffusion and is removed by venous capillaries or lymphatics. The Ahmed Glaucoma Valve (New World Medical, Inc., Rancho Cucamonga, CA) is a glaucoma drainage device that has a 184-mm<sup>2</sup> plate and a unidirectional valve, which minimizes postoperative hypotony and complications associated with hypotony during the immediate postoperative period.

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Additional IOP reduction and long-term success after glaucoma drainage implant surgery may be related to the degree of encapsulation around the implant plate, which provides resistance to the aqueous flow.

The tube has a long extrascleral course that must be covered by donor material such as sclera, dura, or pericardium to prevent conjunctival erosion of the tube.<sup>5,6</sup> Concerns have been raised regarding the potential risk of iatrogenic transmission of variant Creutzfeldt-Jakob disease (vCJD) via graft tissue.<sup>7</sup>

Ozdamar and colleagues described the results of a scleral tunnel without scleral graft in six patients with a Krupin valve implanted.<sup>8</sup>

In this study we describe the results using a needle tract at 5 mm from limbus for tube placement of silicone Ahmed implants in a series of 19 patients with a 12-month follow-up. This technique eliminates the need for a donor scleral graft to cover the site of tube placement.

## Methods

Patients for this study were recruited from Hospital Universitari Bellvitge (Barcelona, Spain). Nineteen consecutive patients were operated on over the period 2006 to 2008 using a modified technique consisting of a needle tract located at 5 mm from corneal limbus and were included in this study.

For inclusion, patients had elevated IOP that was not responsive to conventional medical and surgical therapy or had significant conjunctival scarring or inflammation precluding trabeculectomy. Exclusion criteria included patients younger than 18 years, eyes requiring combined surgery, or eyes with previous cyclodestructive treatment, silicone oil treatment, or previous glaucoma drainage device implantation. All patients were treated with a silicone (model FP7) Ahmed valve.

Information collected before surgery included gender, age, glaucoma diagnosis, lens status, history of laser and surgical treatments, IOP, visual acuity (VA), and glaucoma medications. At each follow-up visit (at weeks 1, 4, 6, 8, and at 12 months postoperatively) the following variables were analyzed: IOP, number of glaucoma medications, VA, and presence of complications.

Bellvitge Hospital human ethics committee approved the study and it was in adherence with the Declaration of Helsinki.

A fornix based conjunctival flap is the first step. A paracentesis with a 30G needle with the extraction of 0.1 mL of aqueous humor and injection of an ophthalmic viscoelastic device (OVD) under the presumed place of entry

of the tube is performed. A tract with a 23 gauge needle connected to an OVD is performed 5 mm posterior to the limbus. The needle should be visible within the sclera and penetrate the anterior chamber in a plane parallel to the iris to avoid trauma.

The 23G needle is then carefully removed injecting the OVD. The Ahmed tube is trimmed at the desired length and inserted into the anterior chamber through the tract created by the needle and the OVD is fixed using two pairs of forceps. The technique is even easier on pseudophakic patients as the tube can be placed in the posterior chamber between iris and intraocular lens. Finally the conjunctiva is closed.

An XLSTAT for Microsoft Excel (version 2009.4.01; Micro soft, Redmond, WA) program was used for statistical analysis. The paired Wilcoxon test was used to assess differences in continuously scaled variables both before and after surgery.

VA measurements were converted to logMAR equivalents to perform analysis. A statistically significant difference was defined as a  $P$ -value  $<0.05$ , 95% confidence intervals (CI) were used to assess plausible ranges of true differences.

Only the first procedure of patients with bilateral Ahmed valve implantation was included in the analysis in order to avoid the effects of correlation.

## Results

A total of 19 consecutive patients underwent Ahmed implant surgery with this modified method. Demographic data are shown in Table 1. The male to female ratio was 9:1 with a mean age of 69.5 years (range 38–89 years). The mean duration of follow up was 24.5 months. Ten cases were neovascular glaucoma (NVG). None of them received anti-vascular endothelial growth factor (VEGF) therapy.

IOP data obtained over the course of the study are summarized in Table 2. The mean preoperative IOP was 39 (standard deviation [SD] 10.63) mmHg and fell to 10 (SD 3.77) mmHg by the final postoperative visit. An average postoperative pressure reduction of 19 mmHg from baseline was observed (95% CI: 1.70 mmHg;  $P < 0.01$ ).

The mean number of glaucoma medications preoperatively was 3 (SD 0.7) dropping to 0 (SD 0.38) at the final postoperative visit (at 12 months).

VA improved in 36.84%, remained unchanged in 57.89%, and worsened in 5.26% of patients.

In the immediate postoperative period ( $<1$  month) complications included: four cases of hyphema; two cases of flat AC; and one case of hypotony. One of the cases with

**Table 1** Baseline characteristics

Case, age, sex, lens status	Glaucoma diagnosis	logMAR BCVA	IOP-pre	Number of medications
1, 59, M, Phakic	Neovascular	2	56	2
2, 89, F, Pseudophakic	POAG	1.6	27	3
3, 53, M, Phakic	Neovascular	3	42	2
4, 73, M, Pseudophakic	Neovascular	0.4	32	3
5, 69, M, Pseudophakic	Neovascular	0.8	40	2
6, 69, M, Pseudophakic	Uveitis	3	26	3
7, 55, M, Phakic	Traumatic	1	30	2
8, 74, M, Phakic	Neovascular	0.7	40	3
9, 78, M, Phakic	CCSF	0.7	45	1
10, 53, M, Phakic	Neovascular	2	50	3
11, 72, M, Pseudophakic	POAG	2	26	2
12, 70, M, Phakic	Neovascular	2	54	3
13, 54, F, Phakic	Neovascular	3	60	1
14, 69, M, Pseudophakic	Neovascular	3	45	3
15, 38, M, Phakic	Neovascular	2	38	3
16, 38, M, Phakic	Neovascular	2	36	3
17, 73, M, Phakic	Neovascular	0.4	30	2
18, 52, M, Phakic	POAG	0.7	41	3
19, 72, M, Phakic	POAG	0.7	31	3
Median: 69.5		Median: 2	Median: 39	
SD: 13.46		SD: 0.9388	SD: 10.63	
CI: 6.05		CI: 0.42	CI: 4.77	

**Abbreviations:** M, male; F, female; BCVA, best-corrected visual acuity; CCSF, carotid-cavernous sinus fistula; POAG, primary open-angle glaucoma; SD, standard deviation; CI, confidence intervals.

**Table 2** Intraocular pressure over the study

Case	Intraocular pressure					Number of medications (postoperative)
	Month 1	Month 3	Month 6	Month 9	Month 12	
1	12	14	12	14	14	0
2	18	16	18	16	14	1
3	11	10	10	10	10	0
4	11	12	12	12	12	0
5	11	10	10	10	10	0
6	12	14	10	10	12	0
7	8	10	14	16	10	0
8	12	14	14	10	10	1
9	26	18	20	26	20	1
10	6	8	18	8	6	0
11	12	14	6	10	12	0
12	8	8	8	6	8	0
13	15	14	14	14	18	0
14	10	12	12	10	10	0
15	16	16	14	16	16	0
16	16	14	14	14	12	0
17	6	6	6	6	6	0
18	8	6	8	10	8	0
19	8	8	6	6	8	0
	Median: 11	Median: 12	Median: 12	Median: 10	Median: 10	
	SD: 4.80	SD: 3.52	SD: 3.85	SD: 4.75	SD: 3.77	
	CI: 2.17	CI: 1.58	CI: 1.73	CI: 2.13	CI: 1.70	

**Abbreviations:** SD, standard deviation; CI, confidence intervals.

hyphema showed the tube was blocked with fibrin needing no hypotensive treatment as IOP was maintained under 8 mmHg (due to a little choroidal detachment). Other complications are listed in Table 3. There was a case of corneal decompensation due to a pseudophakic bullous keratopathy not related to corneal-tube touch, as the tube was implanted behind the iris. No cases of corneal-tube touch were noted. There was no erosion of the conjunctiva overlying the tube portion of the Ahmed implants or tube migration in any patient in the study.

## Discussion

There are several complications of aqueous shunts, including erosion of the tube or explant through overlying conjunctiva that require explanation. The most problematic long-term consequence of anterior chamber tube placement is accelerated damage to the corneal endothelium over time. Due to the fear that conjunctival erosion leading to tube exposure and endophthalmitis may occur,<sup>9</sup> donor scleral grafts have been used by most surgeons.<sup>6,10</sup> Erosion of the tube may occur over a period of weeks to months. If the tube is exposed, difficult and extensive lateral dissection is often necessary to achieve sufficient conjunctival mobility to recover a reattached tube. Conjunctival grafts, placement of amniotic membrane, or both may be necessary.<sup>7,11</sup> The modified technique described in this study successfully eliminates the need for a donor scleral graft or heterologous material.

Ozdamar and colleagues described the use of a 10 mm scleral tunnel for the insertion of a Krupin eye valve.<sup>8</sup> They reported complete or qualified success in the six patients of the study over a 7-month follow up. No conjunctival erosion or tube displacement was observed. They proposed that this scleral tunnel placed at 10 mm from corneal limbus would prevent migration by improving the stability of the tube; however, our experience suggests, for Ahmed implants, a

5 mm needle tract may be sufficient, as erosion occurs most frequently about 2 mm from the limbus.<sup>12</sup>

Similar to other studies, complete success was defined as an IOP between 6 mmHg and 21 mmHg, without additional hypotensive medications and qualified success as an IOP between 6 mmHg and 21 mmHg with additional medication. Failure was defined as an IOP > 21 mmHg, hypotony (IOP < 6 mmHg), a requirement for cyclodestructive procedure, or further glaucoma surgery. Our analysis showed a significant reduction in the mean IOP following surgery associated with a decrease in the number of glaucoma medications required.

Complications in this series are similar to previous reports, corneal decompensation being the most common event (20.6%).<sup>4,13-15</sup> Lim and colleagues suggest this may result from suboptimal tissue compatibility and possibly micromotion from the tube element.<sup>4</sup> Cornea-tube touch is another cause of corneal decompensation.<sup>14</sup>

This modified surgical technique eliminates the need for covering the tract with homologous or heterologous material. A shorter operative time may be anticipated by the surgeon. There were no complications directly attributable to the lack of covering of the tube by homologous or heterologous material. Nevertheless, we cannot establish superiority of this modified technique in the absence of a control group using a scleral patch.

There were no cases of conjunctival erosion in this series of patients over the follow-up period. This outcome may be related to an absence of the immune mediated processes leading to thinning of grafts.<sup>5,13,15-19</sup>

This study has limitations that may have influenced the results: one being the relatively short follow-up period. Erosion through the typical scleral graft occurs most frequently about 2 mm from the limbus and can occur from months to years after installation, therefore necessitating long follow-up periods before comparisons to “standard” techniques. Another limitation of this study is the relatively small sample size.

This study describes a simplified alternative surgical technique for the insertion of implants which provides IOP control in the first postoperative year and eliminates the requirement for homologous or heterologous material. There were no postoperative complications associated specifically to this method.

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**Table 3** Complications

Complications	Number of patients
<b>Tube related</b>	
Eroded plate	0
Tube obstruction	1
Hyphema	4
Cataract	3
Corneal decompensation	1
<b>IOP related</b>	
Hypotony	1
Flat anterior chamber	2

**Abbreviation:** IOP, intraocular pressure.

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